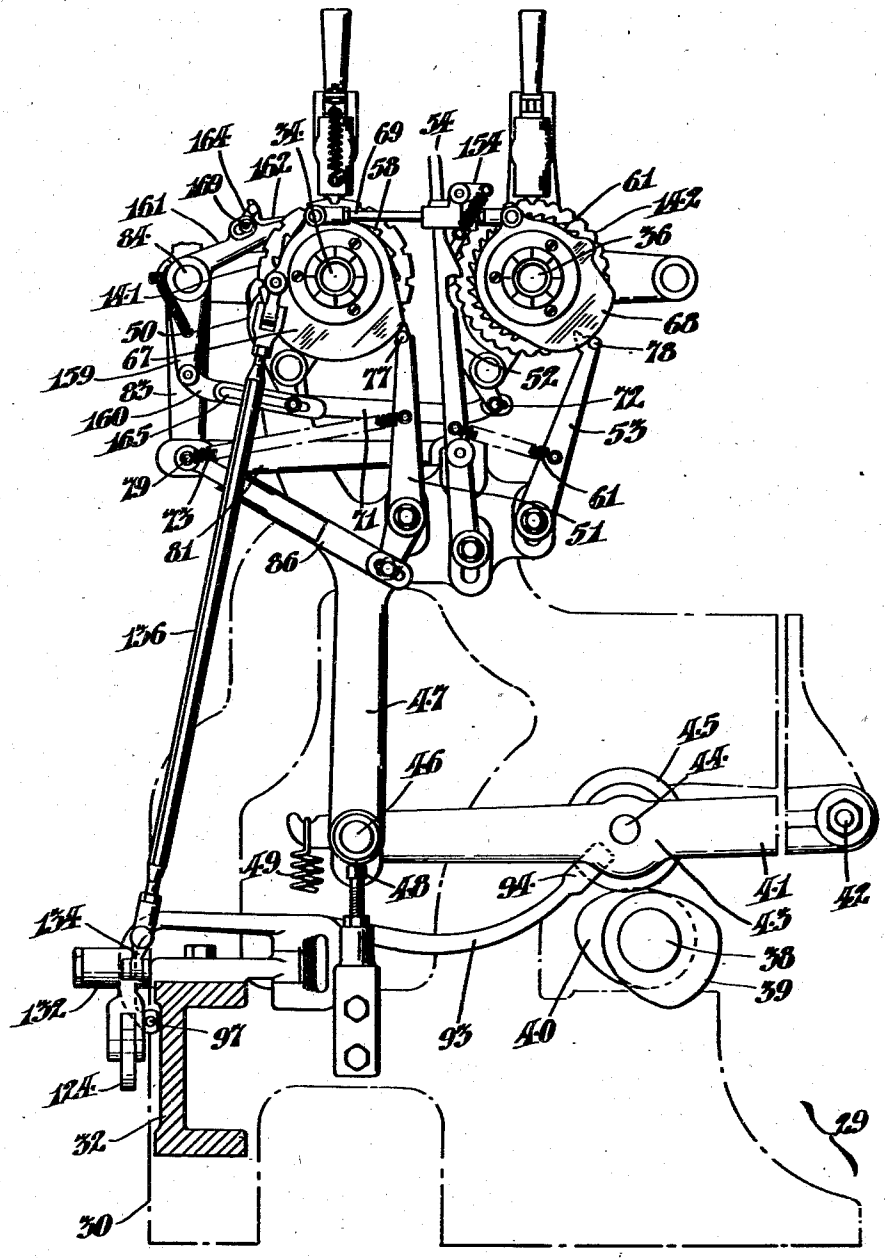
Dec. 9, 1947. H. E. HAEHNEL 2,432,413

KNITTING MACHINE AND METHOD OF OPERATING SAME

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Fig. 1.



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FIG. 2.

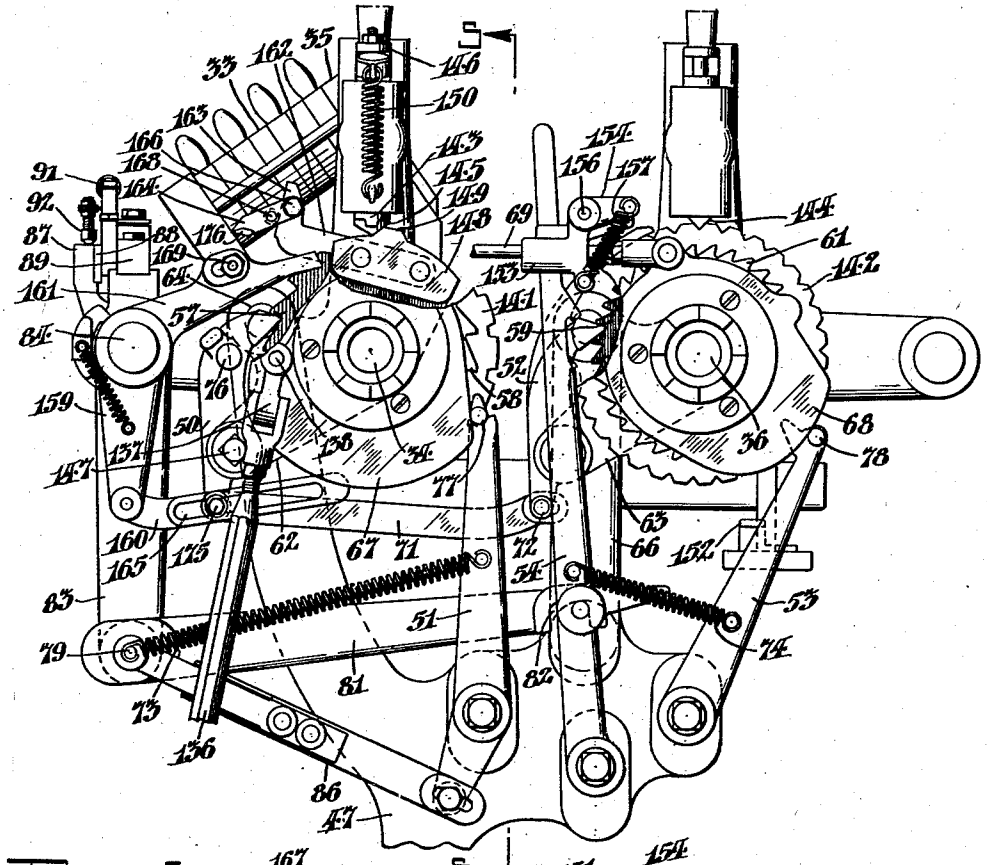
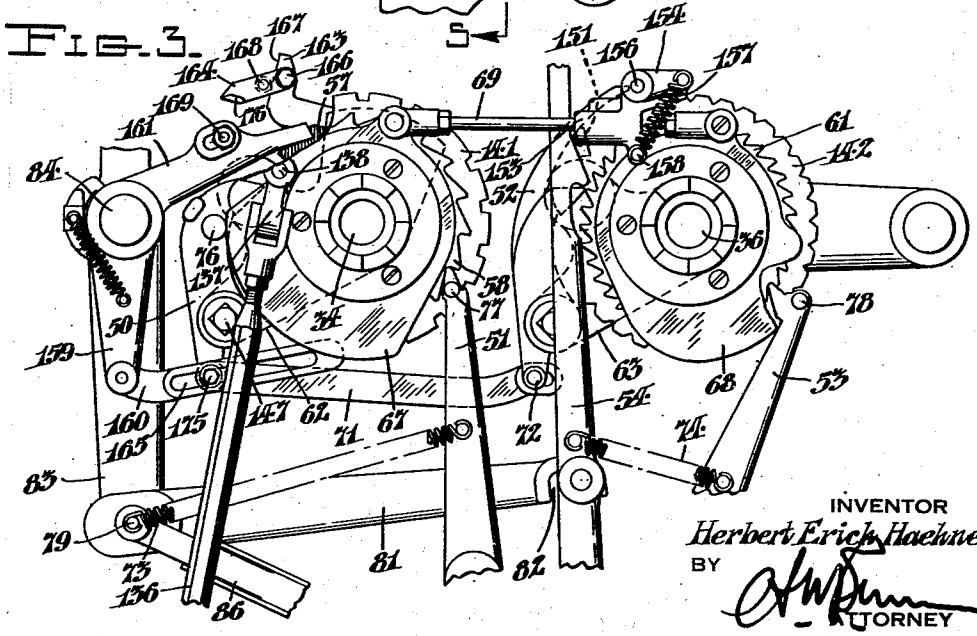


FIG. 3.



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FIG. 4.

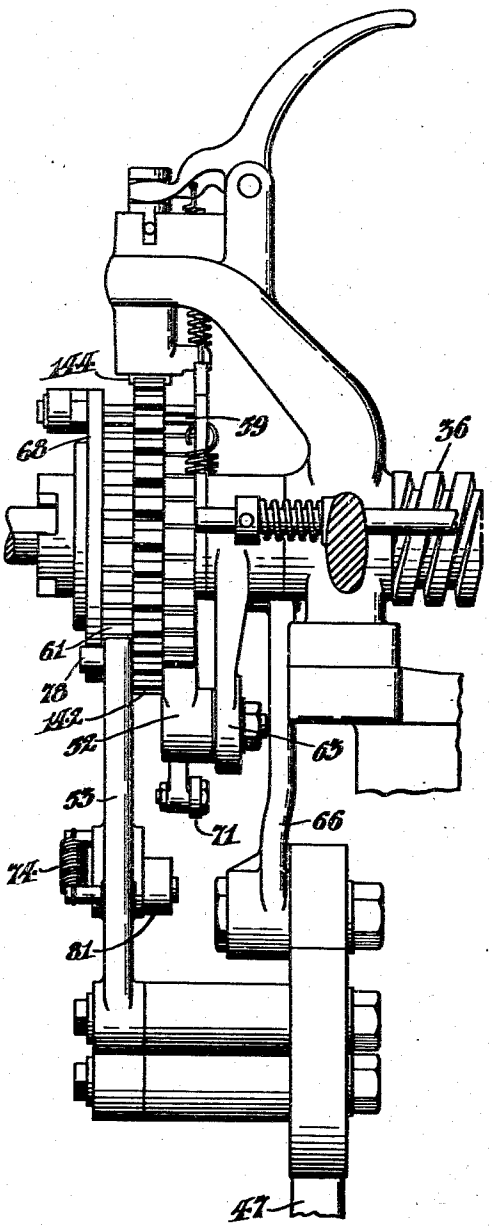
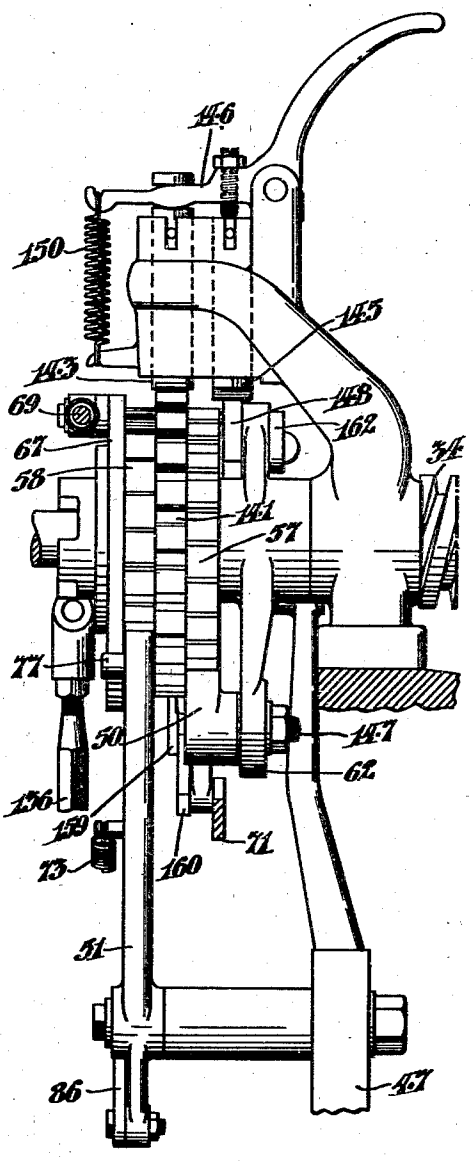


FIG. 5.



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FIG. 6.

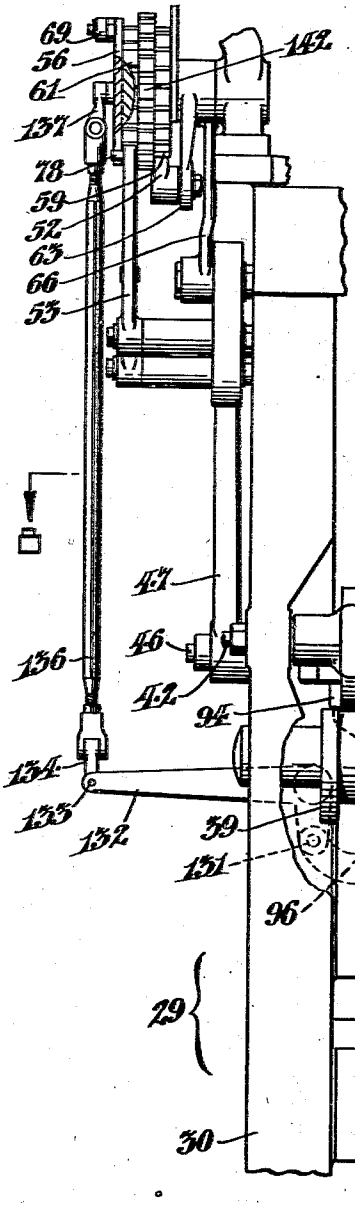
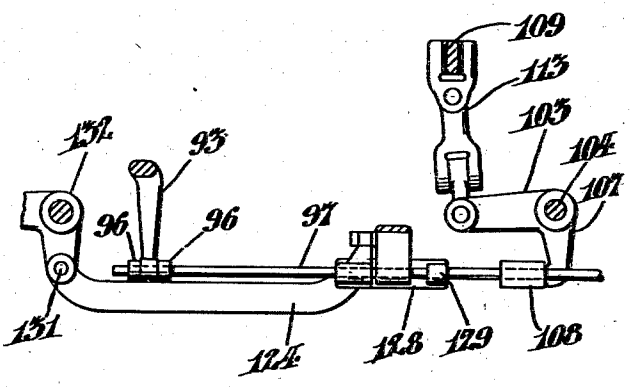
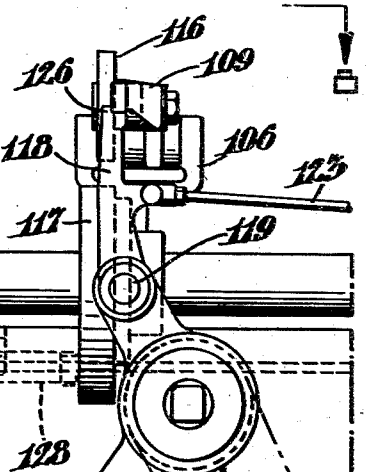


FIG. 7.





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Fig. 8.

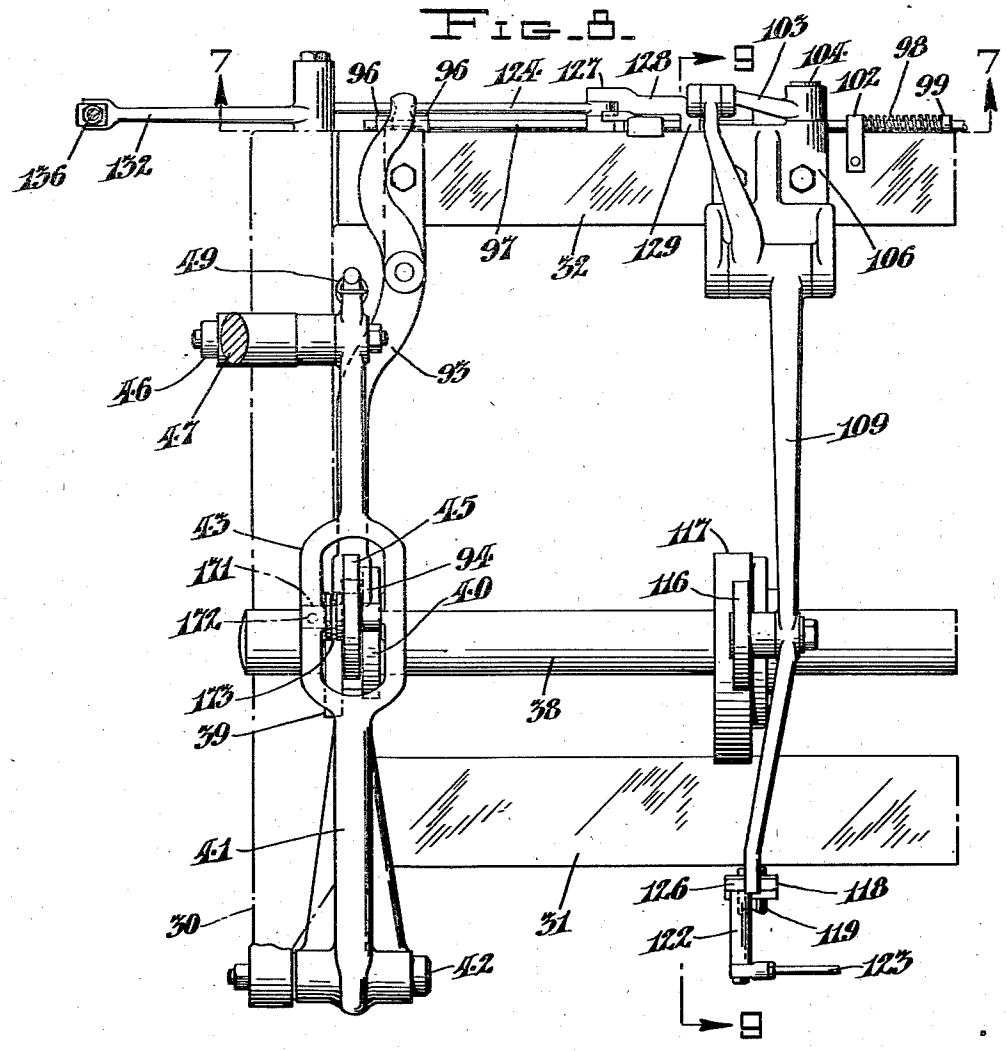
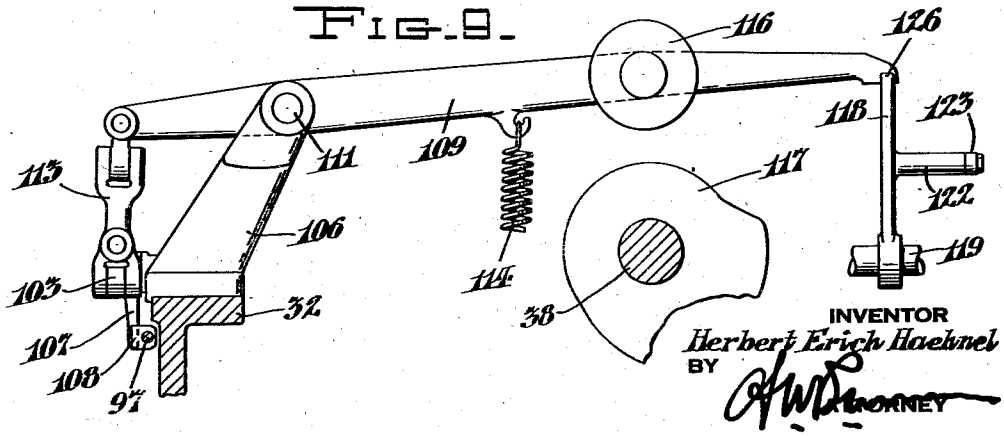


Fig. 9.



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FIG. 10.

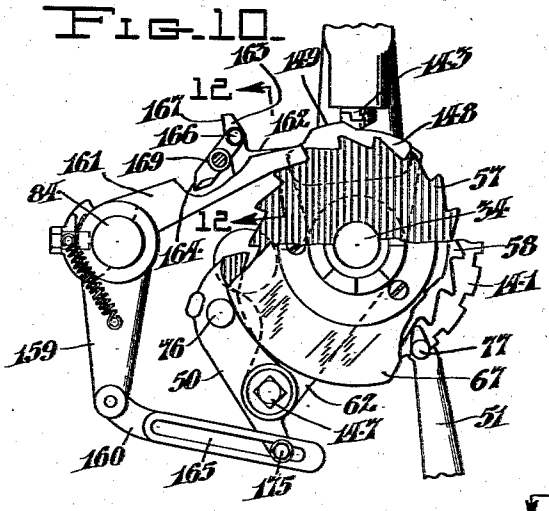


FIG. 12.

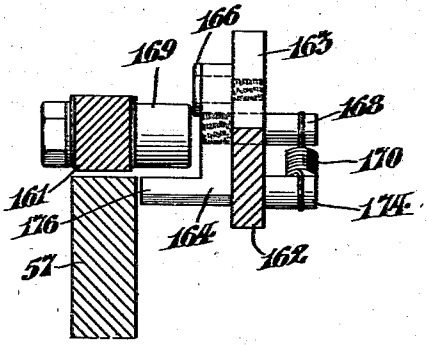


FIG. 13.

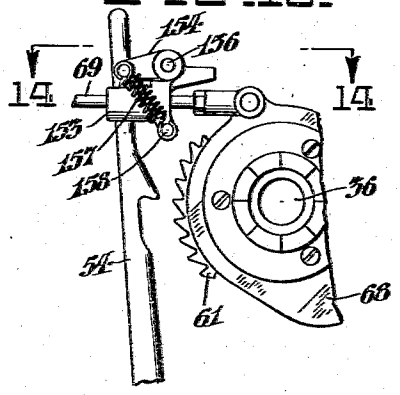


FIG. 11.

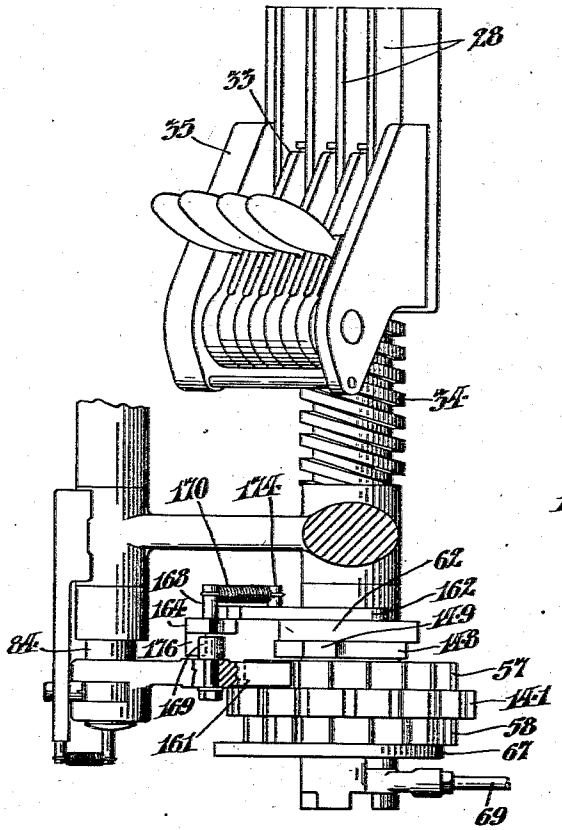
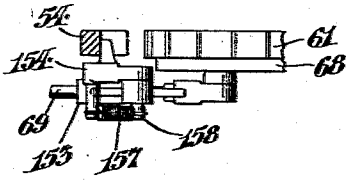


FIG. 14.



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Patented Dec. 9, 1947

2,432,413

UNITED STATES PATENT OFFICE

2,432,413

KNITTING MACHINE AND METHOD OF OPERATING SAME

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Application September 14, 1943, Serial No. 502,359

25 Claims. (Cl. 66—89)

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The present invention relates to full-fashioned knitting machines and more particularly to improvements in the fashioning mechanism for such machines.

It is standard practise to equip both ends of full-fashioned knitting machines with narrowing heads including two threaded spindles, one for moving the position of the end stops for the yarn carrier rods and one for moving the combs for the points. Said spindles are used singly and together in producing a variety of effects in the fabric knitted on the machines, necessitating that the means for turning said spindles be readily adaptable to the particular conditions determined by the desired fabric effect. The means for turning said spindles has for a long time included ratchet wheels fixed to the spindles and pawls for racking said ratchets moved by an actuator member having an up and down motion. Said pawls have been arranged in groups to turn the spindles in either the narrowing direction or the widening direction as desired. Usually, the pawls for turning the spindles in the narrowing direction have operated on the upstroke of the actuator and the pawls for turning the spindles in the widening direction have operated on the downstroke of the actuator. Also, there has usually been provided in the group of narrowing pawls a pawl acting on the comb spindle for turning the comb operating spindle in the widening direction, this latter being commonly termed a back-racking pawl and for which no counter-part is provided in connection with the end stop spindle. In modern full-fashioned knitting machinery the pawl and ratchet devices, with the exception of the back-racking pawl, operate upon the upstroke of the actuator to effect both narrowing and widening of the fabric being knitted, thus facilitating the use also of the back-racking pawl in widening operations. However, when the fabric is to be widened by the movement of the end stops only, i. e. by increasing the travel of the yarn carrier rods, the arrangement in which all but the back-racking pawl operate on the upstroke of the actuator, it is during this part of the operating cycle in which the widening pawl for the end stop spindle moves up that the yarn carrier rods strike the end stops, and the end stop spindle being free to move in the widening direction at this time, the impact of the yarn carrier rods on the end stops frequently moves the end stops beyond their proper positions, thereby causing irregularities in the fabric and/or difficulties in the machine operation.

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It is therefore an object of the invention to provide in the narrowing head of full-fashioned knitting machines widening means which will prevent the stops from moving in the widening direction in response to blows from the yarn carrier rods.

A further object of the invention is to provide a latch pawl for the end stop spindle of a full-fashioned knitting machine for preventing the end stops from moving under the impact of the yarn carrier rods, and means to control it to permit turning said spindle in the widening direction.

Another object of the invention is to provide operating means in connection with the latching pawl for the end stop spindle of a full-fashioned knitting machine, such means being adapted to initially engage the latching pawl on the upstroke of the actuator to permit indexing of the end stop spindle and also to prevent the said indexing beyond a limited predetermined movement.

Another object of the invention is to combine a means for operating a latch pawl for the end stop spindle with the locking plunger for the standard lock dial for said spindle.

Another object is to simplify and increase the adaptability of the spindle operating means for use in performing a number of different functions.

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 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 partial end view of a full-fashioned knitting machine having the invention applied thereto in connection with the spindle operating mechanism;

Fig. 2 is a view of the mechanism shown at the upper part of Fig. 1, enlarged relative thereto, certain parts being added and others broken away;

Fig. 3 is a view similar to a portion of Fig. 2 but with certain of the parts in different relative positions;

Fig. 4 is an elevational view of the mechanism as viewed from the right of Fig. 2;

Fig. 5 is a view taken substantially along the line 5—5 of Fig. 2;

Fig. 6 is a partial front elevation of the left end of the machine showing certain of the spin-

dle operating mechanism and control means therefore;

Fig. 7 is a detail view partially in section taken along the line 7—7 of Fig. 8;

Fig. 8 is a view taken along the line 8—8 of Fig. 6;

Fig. 9 is a view taken substantially along the line 9—9 of Fig. 8;

Fig. 10 is a detail view similar to the left portion of Fig. 3, certain parts being broken away and others omitted;

Fig. 11 is a top plan view of the mechanism shown in Fig. 10 and including the left carrier rod end stops of the machine;

Fig. 12 is a sectional view taken substantially along the line 12—12 of Fig. 10;

Fig. 13 is a detail view of certain of the mechanism shown at the right center of Fig. 2 but with the parts in different relative positions; and

Fig. 14 is a top plan of the mechanism as viewed in the direction of the arrows 14—14 of Fig. 13.

In the drawings and description, only the means and method 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.

An apparatus within the invention such as that shown in the drawings includes a narrowing head of a full-fashioned knitting machine. Said head includes two threaded spindles, an end stop or carrier spindle and a narrowing point comb spindle together with means for turning said spindles either singly or together as circumstances may require, and means for holding the spindles against turning in either direction when the turning means is not to be used. Said turning means includes pawls and control means therefor, one pawl for each spindle being used for turning it in the narrowing direction and one pawl for the end stop spindles being used to turn it in the widening direction and two pawls for the comb spindle being used to turn it in the widening direction and said holding means includes dials and spring plungers seating in notches in the dials of which the dials for the end stop spindles have each substantially square notches so that they hold the spindle against turning when the carrier rods strike one or the other of the groups of end stops. All the said pawls except the second widening pawl for the comb spindle act against their corresponding ratchet wheels on the upstroke of the actuator on which all the widening pawls are mounted. However, the pawls acting on the upstroke of the actuator

engage their ratchet wheels near the beginning of a revolution of the cam shaft and therefore the pawls for narrowing must be thrown clear of their ratchet wheels and maintained clear thereof at the start of a revolution in which there is to be a widening action while the locking dial for the stop spindle is automatically released at the beginning of an upward movement of the actuator. But the yarn carrier rods operate during certain widening cycles and strike their stops during the first part of the revolution tending to move the stops outward in the widening direction when the locking dial for the stop spindle is disengaged. In accordance with the present invention, a latch means is provided for holding the end stop spindle against turning under the impact of the yarn carrier rods. Further, means is provided in accordance with the present invention whereby the latch means is thrown out of latching position in time to permit the widening pawl to act on the carrier spindle and then restored to the latching position prior to the time the carrier rods strike the stops. Preferably, the means for controlling the said latching pawl is associated with the usual means for lifting the plunger for holding the locking dial and comprises preferably a finger so mounted on the oscillating arm forming part of said means as to turn on a pivot on said oscillating arm as such arm carries the pivot downward so as to drop below the latch pawl but to act rigidly with said arm to lift the latch pawl as said arm carries the finger upward.

The spindle operating and controlling mechanism herein disclosed is very flexible being adaptable to at least five different conditions of operations:

(*a*) two needle narrowing by both the end stops and combs;

(*b*) two needle narrowing as under (*a*) with operation of the back-racking pawl to incline the line of the fashion marks to the selvage;

(*c*) widening by means of the end stops alone with two one needle movements of the combs produced one by the widening pawl and one by the back-racking pawl to maintain the combs in a desired relation to the end stops;

(*d*) widening one needle by the combs and two by the end stops with an additional one needle movement of the combs produced by the back-racking pawl to maintain the combs in a given desired relation to the end stops; and

(*e*) lace making by a lace attachment while the comb spindle is out of commission and the fabric is fashioned or shaped by moving the end stops.

Further, according to the present invention, the controlling means for the spindle operating pawls is made more direct, more simple and more convenient to install in that the generally vertical rod for operating the cams for controlling the pawls is placed at the rear of the machine instead of at the front. The drawings of the present disclosure also show novel means within the present invention for controlling some of the pawls ordinarily forming part of the means for turning the spindles of a narrowing head.

Referring to the drawings, the full-fashioned knitting machine shown therein includes a framework 29 (Fig. 1) having transverse end frames 30 and transverse center frames (not shown) on which is a front beam 31 (Fig. 6) and a back-beam 32 tying the transverse frames together. On said frame-work are mounted the necessary mechanisms, arranged largely in sepa-

rate knitting sections, for knitting flat fashioned fabric blanks such as are used in making full-fashioned hosiery. Said mechanisms include sets of generally vertical spring beard needles and means for giving them movements necessary for knitting yarn into blanks, one blank to a knitting section. As is well known, yarn for knitting is laid on the noses of reciprocatory sinkers and dividers which are mounted to move horizontally in sinker heads.

The yarn is laid by yarn carriers, one for each knitting section which are reciprocated by a couliering means so as to lay yarn parallel to and near the line formed by the stems of the needles and on the beard sides thereof. The sinkers are arranged alternately with the dividers and said couliering means includes slur cams one for each knitting section, which follow the yarn carriers while moving along a line parallel to the yarn carriers to slur the sinkers forward and kink the yarn between pairs of needles to thereby measure off the yarn needed to make the loops. The measured yarn is thereafter divided by the dividers to provide a yarn kink on both sides of each needle in use and the needle beards catch the yarn bights which lie against the stems of the needles and draw the bights down through the loops of the previous course to form a new course of loops. Said yarn carriers are fixed to yarn carrier rods 28, certain of which are shown in Fig. 11 and which are coupled in turn to parts of the couliering means whereby they are reciprocated between end stops 33 best shown in Figs. 2 and 11. Two groups of stops 33 are provided, one at each end of the paths of travel of the yarn carrier rods 28 to limit the throw of the carrier rods to thereby determine the number of needles in each section to which yarn is laid and thereby determine the width of the blank for a given setting of the stops. Said stops 33 are mounted on nuts 35 which have threaded engagement with rotatable spindles 34, one at each end of the machine. Parallel to each spindle 34 is a threaded spindle 36 on which are nuts (not shown) for controlling the position of rods on which are mounted point combs for shaping or fashioning the fabric by narrowing and widening it but more commonly used for narrowing and therefore usually known as narrowing rods, while a pair of said spindles 34 and 36 and the attendant mechanism are commonly referred to as a narrowing head. The spindles 34 and 36 at each end of the machine are operated either in the clockwise direction, the narrowing direction, as viewed in Fig. 1 or in the counterclockwise direction, the widening direction, as viewed in Fig. 1.

A mechanism forming part of all full-fashioned knitting machines and commonly functioning at the same times as the narrowing head is the narrowing machine. The narrowing machine comprises a set of heavy curved arms pivotally mounted on a shaft (not shown) at the rear of the machine frame known as the back narrowing shaft and extending upwardly and forwardly therefrom to the front of the machine where they are pivoted to a front narrowing shaft. The front narrowing shaft has supported therefrom brackets which carry, among other things, said rods, so-called narrowing rods, for carrying said combs which include points for engaging loops on selected knitting needles, lifting said loops from the needles and transferring the loops to other needles. The weight of said front narrowing shaft is supported on links which may be elevated and held in the elevated position to

hold the narrowing machine out of operation but which are connected at their lower ends to levers having cam followers thereon, commonly roller type followers. When the narrowing machine is to be used, said links are lowered, either by hand or by a means controlled by the pattern mechanism of the machine, so that said followers rest on round disks and the narrowing machine is inactive so long as the machine continues in the knitting position. When now the narrowing machine is to operate, the pattern means throws into operation a means which shogs the main cam shaft longitudinally to the right of its knitting position as viewed from the front of the machine to the "narrowing" position in which said followers rest on cam disks. As the cam shaft revolves, said cam disks lower the narrowing machine so that one or more points on the combs move into engagement with loops on the needles. The cams for the narrowing machine then lift it enough so that the points clear the needles. At this time, the spindles 34 and 36 are operated, either in the narrowing or the widening direction as determined by the pattern means, to shift the narrowing rods one or two needles as desired. The cams for the narrowing machine then dip the machine again so that the points on the combs restore the loops which had been lifted to needles then in line with the points. The cams for the narrowing machine then lift it so the points are above the needles and the cam shaft is shifted back to knitting position. It will be understood further, that the couliering means, of which the yarn carriers form a part, is automatically disconnected from the cam shaft and is therefore inoperative while the cam shaft is in its right or "narrowing" position. Therefore, the yarn carrier rods do not operate and no yarn is laid during revolutions or cycles of the main cam shaft in which the narrowing machine is operated.

Another mechanism forming part of all full-fashioned knitting machines is the main pattern mechanism (not shown) which comprises a pattern chain composed of links on which buttons may be placed which cooperate with levers and/or rods connected to the levers for throwing into action various mechanisms in the machine which are intermittent in action.

The means for operating spindles 34 and 36 to turn them in the desired directions comprises a main cam shaft 38 extending longitudinally of the machine and adapted to be shogged longitudinally of itself from a knitting to a fashioning position and back, no yarn being laid when the cam shaft is in its fashioning position. On shaft 38 are shown two cams 39 and 40 (Figs. 1, 6 and 8) which transmit through a suitable train of mechanism impulses to turn said spindles, said cams 39 and 40 being spaced somewhat longitudinally on shaft 38. Said mechanism includes a generally horizontal lever 41 running transversely of shaft 38 and pivoted at 42 at its forward end. Lever 41 has a split section 43 intermediate its ends the spaced sides of which afford bearings for a spindle 44 for a roller type cam follower 45 which is adapted to cooperate with either cam 39 or 40 but which for the most part lies in a plane intermediate those of cams 39 and 40. At its rear end, lever 41 has a pivoted connection at 46 with the lower end of an actuator 47, a stop screw 48 supported from the framework 29 serving to support by contact with the pivot 46 the weight of the lever 41 and of the actuator 47 as well as the downward pull of a spring 49 connected to

lever 41 and which serves to hold the follower 45 against cam 39 or 40 when in use. When follower 45 cooperates with either cam 39 or 40, lever 41 is oscillated and thereby produces an upstroke followed by a downstroke of the actuator.

At its upper end actuator 47 is branched to afford connections for pawls for turning spindles 34 and 36. Five such pawls are shown in all (Figs. 1, 2 and 3), a narrowing pawl 50 for end stop spindle 34, a widening pawl 51 for end stop spindle 34, a narrowing pawl 52 for comb spindle 36 and a widening pawl 53 for comb spindle 36 and a second widening pawl or back-racking pawl 54 for comb spindle 36. Spindle 34 has two ratchets fixed thereon, a ratchet 57 for pawl 50 and a ratchet 58 for pawl 51. Also, spindle 36 has a ratchet 59 for pawl 52 and a ratchet 61 for pawls 53 and 54. Said pawls 50 to 53 inclusive all act to turn their spindles on the upstroke of the actuator 47 whereas pawl 54 acts to turn spindle 36 on the downstroke of the actuator. Pawls 51, 53 and 54 all are pivoted directly on actuator 47 while pawls 50 and 52 are pivoted directly on levers 62 and 63 respectively, lever 62 being pivoted on spindle 34 (Fig. 5) and lever 63 on spindle 36 (Fig. 4). Actuator 47 is pivoted to lever 62 at point 64 (Fig. 2) and actuator 47 being connected to lever 63 by a link 66 pivoted at both ends. Lever 62 is shown as having a bell-crank form for reasons pointed out hereinbelow.

When both spindles are to operate, pawls 50 and 52 act at the same time for narrowing movements of the spindles while pawls 51 and 53 act at the same time for widening movements of the spindles. For determining which one of said two pairs of pawls is to act at the time of a given reciprocation of actuator 47, two control cams 67 and 68 are provided, one on spindle 34 and one on spindle 36. Cams 67 and 68 are formed from flat plates and are mounted to turn on the spindles, a link 69 pivoted to both cams connecting them near their top edges so that they always move together. Means for turning cams 67 and 68 on the spindles will be described hereinbelow. Further, a link 71 connects the narrowing pawls 50 and 52 so that pawl 52 is thrown out of active position and thrown into active position when pawl 50 is moved out of and into such positions but, owing to a pin and slot connection and between link 71 and pawl 52 at 72 providing lost motion, the pawl 52 can be thrown out of action without throwing pawl 50 out of action. Widening pawls 51 and 53 have no direct linkage therebetween, but both pawls are urged toward their active positions by springs, spring 73 for pawl 51 and spring 74 for pawl 53. As shown pawls 50, 51 and 53 have pins or projections 76, 77 and 78 respectively thereon so positioned that they are contacted by cams 67 and 68 to swing one set or the other of the pawls out of active position as desired. Also, spring 73 is connected to a pivot point 79 and spring 74 is connected to pawl 54, while pawl 54 is connected to pivot point 79 by a link 81. Link 81 has a lost motion connection with pawl 54 at point 82 whereby pawl 54 may be held out of action when desired as hereinafter set forth. However, the tension of spring 74 is sufficient so that pawls 53 and 54 can be used in the same revolution of the cam shaft if desired, pawl 53 being held by cam 68 at such times so as to rack spindle 36 only one tooth at a time, pawl 54 then racking the spindle another tooth in the same revolution and in the same direction. Pawl 54 can also, of course, be used during the same revolution that pawl 52 is used, pawl 52 turning spindle 36 two teeth in one direction and pawl 54 turning spindle 36 one tooth in the opposite direction, this being the more ordinary occasion for the use of back-racking pawl 54.

It will be seen that for controlling pawl 54 pivot point 79 to which one end of link 81 is connected is at the lower end of an arm 83. Arm 83 is fixed to a shaft 84 which is pivotally mounted along the rear of the machine at about the level of the spindle 34 and 36 and which is part of a means for controlling the position of link 81 and thereby the pawl 54 the action of which is, in general, well known. Also, pawl 51 extends below its pivot and its lower end is pivotally connected by a link 86 with pivot point 79, so that pawl 51 cannot drop into position to rack spindle 34 when pawl 54 is held out of action by link 81, irrespective of the position of cam 67. Further, the means for controlling pawl 54 is so arranged that on arm 87, Fig. 2, is rigid with and travels with the nut 35 on which the end stops 33 are mounted. Arm 87 carries a contact plate 88 on its front face which, as the spindle 34 moves nut 35 along, presses against a cam or cams fixed to a bar 89 fixed to the upper end of arm 83 and above shaft 84, so that contact of plate 88 with any one of certain cams on bar 89 turns the upper end of lever 83 to the right and the lower end to the left as viewed in Figs. 1, 2 and 3 to draw pawl 54 out of active position with respect to spindle 36. On the other hand, when plate 88 is out of contact with the cams on bar 89 the lower end of lever 83 swings to the right under the influence of spring 73 to permit spring 74 to draw pawl 54 into position to rack the spindle 36. None of the features of said means for controlling pawl 54, however, forms a part of the present invention.

Preferably the means for moving and controlling cams 67 and 68 is combined in large measure with the means for moving and controlling the follower 45 to cause operations of the actuator 47 when desired. Said combined means comprises a lever 93 pivoted intermediate its ends to swing about a vertical pivot and having a fork 94 at its front end embracing the edge of the follower 45. The rear end of lever 93 is shown as curved downwardly close to the side of the beam 32 where it extends between two collars 96, 96 (Figs. 7 and 8) on a rod 97 which runs alongside beam 32 and is controlled by the pattern chain. Consequently, when rod 97 is shifted longitudinally of itself and the beam 32 by means about to be described, lever 93 swings on its pivot to shift follower 45. Rod 97 is held normally toward the right as viewed in Fig. 8 by a coil spring 98 which surrounds rod 97 and one end of which presses against a collar 99 on the rod while the other end of the spring presses against a bracket 102 fixed to beam 32 and which surrounds and helps to support rod 97. Rod 97 is shifted against the pressure of spring 98 by a bell-crank lever 103, shown in Fig. 7. Lever 103 is pivoted at 104 on a bracket 106 fixed to beam 32 and has an arm 107 which extends downward alongside a collar 108 on rod 97 and which is positioned so that, as lever 103 swings clockwise as viewed in Figs. 7 and 8, rod 97 is pushed leftward against the pressure of spring 98. The spring 98 moves rod 97 to the right when the lever returns to its position in Fig. 7. For swinging lever 103 from the position shown, a lever 109 is provided which is pivoted at 111 on the

bracket 106 fixed to the back beam 32. Lever 109 is connected by linkage 113, best shown perhaps in Fig. 9, to the upper end of lever 103. A tension spring 114 is connected to lever 109 forward of pivot 111 tending to pull the forward end of lever 109 downward and its rear end upward to thereby turn lever 103 to move rod 97 toward the left against the pressure of its spring 98. Lever 109 has a roller type cam follower 116 pivoted thereon which is adapted to cooperate with a cam 117 on the main cam shaft 38. During knitting operations and narrowing operations, the forward end of lever 109 is supported by a lever 118 pivoted at 119 on a bracket 121 supported from the front beam 31 as shown in Fig. 6. When narrowing is to be performed, the main pattern mechanism of the machine (not shown) throws into operation the mechanism for shogging cam shaft 38 to the right (as viewed from the front of the machine), the lever 118, lever 109 and rod 97 remaining stationary so that follower 45 remains stationary. However, the movement of shaft 38 is just enough to bring cam 39 into the same plane as follower 45 without requiring movement of the cam follower, so that actuator 47 is moved up and down to produce narrowing, the cams 67 and 68 standing normally in positions such that narrowing pawls 50 and 52 are active. In this case, the end stops and narrowing rods are both moved two needles, pawls 50 and 52 acting on spindles 34 and 36 to this effect. This occurs on the upstroke of actuator 47. However, in case the back-racking pawl 54 is in active position, it then moves spindle 36 one needle in the widening direction to move the combs outward a like distance. This action of pawl 54 causes the lines of fashion marks to incline toward the selvages. It will be noted further, that cam 117 is wide enough in the direction longitudinally of shaft 38 so that it cooperates properly with follower 116 both when shaft 38 shifts and when it does not.

Lever 118 is, however, controlled by the main pattern chain mechanism so that lever 118 is withdrawn from beneath lever 109 when a widening operation is to be performed. To permit such control, lever 118 is shown as having a projection 122 which extends forwardly from the front face of the lever, said projection 122 being pivotally connected to one end of a link 123 which is pivotally connected at its other end to a lever (not shown) forming part of said pattern mechanism. On the pattern chain forming part of said pattern mechanism, buttons are placed in positions to cause the desired widening actions of the spindles 34 and 36. When one of said buttons strikes said lever in the patterning means, the lever is operated to move link 123 to in turn to move lever 118 out from under the forward end of lever 109, thereby permitting follower 116 to contact cam 117, and operate lever 109, which action moves lever 93 and thereby follower 45 so that the follower is in the same plane as cam 40. At the same time, rod 97 moves a link 124 which forms a part of the means for turning and controlling the cams 67 and 68 so that they occupy positions throwing off the narrowing pawls and permitting, except for other pawl controlling means which may be in use at the same time as cam 40, the widening pawls to operate. As the cam shaft 38 approaches the end of the revolution in which a widening operation has been performed, the button which operated link 123 releases the link. At the same time, or thereabout, the cam 117 elevates lever 109 and a spring (not shown), moves link 123 to swing lever 118 back under lever 109 so that lever 109 is supported in elevated position until the pattern chain again removes lever 118 from beneath it. As appears in Figs. 7 and 8, lever 118 has a projection 126 at its upper end adapted to engage the left face of lever 109, as viewed from the front, as lever 118 swings beneath lever 109 and to prevent the lever 118 from swinging past lever 109.

Said controlling means for cams 67 and 68 includes an arrangement whereby, at its right hand end as viewed in Fig. 8, the link 124 is pivotally connected at 127 to the left end of a block 128 which lies generally behind and at the same level as rod 97 and has at its right end a collar 129 surrounding and fixed to the rod 97. Link 124 runs generally parallel to and at somewhat a lower level than rod 97 and at its left end is pivoted at 131 to the lower end of the vertical arm of a bell-crank lever 132. Lever 132 has a horizontal arm the free end of which is pivoted at 133 to a short link 134 the upper end of which is pivoted in turn to the lower end of a relatively long link 136. At its upper end, link 136 is pivotally connected to a short link 137 which is pivoted in turn to a pin 138 (Figs. 2 and 3) on cam 67. It will be seen therefore that as rod 97 moves toward the left as viewed in Fig. 8, it not only shifts the cam follower 45 into position to cooperate with the cam 40 to cause a movement of actuator 47 suitable to a widening movement of spindles 34 and 36 but also swings bell-crank lever 132 so that its horizontal arm lifts link 136 to swing cams 67 and 68 in the clockwise direction as viewed in Fig. 1 and to thereby position the racking pawls for spindles 34 and 36 properly for a widening movement of the spindles at the same time that cam 40 is in action to produce such a movement of actuator 47. The arrangement described for operating link 136 and thereby control cams 67 and 68 from link 97 is novel and advantageous in that the operation of the vertical link does not depend on the movement of the follower 45 and the lever 93 as is the case in mechanisms having the equivalent of the vertical link 136 for the control cams at the front of the machine. Therefore, it is feasible to disconnect the rod 97 from the lever 93 when it is desired to do so. It will be understood that plate type control cam 68 is so formed that it permits widening pawl 53 to turn spindle 36 only a distance of one needle. Therefore, pawl 54 is normally in action when widening is performed to step spindle 36 another needle on the downstroke of actuator 47, this being desired to maintain the points on the combs in the same position relative to the end stops.

As above mentioned when a narrowing action of the actuator 47 is desired, the pattern chain merely throws into action the means for shogging the cam shaft 38 to the right without permitting or causing an action of the control lever 109. Shaft 38, therefore, shifts to the right and thereby brings cam 39 into the plane of follower 45 as it stands in Fig. 8 so that narrowing cam 39 delivers an impulse to the actuator. No motion of link 136 having been caused by lever 109, rod 97 and the connecting train of mechanism, cams 67 and 68 remain in the positions shown in Figs. 1 and 2 and prevent widening pawls 51 and 53 from acting while, actuator 47 having been elevated by cam 39 as shown in Fig. 2, narrowing pawls 50 and 52 act on their respective ratchet wheels as shown in Fig. 2 to turn spindles 34 and 36 two needles in the clockwise or narrowing direction.

It has long been the custom to provide indexing

means including dials such as 141 and 142 for spindles 34 and 36 respectively, said dials having notched edges for receiving the lower bevelled ends of spring pressed locking plungers 143 and 144 respectively to hold the spindles 34 and 36 in definite indexed relation to the needles in the needle rows. However, only dial 141 for spindle 34 has substantially square or rectangular notches, dial 142 having V-shaped notches. Therefore, pawls 52, 53 and 54 can turn spindle 36 without need of lifting plunger 144 from dial 142, but dial 141 has a locking action when plunger 143 is firmly seated in its notches so that plunger 143 must be lifted out of the notch it was in contact with before pressure is applied to the pawl 50 or 51. For this purpose, rock lever 62, to which pawl 50 is pivoted, is made of bell-crank form and pivotally mounted on spindle 34 as well as pivotally connected to actuator 47 at point 64 so that the said lever turns clockwise about the spindle as the actuator rises and turns counterclockwise as the actuator descends. Lever 62, shown principally in dotted lines in Figs. 2 and 3, has a downwardly extending arm to which pawl 50 is pivoted at 147. Lever 62 has also an upwardly extending arm to which a cam plate 148 is attached. Plate 148 has an upwardly projecting lug 149 thereon having inclined sides which act as cam edges against the bevelled ends of a plunger 145, best shown in Figs. 2 and 5, to lift the plunger 143 by contact of the upper end of plunger 145 with a screw on the under side of a lever 146 pivoted slightly above and to the rear of the top of plunger 145 and projecting forwardly so as to engage in a groove in the upper end of plunger 143. Further, lever 146 projects outwardly beyond the plunger 143 and has a spring 150 attached between its outer end and a fixed point below the end of the arm so that the arm is urged downwardly by the spring and maintains plungers 143 and 145 respectively in contact with the dial 141 and the lug 149 on arm plate 148. Therefore, lever 146 lifts the plunger 143 each time lever 62 passes the central portion of its path and allows the plunger to move down into engagement with dial 141 when the lever moves toward the end of its path so as to engage in notches in the edge of dial 141.

Special controls are provided so that the pawls for the comb spindle 36 may all be thrown out of action at times. For this purpose, a finger is provided on the outer nut on each comb spindle which automatically moves under pawl 52 so as to disable it when the nut approaches the outer end of its path. Such finger is shown only diagrammatically at 151 (Fig. 3) because it forms per se no part of the present invention. Similarly, a finger 152 is provided to disable widening pawl 53 for spindle 36. Finger 152 is fixed to the outer nut (not shown) on spindle 36 and so placed with respect thereto that as the nut approaches the outer end of its path, finger 152 comes into contact with the pawl to hold it out of active position. Further, so that backracking pawl 54 may be disabled also, a collar 153 is provided on the rod 69 (Figs. 2, 3, 13 and 14) and fixed thereto in position such that a lever 154 pivoted on collar 153 at 156 may be turned to hold pawl 54 out of action. Lever 154 is connected at its free end to one end of a throw-over or snap spring 157, the other end of which is connected to collar 153 at point 158 which is so placed that spring 157 holds lever 154 in either the position shown in Figs. 2 and 3 or in that shown in Fig. 13.

In the position of the parts as shown in Figs. 2 and 3, pawl 54 will act on its ratchet wheel whenever permitted by link 81. When, however, the attendant throws lever 154 over into the position of Fig. 13, the lever prevents pawl 54 from coacting with its ratchet to affect spindle 36. Such disabling of all the pawls for spindle 36 is carried out only when lace fabric is being made by the use of a special lace attachment, a situation more fully discussed hereinbelow.

When the apparatus is to be operated under condition (c) mentioned hereinabove and widening is to be carried out by the carrier rods and end stops alone, the rod 97 is operated as previously described in response to withdrawal of lever 118 from beneath lever 109, thereby shifting link 136 to move cams 67 and 68 into position to throw narrowing pawls 50 and 52 out of action and to permit widening pawls 51, 53 and 54 to operate as shown in Fig. 3. As the widening is to be carried out entirely by the carrier rods and end stops, the pattern chain does not throw the means for shogging cam shaft 38 into operation and, further, the narrowing machine is not dipped, a dipping action of the narrowing machine and therefore of the combs carried thereby occurring only when the cam shaft 38 is in its right hand or narrowing position. Further, follower 45 must be shifted by lever 93 under such conditions to cause the movement of the actuator 47 by cam 40 so the actuator and pawl movements may come during the first or coulier-ing portion of the cam shaft cycle. The parts 93 and 136 being connected to rod 97 as previously described, the operation of rod 97 in response to operation of lever 118 by the pattern chain causes the follower 45 to shift to cooperate with cam 40 at the same time that cams 67 and 68 are shifted by link 136 to throw the narrowing pawls out of active position. Pawl 51, however, acts on the upstroke of the actuator 47 to turn the spindle 34 two needles in the widening direction. Pawl 53, on the other hand, is held by cam 68 so that it can move spindle 36 only one needle per operation of actuator 47 on the upstroke of the actuator. In order that the combs may maintain a given desired relation to the end stops, the pawl 54 is put into action during widening by the end stops and gives the spindle 36 a second step of one needle in the widening direction on the downstroke of actuator 47. However, as the combs are not dipped such widening movements of spindle 36 are idling movements. This situation is in general that mentioned hereinabove as condition (c).

It will be noted as to said condition (c), however, that as the cam shaft has not shifted and actuator 47 is operated by cam 40, the actuator moves upward during the first part of the cycle of the shaft 38 during the period the yarn carrier rods and the carriers thereon are laying yarns. It follows that the plunger 143 is fully removed from any notch in disk 141 at the time the carrier rod or rods strike the end stops. Therefore, the impacts of the rods tend to shift the spindle 34 beyond the desired point to which it was turned by pawl 51. To prevent this, a pawl 161 is employed which is pivotally mounted on the outer end of shaft 84 and which is arranged to engage the teeth of the ratchet wheel 57 to prevent the spindle from turning in the widening direction except when the pawl 161 is lifted. For lifting pawl 161 at the proper time, an arrangement is provided best shown in Figs. 2, 3, 10, 11 and 12 and comprising an arm 162 fixed to lever 62 in

the rear of plate 148 and having an upturned finger 163 at its left end as viewed in Fig. 2 to which a movable finger or lever 164 is pivoted at 166 to turn freely on its pivot. The left edge 167 of finger 163 is planed off straight at about right angles to the length of arm 162 and finger 164 has a pin 168 fixed therein about midway of its length and projecting therefrom, the pin 168 being biased against the straight edge 167 by a spring 170, one end being anchored to the pin 168 and the other end to a pin 174 on the arm 162 so as to determine the position of the finger 164. The finger 164 is free to turn clockwise against the action of spring 170 when pressure is applied to its lower edge. Pawl 161 has a pin or short bolt 169 fixed thereto intermediate its ends which projects into the path of a projection 176 which is fixed to and stands out laterally from pivoted finger 164. When pawl 161 is in engagement with a tooth of its ratchet wheel and lever 62 is turned counterclockwise by a downstroke of actuator 47, bolt 169 first lifts finger 164 and then allows it to drop below the level of the bolt. The parts are so arranged that as actuator 47 begins its next upward stroke finger 164 engages bolt 169 and lifts pawl 161 free of its ratchet. By the time the cam 149 has lifted plunger 143 enough to permit its dial to turn, pawl 51 has engaged a tooth of the ratchet wheel 58, pawl 50 being out of commission due to cam 67. As actuator 47 continues to rise, pawl 51 turns spindle 34 two needles. However, as the actuator rises lever 62 moves more to the right as viewed in Figs. 2 and 3 so that pawl 161 drops off the pointed free end of finger 164 into engagement with the ratchet 57 before the end of the upward movement of pawl 51. This is just before the yarn carrier rods strike the end stops, so that the spindle is held against turning by pawl 161 at the moments of impact. As actuator 47 reaches the extreme limit of its upward movement plunger 143 passes off the lug portion 149 of plate 148 so that the plunger seats in a notch in dial 141 to lock the spindle 34. This however, is of importance principally in narrowing operations as pawl 161 holds spindle 34 sufficiently during widening movements. On the return movement of the actuator, cam 149 again lifts plunger 143 to release the dial 141. At this time, however, there is nothing which will act to force the spindle beyond the point to which the pawl turned it and the plunger quickly seats itself again. As the actuator 47 moves downward, arm 162 moves counterclockwise as viewed in Figs. 2 and 3 carrying finger 164 against pin 169, first lifting finger 164 and then letting it drop below the pin.

The pawl 161 is provided with an extension 159 having pivoted thereto a link 160 which is provided with a slot 165 and which forms with a pin 175, carried on the pawl 50, a lost motion connection between the pawls 50 and 161. With this arrangement when the spindle 34 is to be manually turned to move the nut 35 outwardly to its starting position, the pawl 50 is manually turned in a counterclockwise direction to release the pawl 50 from the ratchet 57 which action engages the pin 175 with the right end of the link 160 thereby also releasing the pawl 161 from the ratchet 57 during said manually repositioning of the spindle 34.

Another situation which occurs with more or less frequency in the operation of full-fashioned knitting machines is the one in which it is desired to widen the fabric by the combined effects of the point combs and the yarn carrying rods. This is the situation mentioned hereinabove as situation or condition (*d*). In this case, the connection between the follower 45 and rod 97 is interrupted by loosening the collars 96 on rod 97 so that the rod 97 can move without affecting shift lever 93. Then, in order to prevent accidental movement of follower 45, it may be locked in place of its shaft by a member 171 shown in Fig. 8 in dot and dash lines and which is held in place by a screw 172, piece 171 having a flange which extends into a groove 173 on the hub of follower 45 to lock the follower in place on its lever 41. However, the form of the means for preventing accidental movement of follower 45 is immaterial. Therefore, when the cam shaft 38 is shifted to its narrowing position in response to action of the pattern chain, follower 45 cooperates with cam 39 to raise and lower actuator 47. At the same time or before the shaft 38 shifts, the pattern chain operates to throw the lever 118 out from under the front end of lever 169 so that rod 97 is operated to shift the cams 67 and 68 to disable the narrowing pawls and to throw the widening pawls 51, 53 and 54 into action. As the cam shaft has shifted, the narrowing machine will be dipped, assuming the narrowing machine has been lowered to rest its weight on the cam shaft and the combs have been set in proper relation to the selvage loops, and pawl 53 will shift the spindle 36 so that the combs will transfer the edge loops one needle space in the widening direction. At the same time, pawl 51 will shift the spindle 34 so as to move the end stops two needles. On the downstroke of the actuator 47, pawl 54 will shift spindle 36 another needle distance to maintain the combs in the same relative position to the end stops as at the beginning of the cycle. The cam shaft 38 then, of course, is shifted back to knitting position so that yarn is laid to the needles on the next revolution of the shaft and a widened course is then knitted.

A third situation for which the apparatus according to the present invention is adapted and which occurs with more or less frequency in the operation of full-fashioned knitting machines is the one in which lace making is carried on. This is the situation mentioned hereinabove as situation or condition (*e*). In lace making the spindle 36 is put completely out of operation, the fashioning combs mentioned hereinbefore for widening and narrowing being moved out of the knitting field and a lace comb having lace making points thereon being thrown into position to act on the fabric loops on the needles when the narrowing machine is dipped. The spindle 36 therefore should remain idle during lace making and therefore, before lace is begun, it is turned to its extreme position in the widening direction by a hand lever which can be engaged with the end of the spindle. In this position, all the pawls for spindle 36 are out of commission and held so as hereinbefore explained, so that there is no danger that the spindle 36 will be moved until it is desired that it should be. In this position pawl 52 is prevented from acting on spindle 36 by stop 151 on the outer nut on spindle 36 and pawl 53 is prevented from acting on spindle 36 by stop 152, also on said outer nut, while pawl 54 is prevented from acting on spindle 36 by the lever 154.

During such lace making periods it may, however, be desired to widen or narrow the fabric and this is then accomplished by the end stops. When narrowing is desired, the pattern chain causes the follower 45 to stand in the position shown in Figs. 1, 6 and 8 by omitting to move lever 118. As the main cam shaft 38 shifts to the right dur-

ing lace making, cam 39 will then be brought into the plane of follower 45 so that actuator 47 will be carried through an up and down cycle. Also, the cam 67 will be in the correct position for a narrowing operation to be performed by pawl 50, since cams 67 and 68 are normally held by rod 97 and link 136 in the positions to cause narrowing. When widening is to be performed on a section of fabric containing lace lever 118 is operated in a knitting cycle, that is when main cam shaft 38 is not shifted, to throw cam 67 into position to throw narrowing pawl 50 out of action and to permit widening pawl 51 to act on spindle 34, at the same time that follower 45 is moved to cooperate with cam 40 as previously described. When neither narrowing or widening is desired in making a section of fabric containing lace, follower 45 must be shifted to a position intermediate those for narrowing and widening so that actuator 47 will not be reciprocated. For so moving follower 45, rod 97 is moved by the pattern controlled cam and lever shown in Figs. 8 and 9. Therefore, at such times, the pattern chain throws lever 118 out from under lever 109 and moves the lever 118 for actuating rod 97 and the rod 97 moves the follower 45 to right and left in step with cam shaft 38, so that follower 45 keeps between cams 39 and 40 while the actuator 47 and the spindles 34 and 36 are all prevented from moving.

The widening operations listed hereinabove as (*a*), and (*b*) being performed by the present mechanism in the usual way will not be further described.

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

I claim as my invention:

1. In a full-fashioned knitting machine, the combination of a series of yarn carrier rods, stops for said rods, a threaded spindle for moving said stops in response to rotative movements of the spindle, means including an actuator for racking said spindle on the upstroke of said actuator in either the narrowing direction or the widening direction as desired, indexing means holding said spindle during non-fashioning knitting but apt to be out of action at the time of impact of said rods when widening solely by said rods, and means for holding the spindle against movements in the widening direction in response to impact of said rods.

2. In a full-fashioned knitting machine, the combination with a series of yarn carrier rods, stops for said rods, a threaded spindle for moving said stops in response to rotative movements of the spindle, means for racking said spindle to move said stops in either the narrowing direction or the widening direction as desired including ratchet wheels and racking pawls therefor, a latch pawl for cooperating with one of said wheels to prevent movement of said spindle in the widening direction in response to the action of said rods on said stops, and means to lift the latch pawl when racking the spindle in the widening direction.

3. In a full-fashioned knitting machine, the combination of a series of yarn carrier rods, stops for said rods, a threaded spindle, a nut on said spindle to move said stops in response to rotative movements of said spindle, means for racking said spindle to move said nut in either the narrowing direction or the widening direction as desired including an actuating member having an up and down movement and a narrowing pawl and a widening pawl pivoted thereon and arranged always to turn the spindle on the upstroke of said actuating member, a latch pawl cooperating with said means to prevent movement of said spindle in the widening direction in response to the action of said rods on said stops, and means to lift said latch pawl when racking the spindle in the widening direction.

4. In a full-fashioned knitting machine, the combination of a series of yarn carrier rods, stops for said rods, a threaded spindle, a nut on said spindle for moving said stops in response to rotative movements of said spindle, means for racking said spindle in either the narrowing direction or the widening direction as desired including an actuator having an up and down movement and a narrowing pawl and a widening pawl pivoted thereon and arranged to always turn the spindle on the upstroke of the actuator, a latch pawl for holding the spindle against movements in the widening direction in response to impact of said rods, and a one way actuating means lifting said latch pawl only at the time the spindle is beginning a rotative movement.

5. In a full-fashioned knitting machine, the combination of a series of yarn carrier rods, stops for said rods, a threaded spindle, a nut on said spindle for moving said stops in response to rotative movements of the spindle, means for racking said spindle to move said nut in either the narrowing direction or the widening direction as desired including ratchet wheels and racking pawls therefor, an actuator having an up and down movement, a latch pawl cooperating with one of said ratchet wheels to prevent movement of said spindle in the widening direction in response to the action of said rods on said stops, and means for lifting said latch pawl near the beginning of the upstroke of the actuator and dropping it before said upstroke is completed.

6. In a full-fashioned knitting machine, the combination with a series of yarn carrier rods, stops for said rods, a threaded spindle, a nut on said spindle for moving said stops in response to rotative movements of said spindle, means for racking said spindle to move said nut in either the narrowing direction or the widening direction as desired including ratchet wheels, an actuator, and racking pawls thereon for said wheels, a latch pawl cooperating with one of said wheels to prevent movement of said spindle in the widening direction in response to the action of said rods on said stops, and means lifting said latch pawl including a pivoted finger arranged to move up on the upstroke of the actuator to engage and lift the latch pawl but moving free of the pawl to permit the pawl to drop while the finger is still moving up, said finger turning on its pivot on the downstroke of the actuator to drop below the latch pawl.

7. In a full-fashioned knitting machine, the combination of a series of yarn carrier rods, stops for said rods, a threaded spindle, a nut on said spindle for moving said stops in response to rotative movements of the spindle, means for racking said spindle in either the narrowing direction or the widening direction as desired including an actuator having an up and down movement and a narrowing pawl and a widening pawl pivoted thereon and arranged to act always on the upstroke of the actuator, a latch pawl to prevent movement of the spindle in the widening direction, a pivoted finger arranged to move up on

the upstroke of the actuator to engage and lift the latch pawl but moving free of the pawl to permit the pawl to drop while the finger is still moving up, said finger turning on its pivot on the downstroke of the actuator to drop below the latch pawl.

8. In a full-fashioned knitting machine, the combination with a series of yarn carrier rods, stops for said rods, a threaded spindle, a nut on said spindle for moving said stops in response to rotative movements of said spindle, means for racking said spindle to move said nut in either the narrowing direction or the widening direction as desired including ratchet wheels on the spindle, an actuator having an up and down movement, and racking pawls for said wheels on said actuator, a latch pawl cooperating with one of said wheels to prevent movement of said spindle in the widening direction in response to the action of said rods on said stops, an arm pivoted on said spindle, a spring pressed member for holding said spindle from turning in either direction except as desired, a cam on said arm lifting the spring pressed member, and a finger pivoted on said arm for lifting said latch pawl on the upstroke of the actuator, said finger arranged to engage and lift the pawl in moving upward but moving free of the pawl to permit it to drop while the finger is still moving up, said finger turning on its pivot on the downstroke of the actuator to drop below the latch pawl.

9. In a full-fashioned knitting machine, the combination of a comb spindle, an end stop spindle, means for turning said spindles in either the narrowing direction or the widening direction as desired comprising ratchets on said spindles and two pawls for each spindle together with a third pawl for said comb spindle for acting in the widening direction, cam means throwing out of action either the two narrowing pawls or the two widening pawls for said spindles as desired, and means moving synchronously with said cam means for throwing out of action said third pawl for the comb spindle.

10. In a knitting machine of the type having a narrowing machine, the combination of a series of yarn carrier rods, stops for said rods, a threaded spindle for moving said stops, point combs, a threaded spindle for moving said combs, means including an actuator member having an up and down motion and pawls, two for said first spindle and two for said second spindle, all acting on the upstroke of the actuator member for turning said spindles, a third pawl for the second spindle arranged to act on the downstroke of the actuator member to maintain the combs in desired relation to the end stops when the narrowing machine is out of action in a cycle involving operation of said spindles, and means for holding the end stop spindle against movements in the widening direction in response to impact of said rods on said stops following the times the end stop spindle is racked in the widening direction.

11. In a full-fashioned knitting machine of a type having a narrowing machine, the combination of a series of yarn carrier rods, stops for said rods, a threaded spindle for moving said stops, point combs, a threaded spindle for moving said combs, means for turning said spindles including an actuator member having an up and down motion in use and pawls, two for said first spindle and two for said second spindle all acting on the upstroke of the actuator member, a third pawl for said second spindle arranged to act on the downstroke of the actuator member to maintain the combs in desired relation to the end stops when the narrowing machine is out of action in a cycle involving operation of said spindles, indexing means holding said first spindle during non-fashioning knitting but out of action during widening when the narrowing machine is out of action, and means for holding said first spindle against movements in the widening direction in response to impact of said rods on said stops.

12. In a full-fashioned knitting machine, the combination with a series of yarn carrier rods, stops for said rods, a threaded spindle for moving said stops in response to rotative movements of the spindle, a point comb, a threaded spindle for moving said comb, means for racking said spindles to move said stops and said comb in either the narrowing direction or the widening direction as desired including ratchet wheels and racking pawls two for said first spindle and two for said second spindle together with a third pawl for the second spindle, one of said second two pawls and said third pawl acting on said second spindle to maintain said comb in the desired relation to the end stops when widening by the combined comb and end stop action, an actuator for driving said pawls, a cam shaft having two cams fixed thereon for thrusting said actuator, a cam follower for transmitting thrusts from said cams to said actuator, and means for shifting said follower from one cam to the other and for also controlling said pawls to determine the direction of rotation of said spindles, said means adjustable to permit said follower to cooperate with one of said cams only while using both spindles for widening fabric.

13. The method of operating a full-fashioned knitting machine having a narrowing head including end stops, a spindle for operating said end stops, a point comb, a spindle for operating said comb, means including pawls for turning said spindles in either the narrowing direction or in the widening direction, and indexing means for said spindles which is out of action during yarn laying for widening, comprising the steps of widening fabric during a knitting cycle by throwing out of action the pawls for turning said spindles in the narrowing direction, turning said end stop spindle in the widening direction during yarn laying so that the yarn carrier rods strike the end stops while said end stop spindle is released from its indexing means, and preventing turning of the end stop spindle by the impact of the rods.

14. In a method of operating a full-fashioned knitting machine having a narrowing head including end stops for carrier rods, a spindle for moving said stops, a point comb, a spindle for moving said comb, pawl and ratchet means for racking said spindles in either the narrowing direction or the widening direction as desired, a latch pawl for said first spindle cooperating with a ratchet of said means, and an indexing means for said spindles which is out of action during yarn laying for widening, the steps comprising widening fabric during a knitting cycle by preventing said pawl and ratchet means from turning said spindles in the narrowing direction, turning said end stop spindle by said means in the widening direction during yarn laying so that the carrier rods strike said end stops while said end stop spindle is released from its indexing means, lifting said latch pawl out of latching position to permit the end stop spindle to be racked, and dropping said latch pawl into latching position

prior to the impact of the yarn carrier rods against the end stops.

15. In a full-fashioned knitting machine, the combination of a narrowing head having an end stop spindle and a comb spindle, an actuator having an up and down motion and having pawls connected thereto for racking said spindles in either the narrowing direction or the widening direction as desired, a main cam shaft having cams thereon for operating said actuator, one cam for fashioning cycles and one cam for knitting cycles, a cam follower for cooperating with said cams one at a time, a lever for shifting said follower from a position for cooperating with one of said cams to a position for cooperating with the other of said cams and also for shifting said follower at times to prevent it from cooperating with either of said cams, means for controlling said pawls, a rod for operating said follower shifting lever and for operating said pawl controlling means and separately connected to each, and a readily disconnectible connection between said follower shifting lever and said rod, whereby said rod may operate said pawl controlling means by itself when desired.

16. In a full-fashioned knitting machine, the combination as set forth in claim 15 together with pattern controlled means for shifting the main cam shaft from knitting to fashioning position, and pattern controlled means for moving the rod longitudinally of itself when the cam shaft is in either knitting or fashioning position.

17. In a full-fashioned knitting machine, in combination, a series of yarn carrier rods, stops for said rods, a threaded spindle for moving said stops in response to rotative movements of the spindle, means for racking said spindle to move said stops in either the narrowing direction or the widening direction as desired including an actuator having an up and down motion, ratchet wheels and racking pawls therefor acting all on the upstroke of said actuator, a pivoted latch pawl for cooperating with one of said wheels to prevent movement of said spindle in the widening direction in response to the action of said rods on said stops, an arm fixed to said latching pawl extending on the opposite side of its pivot, the pawl for racking said spindle in the narrowing direction having an arm extending on the opposite side of its pivot, and a link connected to said arms and affording a lost motion connection therebetween for racking operations but arranged so that turning said racking pawl on its pivot to a certain extent lifts said latch pawl from its ratchet.

18. In a full-fashioned knitting machine, in combination, a series of yarn carrier rods, stops for said rods, a threaded spindle for moving said stops in response to rotary movements of said spindle, means for racking said spindle to move said stops in either the narrowing direction or the widening direction as desired including ratchet wheels and pivoted racking pawls therefor, a pivoted arm turning on its pivot in response to changes in position of said end stops, the pawl for racking said spindle in the widening direction having an arm extending on the other side of its pivot from the end which engages the ratchet, and a link connecting said arms and affording a lost motion connection therebetween during racking operations of the widening pawl but maintaining the widening pawl free of its ratchet when said stops are in certain positions.

19. In a full-fashioned knitting machine including a main cam shaft adapted to occupy both knitting and fashioning positions, yarn carrier

rods, a point comb and a narrowing head having end stops for said rods, and spindles for moving said stops and comb, the combination with said head of operating and controlling means therefor capable of adjustment to adapt the head for widening fabric by the end stops and carrier rods with the cam shaft in knitting position, for widening by joint action of the comb and end stops, with the cam shaft in fashioning position, and for lace making operations with the cam shaft in fashioning position and the spindles of the head operating in either direction in lace making cycles, and pattern controlled means for determining the position of said cam shaft for knitting or fashioning and the direction of movement of said spindles.

20. In a full-fashioned knitting machine, in combination, end stops, an end stop spindle, a comb spindle, means for turning said spindles in either the widening or narrowing direction as desired including an actuator having an up and down motion, a pawl for racking said first spindle in the widening direction on the upstroke of said actuator, a pawl for racking said second spindle in the widening direction on the downstroke of said actuator, means for controlling said first pawl to hold it out of action during narrowing, means for controlling said second pawl to prevent it from acting at certain positions of said end stops, and a link between said first pawl and said second control means affording a lost motion connection for normal operation of the first pawl but preventing operation thereof in case said second pawl is held out of action by said second control means, irrespective of the position of said first control means.

21. In a full-fashioned knitting machine, the combination of a comb spindle, an end stop spindle, means for turning said spindles in either the narrowing direction or the widening direction as desired comprising ratchets on said spindles and two pawls for each spindle together with a third pawl for said comb spindle for acting in the widening direction, cam means throwing out of action either the two narrowing pawls or the two widening pawls for said spindles as desired, and means supported on a portion of said cam means for throwing out of action said third pawl for the comb spindle.

22. In a full-fashioned knitting machine, the combination of a comb spindle, an end stop spindle, means for turning said spindles in either the narrowing direction or the widening direction as desired comprising ratchets on said spindles and two pawls for each spindle together with a third pawl for said comb spindle for acting in the widening direction, cam means for throwing out of action either the two narrowing pawls or the two widening pawls for said spindles as desired, including a cam for each of said spindles and a rod transverse to the spindles connecting said cams, and means supported on said rod for throwing out of action said third pawl for the comb spindle.

23. In a full-fashioned knitting machine, the combination of a comb spindle, an end stop spindle, means for turning said spindles in either the narrowing direction or the widening direction as desired comprising ratchets on said spindles and two pawls for each spindle together with a third pawl for said comb spindle for acting in the widening direction, cam means for throwing out of action either the two narrowing pawls or the two widening pawls as desired including a cam for each of said spindles and a connecting rod

between said cams, and a throw over latch on said rod adapted to prevent said third pawl from acting on the comb spindle.

24. In a full-fashioned knitting machine, the combination of a narrowing head having an end stop spindle and a comb spindle, an actuator having an up and down motion and having pawls connected thereto for racking said spindles in either the narrowing direction or the widening direction as desired, means for controlling said pawls to cause either narrowing or widening movements as desired, a rod extending along the back of the machine and movable longitudinally thereof, a bell-crank lever operated by said rod and a link extending from said lever to said controlling means for operating the controlling means and lying generally at the rear of the machine.

25. In a full-fashioned knitting machine, the combination with a series of yarn carrier rods, of stops for said rods, a threaded spindle, means for racking said spindle to move said stops in either the narrowing direction or the widening direction as desired including ratchet wheels and racking pawls therefor having an up and down motion and delivering their racking impulses on upstrokes, and a latch to prevent movement of said spindle in the widening direction in response to the action of said rods on said stops following the times the stop spindle is racked in the widening direction.

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