June 13, 1939. J. H. MILLER ET AL 2,161,880

CIRCULAR KNITTING MACHINE

Filed May 6, 1938 12 Sheets-Sheet 1

Fig. 1.

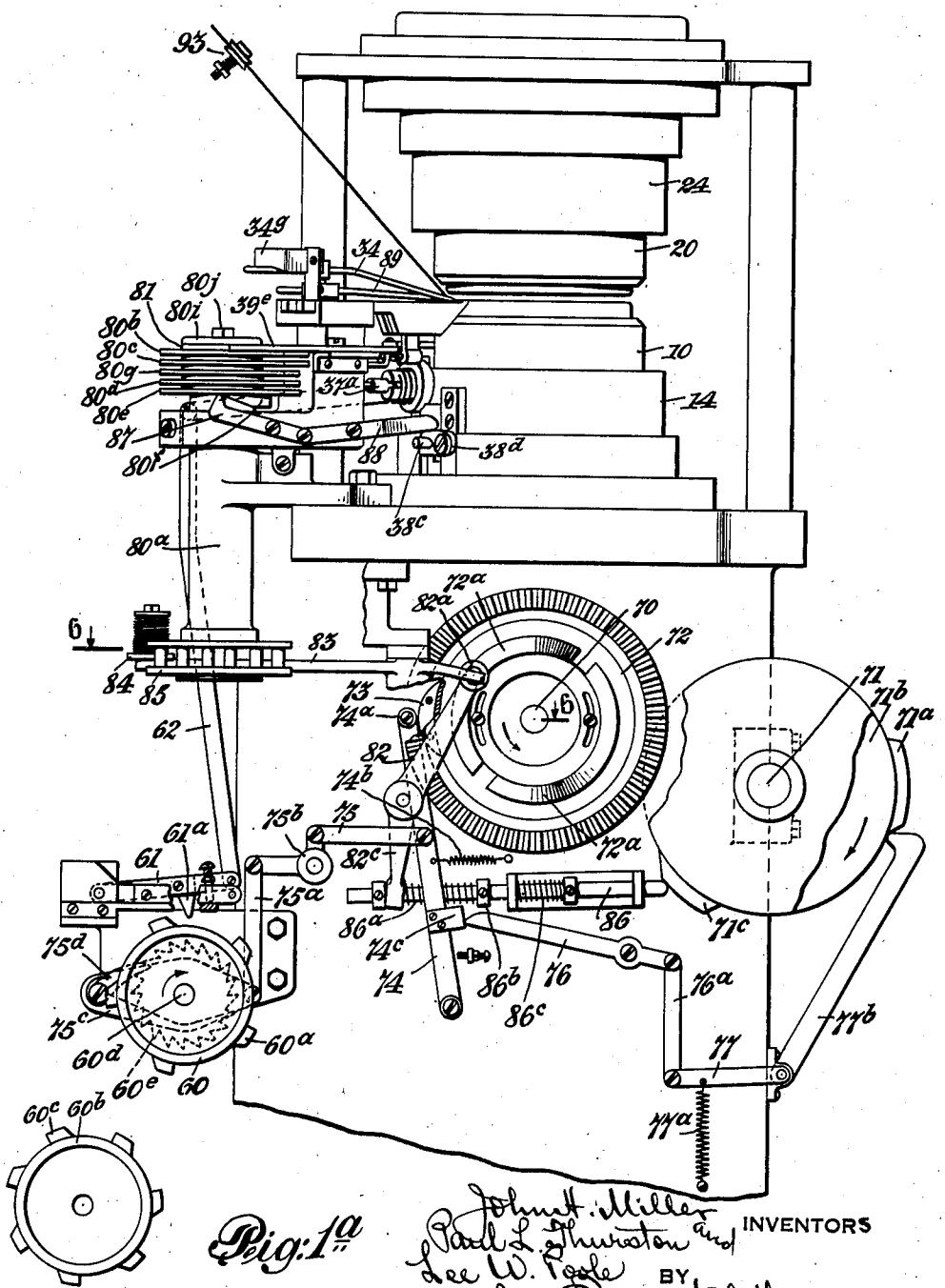


Fig. 1a

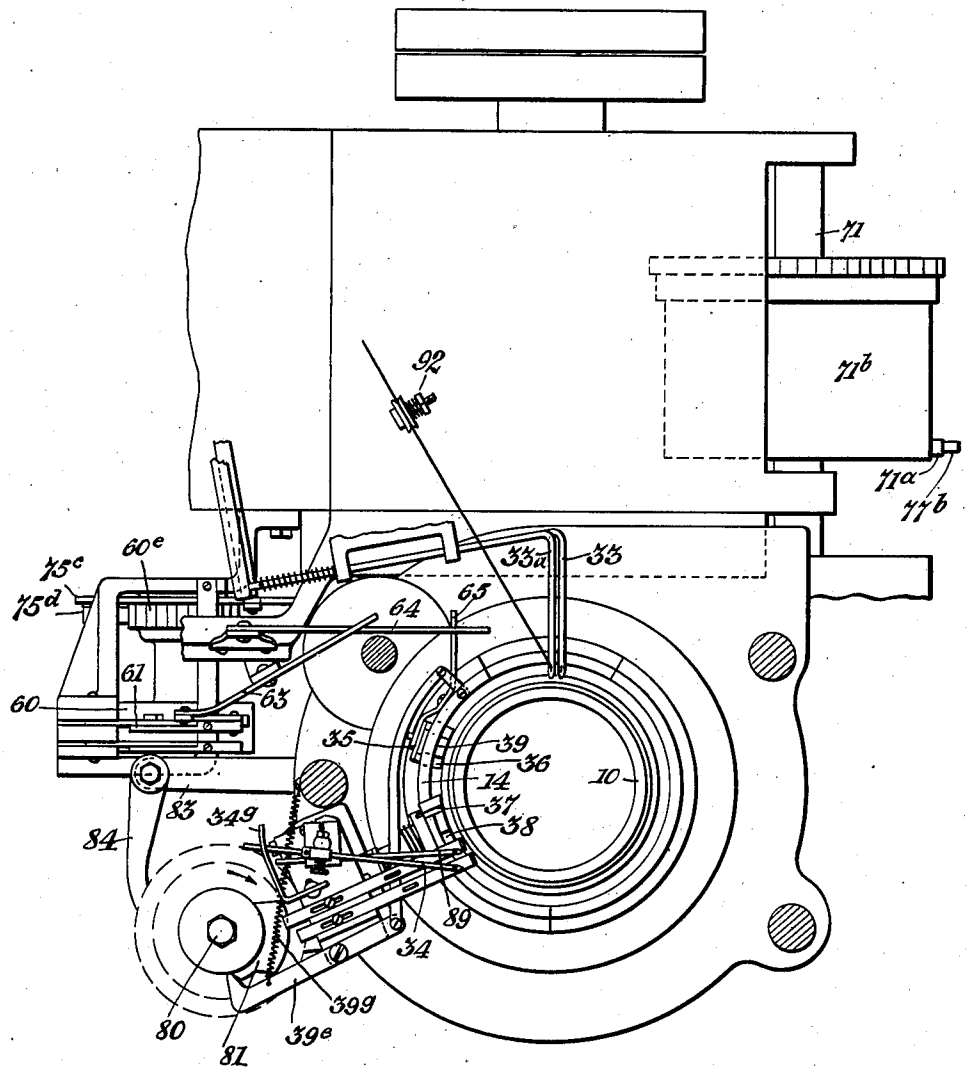
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CIRCULAR KNITTING MACHINE

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Fig. 2.



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Fig. 3.

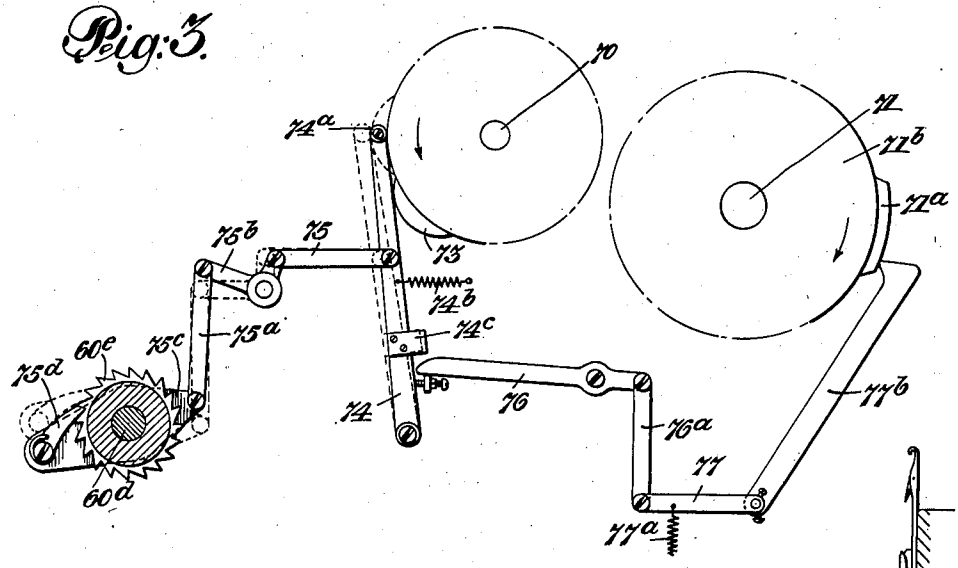
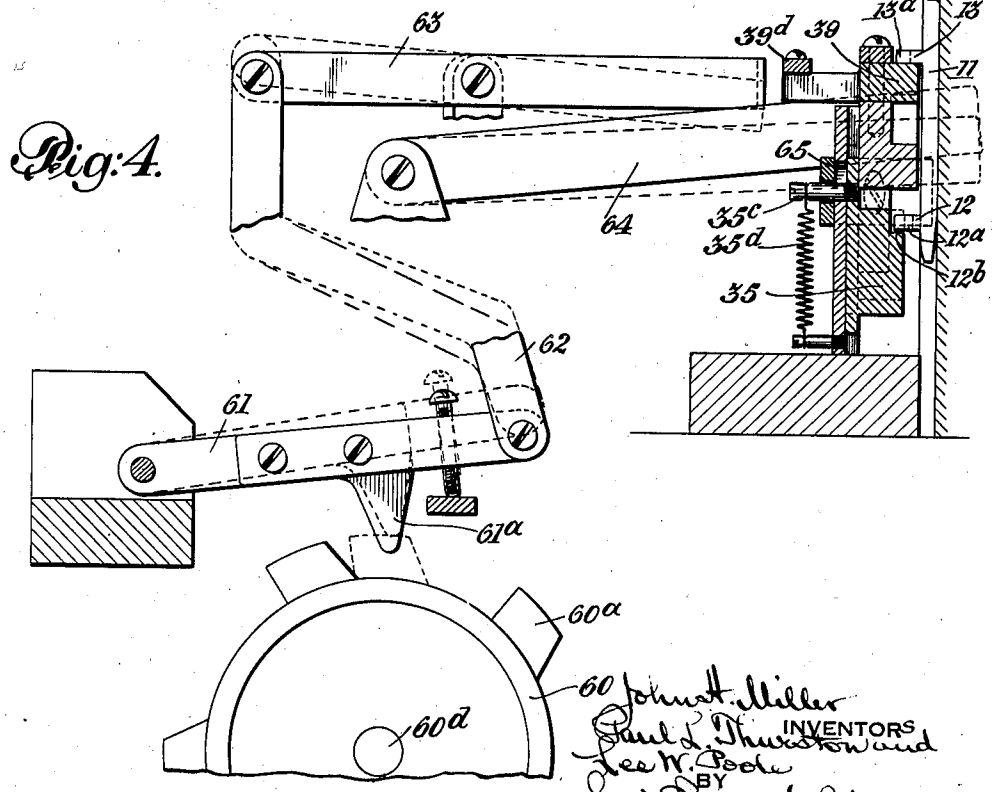


Fig. 4.



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CIRCULAR KNITTING MACHINE

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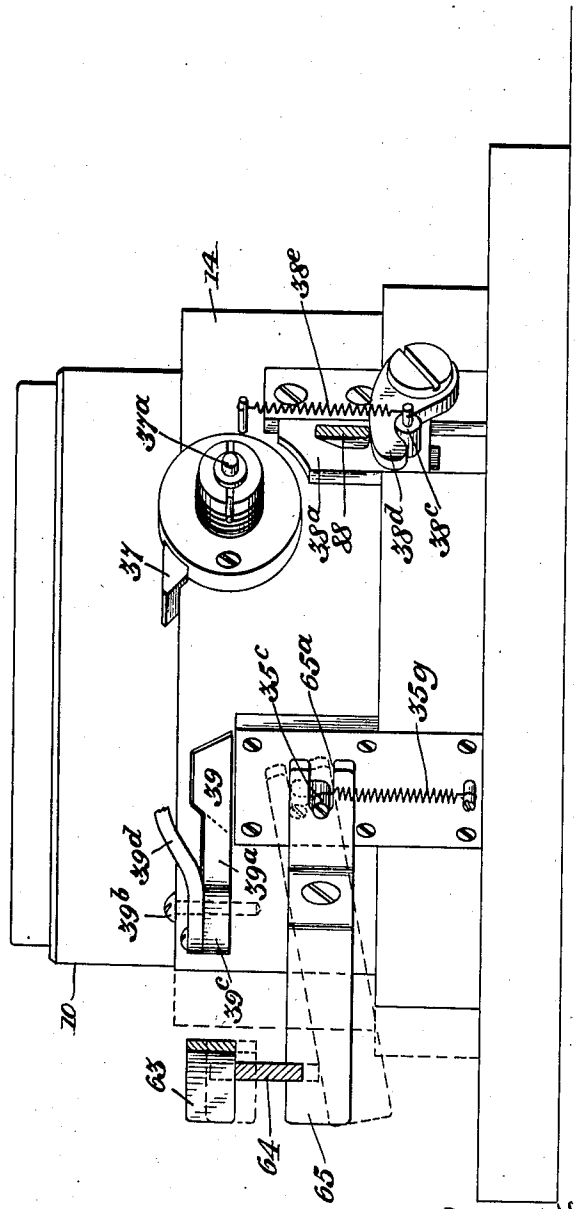


Fig. 5.

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CIRCULAR KNITTING MACHINE

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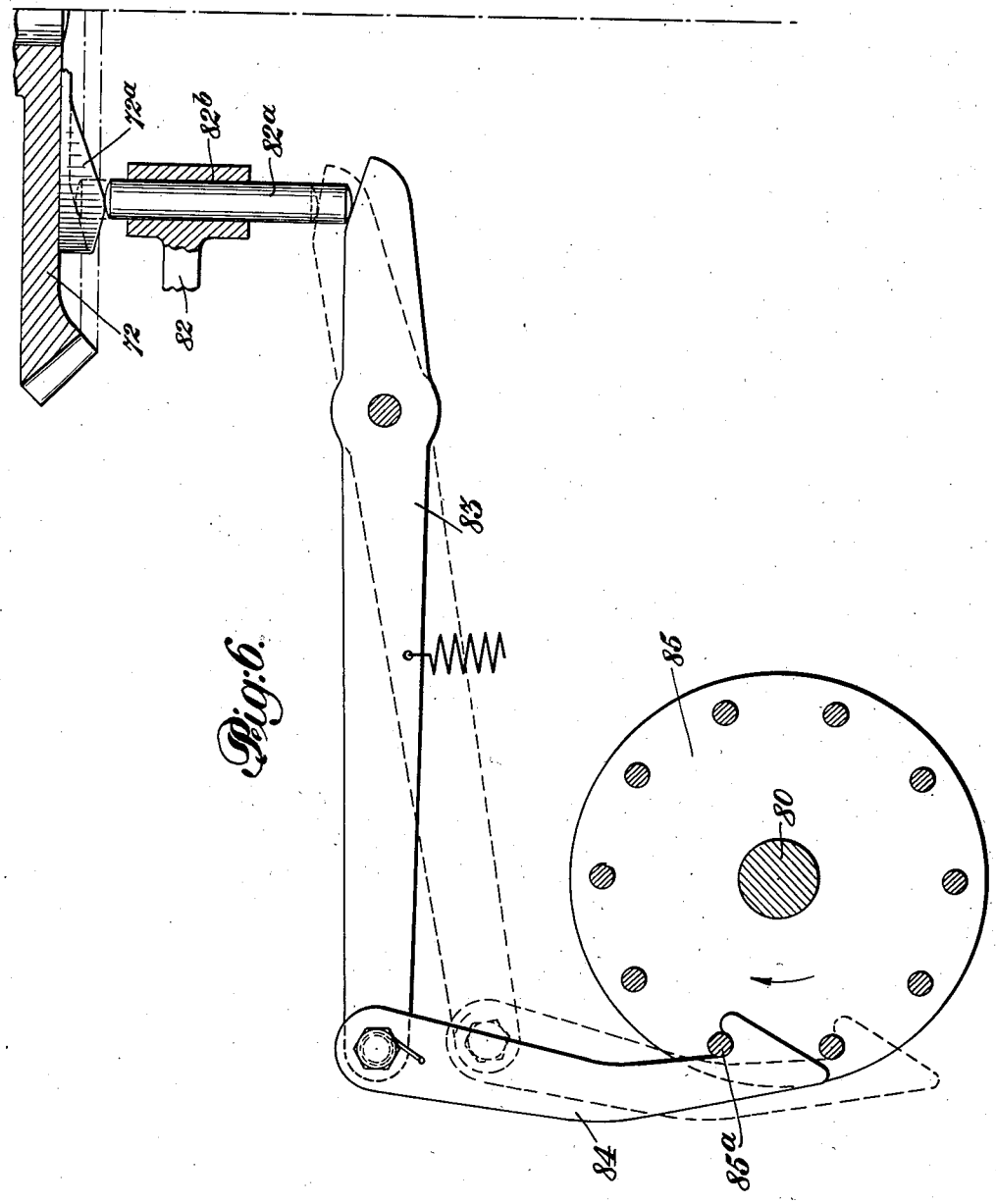


Fig. 6.

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CIRCULAR KNITTING MACHINE

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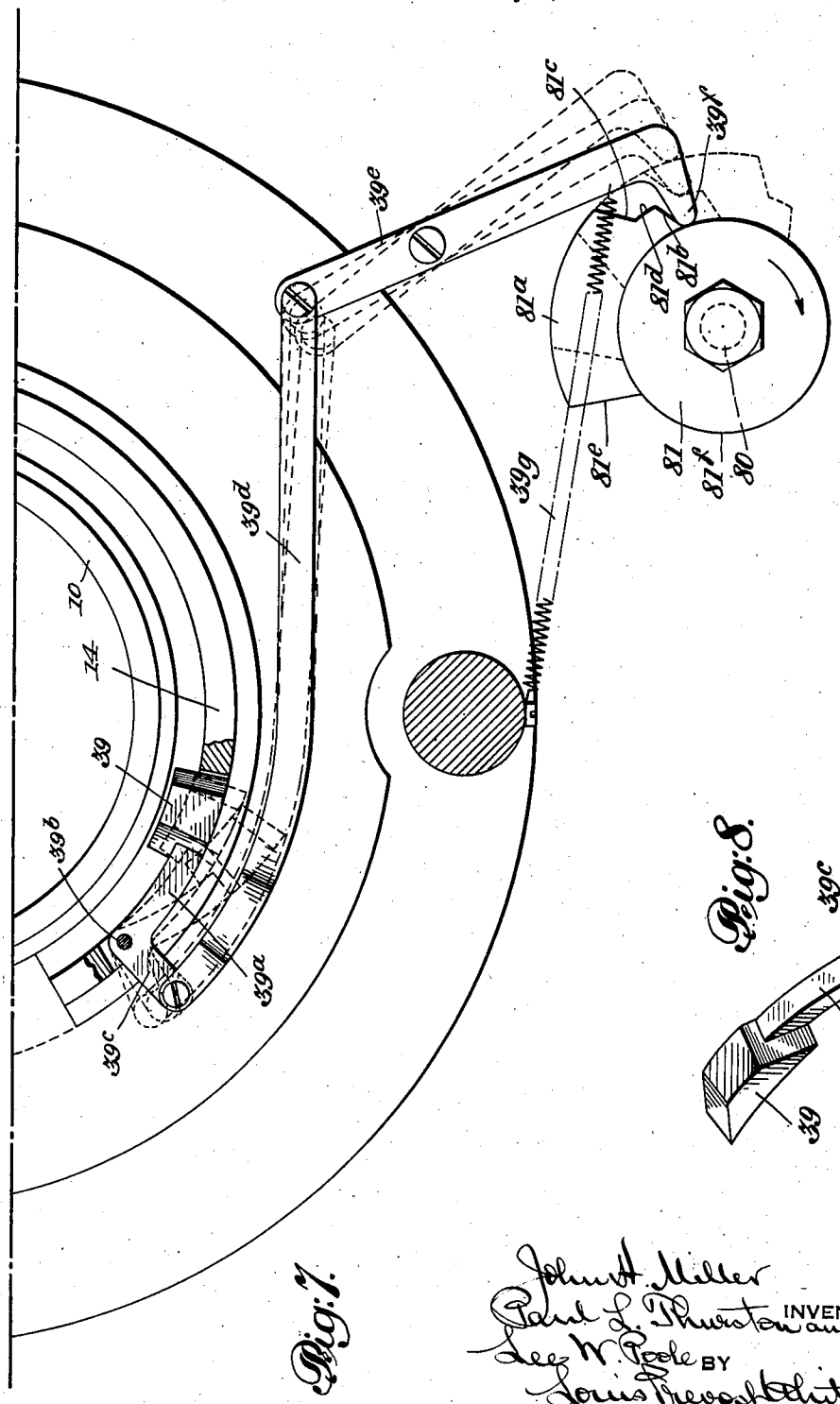


Fig. 7.

Fig. 8.

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CIRCULAR KNITTING MACHINE

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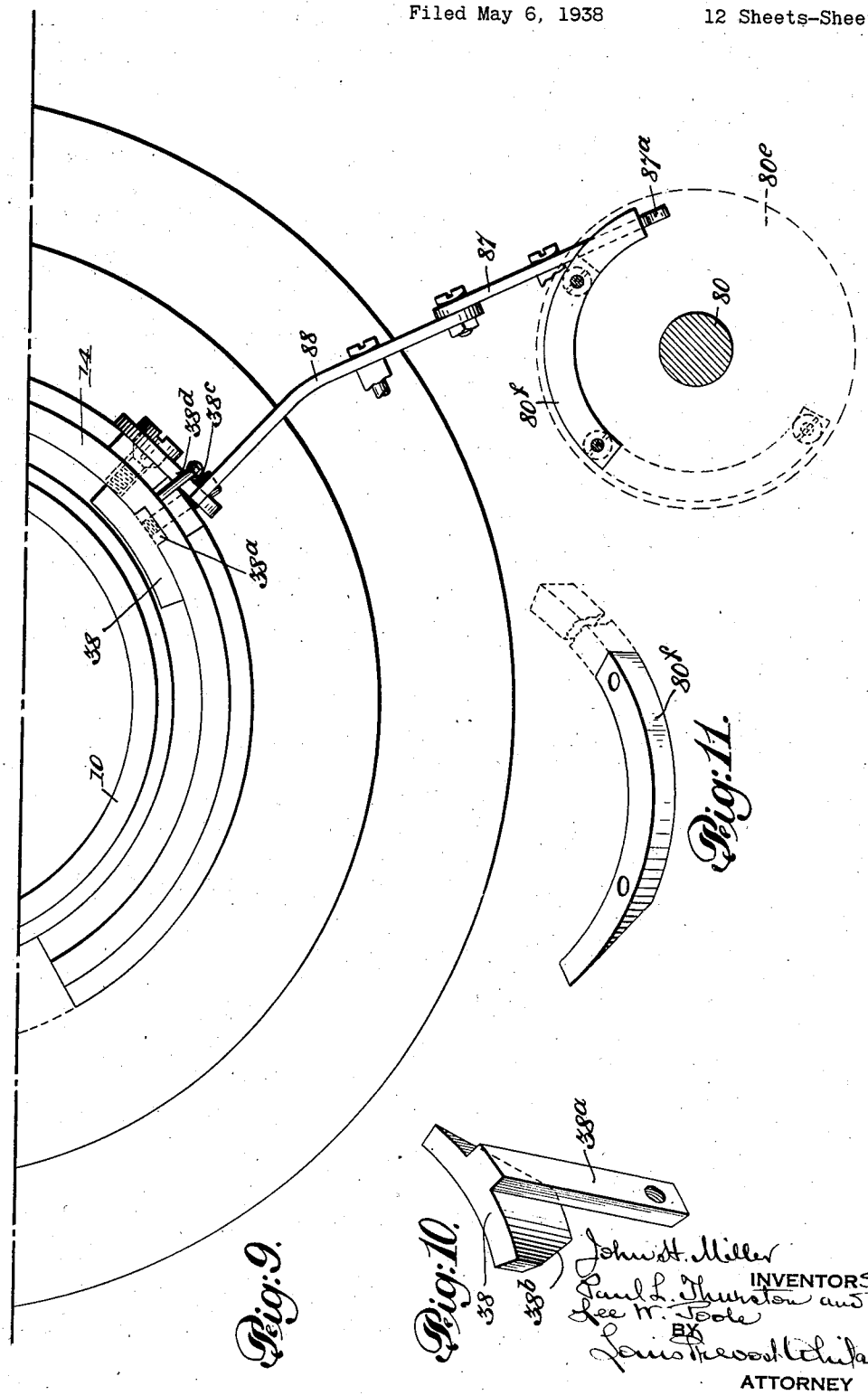


Fig. 9.

Fig. 11.

Fig. 10.

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Fig. 12.

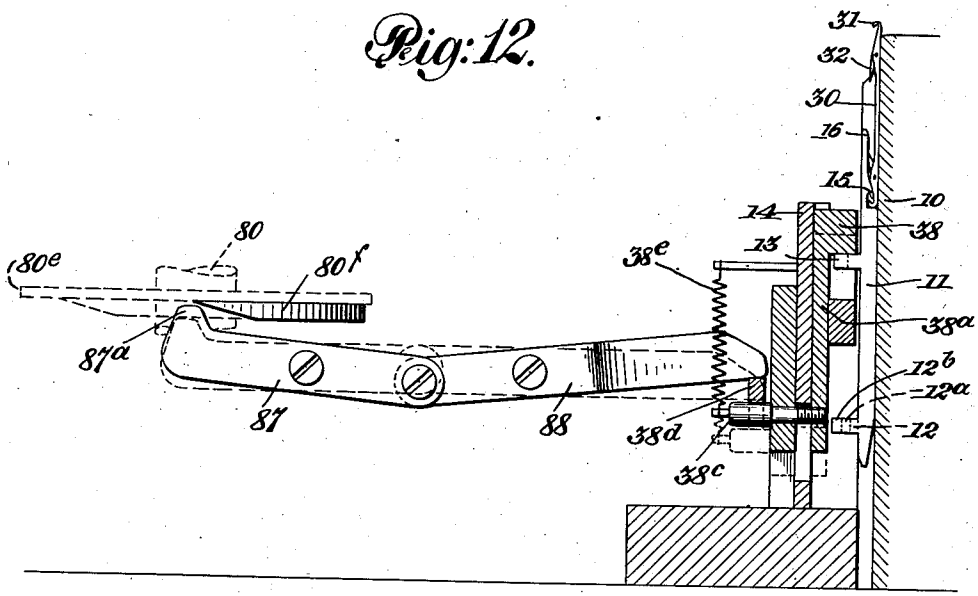
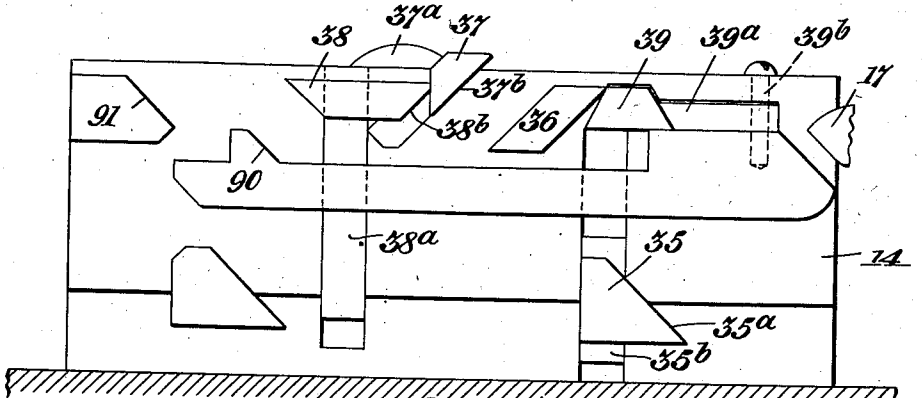


Fig. 13.



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CIRCULAR KNITTING MACHINE

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Fig. 16.

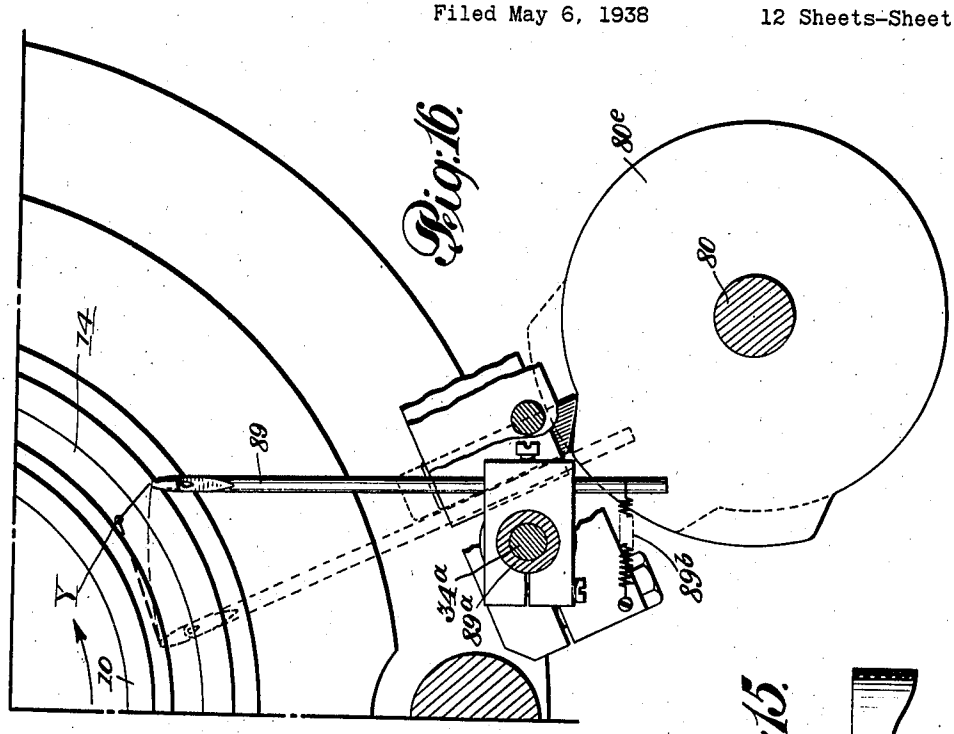
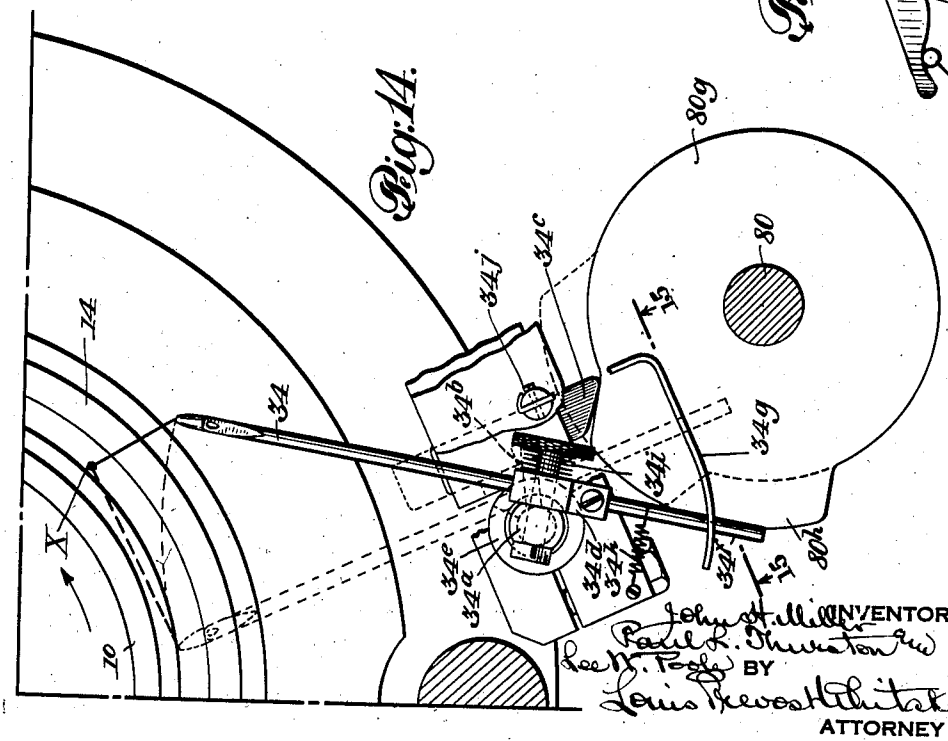


Fig. 15.



Fig. 14.



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CIRCULAR KNITTING MACHINE

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Fig. 17.

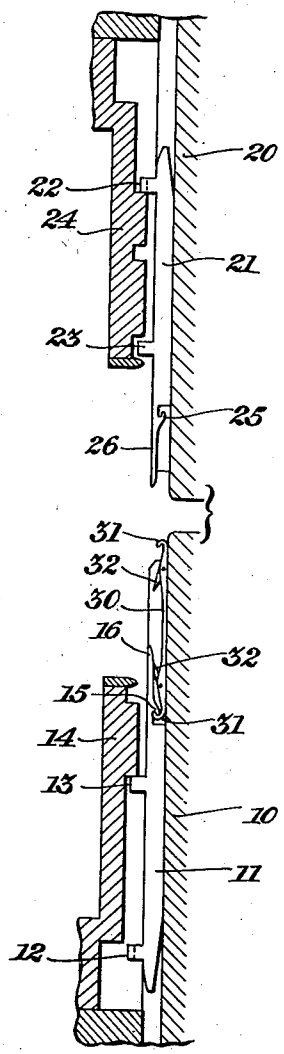
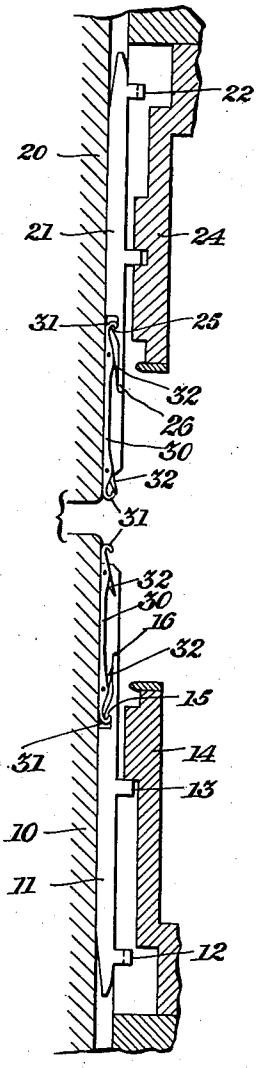


Fig. 18.



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CIRCULAR KNITTING MACHINE

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Fig. 19.

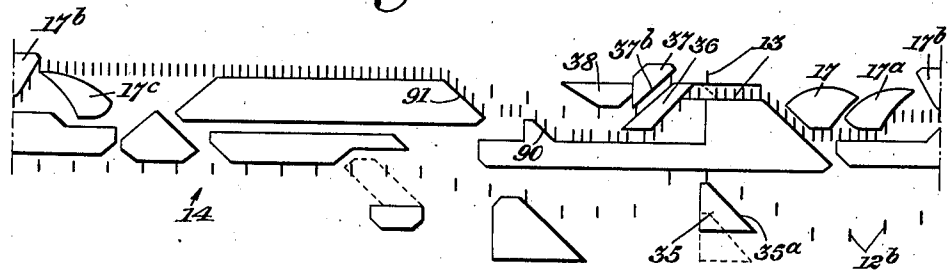


Fig. 20.

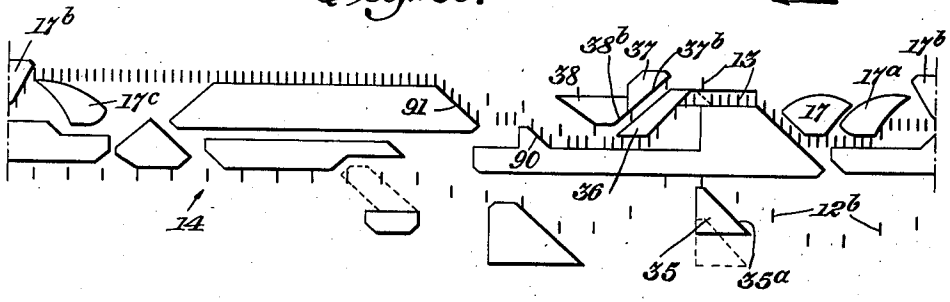
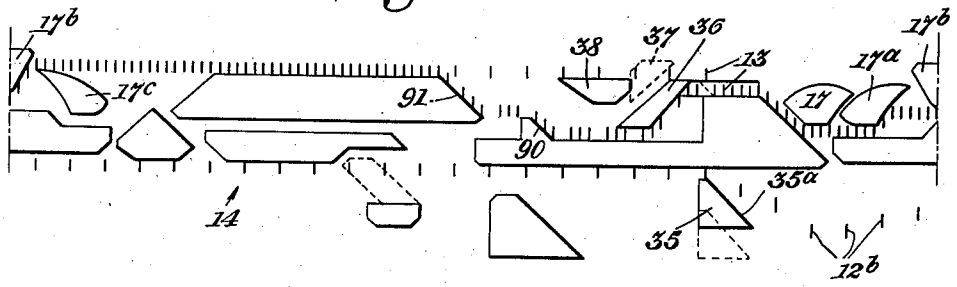


Fig. 21.



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CIRCULAR KNITTING MACHINE

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Fig:26.

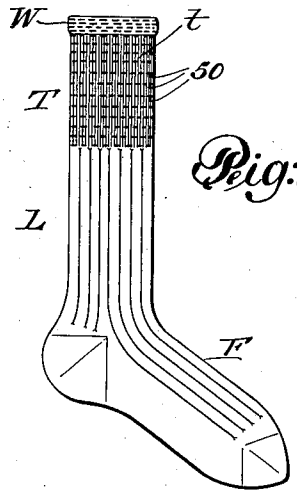


Fig:23.

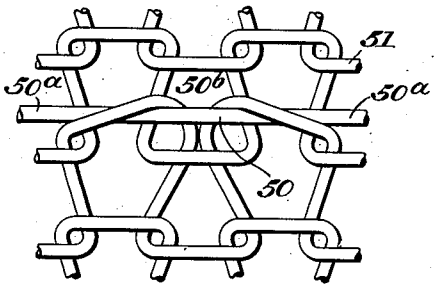


Fig:24.

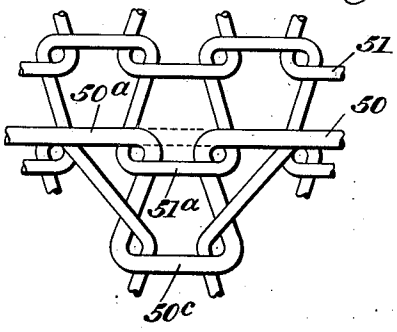


Fig:27.

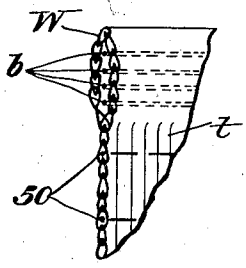


Fig:25.

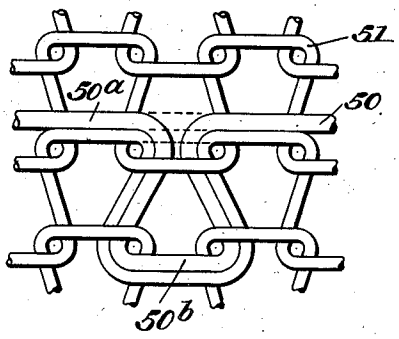
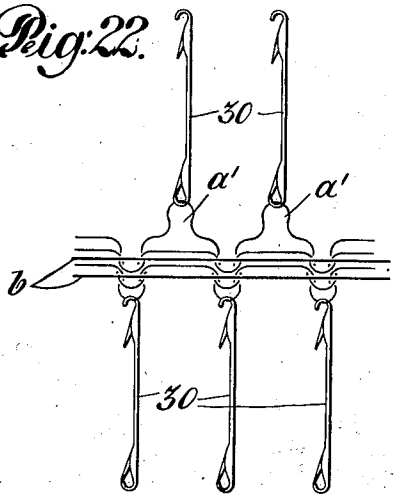


Fig:22.



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Patented June 13, 1939 2,161,880

UNITED STATES PATENT OFFICE

2,161,880

CIRCULAR KNITTING MACHINE

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Application May 6, 1938, Serial No. 206,464

13 Claims. (Cl. 66—14)

Our invention consists in the novel features hereinafter described, reference being had to the accompanying drawings which illustrate one embodiment of the same, selected by us for purposes of illustration, and the said invention is fully disclosed in the following description and claims.

Our invention consists in improvements in a circular, or seamless knitting machine of the type in which two coaxial cylinders located one above the other are employed, in connection with a circular series of needles, each having a hook and latch at each end, the needle grooves of the coaxial cylinders being in vertical alignment so that all of the needles may be operated in conjunction with suitable cam mechanism in one cylinder, as the lower cylinder, for knitting plain knit fabric, while selected needles may be transferred vertically into the grooves of the upper cylinder while retaining the stitches thereon and caused to knit at their opposite ends in conjunction with the non-selected needles remaining in the lower cylinder for the production of rib knitting, and for other purposes hereinafter explained. Our invention is directed more particularly to the provision of means in a machine of this type whereby an elastic thread may be introduced within and during the formation of a tubular welt at the upper end of a form-fitting and self-supporting top of a sock or anklet, said top being thereafter formed of plain knitting with an elastic thread introduced, under tension, in certain courses, preferably spaced by an intervening course or courses not containing the elastic thread, the elastic thread being united to the plain knit fabric at spaced points in each course containing it, and being floated on the inner face of the fabric between such points, so as to form substantially continuous horizontal beads on the inner face of the fabric, which indent the flesh of the wearer when the sock or anklet is worn and support the leg of the stocking with minimum tension and without inconvenience to the wearer, the machine being constructed to incorporate the elastic thread in the selected courses of the top in any one of several ways hereinafter more particularly described. The machine is constructed to knit the leg portion and top of the foot by either plain knitting or rib knitting with any desired rib pattern and to form the heel and toe pockets and the sole of the foot in the usual manner to complete the sock or anklet.

In the accompanying drawings we have illustrated so much of a machine of the type described, made by the Bentley Engineering Company of Leicester, England, and known as the "Komet" knitting machine, as is necessary for a complete understanding of our invention shown embodied therein.

In the accompanying drawings,

Fig. 1 is a side elevation of a portion of a knitting machine embodying our invention.

Fig. 1*a* is a modified form of cam wheel which may be used in lieu of the corresponding cam wheel shown in Fig. 1.

Fig. 2 is a top plan view of the machine, parts not relevant to our present invention being omitted.

Fig. 3 is an enlarged detail view of part of the mechanism for operating the special pattern wheel which controls the selecting cam of the lower cylinder for selecting the needles which receive the elastic thread in the formation of the plain knit top, the pattern wheel itself being removed.

Fig. 4 is an enlarged detail view of the pattern wheel referred to, and the mechanism extending therefrom to the cam operated thereby.

Fig. 5 is an enlarged detail view of a portion of the apparatus shown at the right in Fig. 4.

Fig. 6 is an enlarged plan view, partly in section, taken on the line 6—6 of Fig. 1.

Fig. 7 is an enlarged plan view, parts being indicated in dotted lines, showing the special pattern cam for throwing the shunt cam of the lower cylinder into and out of operative position.

Fig. 8 is a detail perspective view of the shunt cam.

Fig. 9 is an enlarged plan view of the mechanism for moving the drawdown cam of the auxiliary stitch cam mechanism of the lower cylinder into and out of operative position.

Fig. 10 is a detail perspective view of the movable drawdown cam.

Fig. 11 is a detail perspective view of a portion of the pattern cam shown in Fig. 9.

Fig. 12 is a side elevation, partly in section, showing the mechanism illustrated in Fig. 9.

Fig. 13 is an inside view of one of the cam blocks for the lower cylinder spread out in a plane.

Fig. 14 is an enlarged plan view of the feed finger for the elastic thread incorporated in the selected courses of the top and the adjacent mechanism for operating it.

Fig. 15 is an elevation on line 15—15 of Fig. 14.

Fig. 16 is a top plan view of the feed finger for feeding the draw thread and adjacent operating mechanisms therefor.

Fig. 17 represents a partial vertical section of

the upper and lower cylinders and their respective cam rings, showing all of the needles in the lower cylinder.

Fig. 18 is a similar view showing part of the needles transferred into the upper cylinder.

Fig. 19 represents a plane view of the interior of the lower cam ring with the parts in position to effect the insertion of the elastic thread without knitting it.

Fig. 20 is a similar view showing a slightly different arrangement of the cams for incorporating the elastic thread and drawing stitches thereof by the selected needles.

Fig. 21 is a similar view showing a different arrangement of the cams for incorporating the elastic thread by drawing stitches by the selected needles containing both the elastic and body threads.

Fig. 22 is a diagrammatic view illustrating the formation of the tubular welt containing a plurality of rounds of elastic thread under tension.

Fig. 23 is a detail diagrammatic inside view of a portion of the fabric of the plain knit top in which the elastic thread is incorporated without knitting.

Fig. 24 is a similar view showing a portion of a fabric in which the elastic thread is incorporated and the selected needles draw stitches of elastic thread only.

Fig. 25 is a similar view in which the selected needles draw stitches composed of both body thread and elastic thread.

Fig. 26 is a view of a sock comprising a tubular welt containing a plurality of rounds of elastic thread under tension, a continuous plain knit top having elastic thread incorporated in spaced courses, and united to the fabric at separated wales and drawing the fabric into vertically disposed ridges, and having an integral leg and top of the foot formed of 6 x 3 rib.

Fig. 27 is an enlarged diagrammatic sectional view showing the welt and an adjacent portion of the plain knit top.

Referring to the drawings, 10 represents the lower knitting cylinder provided with vertically movable sliders 11 located in the grooves thereof, and having selecting butts 12 and knitting butts 13 for engaging suitable cams on the cam ring, indicated at 14, each of the sliders 11 being provided at its upper end with a terminal portion engaging a needle engaging hook 15 and a latch engaging extension 16 for connecting the sliders with such needles as are present in the lower knitting cylinder. 20 represents the upper needle cylinder provided with a series of sliders 21 engaging the grooves thereof and having selecting butts 22 and knitting butts 23 for engaging the upper cam ring 24. The upper set of sliders are each provided at their lower ends with a terminal portion comprising the needle engaging hook 25 and latch engaging extension 26 for engaging the upper ends of the needles when they are transferred to the upper cylinder. The specific construction of these parts and the transfer mechanism by which selected needles are transferred from one cylinder to the other form no part of our present invention. The needles, indicated at 30, are each provided as shown with the usual hook 31 and latch 32 at each end. When the needles are in the lower cylinder their lower hooks will engage the hooks 15 of the corresponding sliders 11 and the extensions 16 will engage the lower latches, so that the needles will be operated by and with the sliders 11. When all the needles 30 are in the lower cylinder, the machine is adjusted for plain knitting. For the production of rib knitting certain of the needles will be transferred to the upper cylinder, for example in making 1 x 1 rib, every other needle will be transferred to the upper cylinder, while for making 6 x 3 rib, for example, groups of three consecutive needles will be transferred to the upper cylinder in alternation with groups of six consecutive needles, which remain in the lower cylinder.

The cam ring 14 for the lower cylinder will be provided with the usual knitting cams adjacent to the throat, which is provided with a plurality of thread feed fingers two of which, 33, 33*a*, are shown in Fig. 2. Fig. 13 shows a portion of the inner face of the cam ring 14, a portion of the main knitting cams being indicated at 17 therein. At approximately 90° beyond the center of the knitting wave the cam cylinder 14 is provided with supplemental knitting cams for acting upon the sliders of selected needles which are to receive the elastic thread, thereby producing a supplemental knitting wave. The elastic thread 50 is supplied to the selected needles by a supplemental thread guide 34, shown in detail in Fig. 14, which is preferably mounted pivotally so that it can be swung into and out of operative relation with the lower needle cylinder. In connection with the auxiliary or supplemental knitting cams we provide a needle selecting cam 35 movable into and out of operative position, which has an inclined face 35*a* cooperating with the special selecting butts of the sliders of the selected needles, as every second, third, fourth, fifth or sixth needle, etc., according to the spacing desired between the points at which the elastic thread is to be united to the fabric in the courses containing it. Some of the sliders in the lower cylinder may be without selecting butts at all, as certain of the needles will not need to be transferred to the upper cylinder at any time during the normal operation of the machine, or otherwise selected. Other sliders will be provided with selecting butts in different lengths in accordance with the purpose for which the needles are to be selected, as indicated in Fig. 4.

It will be understood that the sliders for the lower cylinder will also be provided with knitting butts, also of different lengths. In Fig. 4 we have indicated the long and short knitting butts 13 and 13*a*, the short butts operating the needles during reciprocating work in knitting the heel and toe pockets in the usual manner, and a greater number of different lengths of knitting butts may also be provided, as desired. The sliders for the selected needles which are to receive the elastic thread are provided with special long butts, indicated at 12*b* in Fig. 4, of a suitable length to engage the selecting cam 35 when the latter is in operative position, and thus raise the selected needles above the remaining needles and into a position to receive the elastic thread.

The selecting cam 35 is preferably mounted on a vertically movable block 35*b* provided with a pin 35*c* extending through a vertical slot in the cam ring, and connected with a spring 35*d* which normally holds the cam 35 in its lowermost position (see Fig. 4). We provide a special pattern cam wheel 60 on the machine operated from the main pattern shaft of the machine, in the manner hereinafter described for moving the selecting cam 35 into and out of operation. For example, the cam wheel 60, as shown in Figs. 1 and 4, is provided with a series of projections 60*a* so arranged as to move the selecting cam 35 into position after the completion of three courses 7*c*

of body yarn only, or in other words, for every fourth course, and hold it in operative position for a single course, so that the elastic thread will be incorporated in every fourth course of the plain knit top. If a closer spacing is desired, however, a different cam wheel, as 60*b*, for example, shown in Fig. 1*a*, having cam projections 60*c* more closely related to produce an elastic incorporated course spaced by two intervening courses from the preceding elastic incorporated course, may be substituted for the cam wheel 60 and obviously by using the proper cam wheels any desired separation of the elastic incorporated courses may be obtained. Above the cam wheel 60 is an actuating lever 61 provided with a downwardly extending projection 61*a*, to engage the projections of the cam wheel, and this lever is connected by a vertical link 62 with the outer end of a horizontal lever 63 (see Fig. 4) pivoted between its ends to a suitable support and having the opposite end engaging a second lever 64 engaging a third lever 65, also pivoted between its ends and provided with a notched or slotted portion 65*a* engaging the pin 35*c* (see Fig. 5) thus elevating the cam 35 into operative position, as each projection on the cam wheel 60 engages the projection 61*a*. The outer surfaces of the projections, as 60*a*, on the cam wheel 60, are of such length that the cam 35 will be maintained in operative position during a single revolution of the knitting cylinders, after which the lever 61 will be released and the cam 35 will be lowered by its spring 35*d* to inoperative position.

In Figs. 1 and 3 we have shown our preferred means for operating the cam wheel 60 from the main drive shaft 70 of the machine under the control of the main pattern shaft 71. The main drive shaft carries a wheel 72 provided with a cam 73 for engaging a friction roll 74*a* at the upper end of a lever 74 pivoted to a fixed point on the machine and held in engagement with the cam 73 by a spring 74*b*. The lever 74 is connected by links 75, 75*a* and a bell crank 75*b* with a pawl carrier 75*c* mounted on the shaft 60*d* carrying the cam wheel 60, and provided with a pawl 75*d*. This pawl engages a ratchet wheel 60*e*, on the shaft 60*d*, so that each revolution of the main drive shaft 70 will rack the ratchet wheel 60*e* forward one tooth and correspondingly move the pattern wheel 60.

It will be understood that after the top of the sock or anklet has been completed no further feed of the elastic thread is ordinarily desired until the corresponding portion of another stocking is made, and it is necessary, therefore, to hold the mechanism for operating the selecting cam 35 out of operative position until the top of another sock or anklet is commenced. In order to accomplish this we provide a pivoted locking lever 76 pivoted on the machine and having one end in position to engage a projection 74*c* on the lever 74 when the latter is in engagement with the cam 73, as indicated, for example in Fig. 1, thus holding the lever 74 in a position where it will be no longer acted upon by the cam 73. The opposite end of the lever 76 is connected by a link 76*a* with an arm 77 acted on by a spring 77*a* and operatively connected with a pivoted trip arm 77*b*, the upper end of which is in position to engage a cam 71*a* on the pattern drum 71*b* carried by the main pattern shaft 71 of the machine. The cam 71*a* is so located that it engages the trip arm 77*b* at the instant that it is desired to begin the introduction of elastic thread into selected courses of the top, and moves the trip arm outwardly, thereby disengaging the locking lever 76 from the lever 74 and the said lever 74 will immediately be oscillated by the cam 73 and impart motion to the pattern wheel 60, thus operating the selecting cam 35 in the manner previously described.

Referring now to Fig. 13 and the cam mechanism therein illustrated, it will be noted that immediately above the selecting cam 35 there is a movable cam 39, which we term a shunt cam, and which in this instance is carried by an arm 39*a* pivoted on a vertical pivot 39*b* to the cam ring, so as to be swung horizontally in a corresponding aperture in the cam ring, into and out of operative position. When the shunt cam is in operative position, as indicated in Fig. 13 for example, the knitting butts 13 of all the sliders in the lower cylinder will pass over the shunt cam and be drawn down by the auxiliary knitting cams 37 and 38, hereinafter referred to. When, however, the selecting cam 35 is in operative position it will be understood that the selected needles only pass over the fixed cam 36, while the non-selected needles engage the cam 36 and are drawn downward so as not to take the elastic thread. It becomes necessary, therefore, to throw the shunt cam 39 out of operative position whenever the selecting cam 35 is moved into operative position. The particular mechanism disclosed herein for accomplishing this result will now be described.

The arm 39*a* is provided with a short actuating arm 39*c* which is connected by a link 39*d* with one end of a pivoted lever 39*e*, the other end of which is provided with a projection 39*f* adapted to engage a special pattern cam plate or disc 81 on a vertical shaft 80, mounted in a bracket 80*a* secured to the machine frame, the said cam disc 81 being provided with a cam projection 81*a* having a concentric outer face terminating at one end in a pair of cam grades 81*b*, 81*c*, connected by a short intermediate dwell 81*d* and at the other end in a single grade or face 81*e*. A coil spring 39*g* connected to the outer end of the lever 39*e* holds the projection 39*f* in connection with the cam plate 81, which has a concentric peripheral portion or dwell 81*f* extending from the cam grade 81*e* to the cam grade 81*b* of shorter radius than the peripheral surface of the projection 81*a*. The cam shaft 80 is operated from the main pattern mechanism of the machine in the usual manner, which will be hereinafter briefly described. In Fig. 7 the parts are shown in full lines with the cam 39 in operative position, and it will be seen that as the cam plate 81 rotates at the proper time, the lower end of lever 39*e* will be moved outwardly first by the cam grade 81*b* to effect the movement of the cam 39 outwardly far enough to disengage the short butts, and will then be moved further outwardly by the cam grade 81*c* to move the cam 39 to inoperative relation with the long butts also, this being desirable to avoid injury to the butts. The cam will be held out of operation while the projection 39*f* passes over the peripheral portion of the projection 81*a*, after which the said projection 39*f* will be released from the projection 81*a* and its spring 39*g* will move the cam 39 inwardly toward operative position, under the action of the spring, so as to bring it first into contact with the outer edges of the short butts and permit the long butts to engage the cam, after which it moves into its full operative position, so as to act upon all of the butts of the

sliders in the lower cylinder, and thus avoiding injury to any of the slider butts.

The mechanism for imparting rotary motion at the proper time to the vertical cam shaft **80** forms no part of our present invention, but is illustrated in Fig. 1, and in detail in Fig. 6, for purposes of clearness and will be briefly described. The wheel **72** on the main drive shaft **70** is provided with two nearly semi-circular side cams **72***a*, one of which is illustrated in Fig. 6, for the purpose of engaging a horizontally movable pin **82***a*, carried in a bearing **82***b* at the outer end of a pivot lever **82**, pivoted to the machine frame and capable of swinging so as to move the pin **82***a* into and out of operative relation with the cams **72***a*. The pin **82***a* is adapted to engage one end of a lever **83**, the opposite end of which carries a hook-shaped pawl **84**, which engages pins **85***a* in a ratchet wheel **85** secured to the lower end of the cam shaft **80** so that when the arm **82** is moved so as to hold the pin **82***a* in position to be engaged by the cams **72***a* on the wheel **72** the arm **83** will be actuated twice in each revolution of the main driving shaft **70** which corresponds with the revolution of the cylinders, and will impart two movements to the shaft **80** in the direction of the arrow shown in Fig. 6. The arm **82** is moved into and out of operative position by means of a projection **71***c* on a pattern drum mounted on the main pattern drum shaft **71**, which engages a sliding rod **86** (see Fig. 1) operatively connected with an arm **82***c* connected with the arm **82**, the connection being preferably a yielding one formed by a spring **86***a* surrounding the rod **86** and interposed between the arm **82***c* and a collar **86***b* on the rod **86**. A second spring **86***c* operatively connected with the rod **86** holds it in engagement with the pattern drum carrying the projection **71***c*.

Just beyond the cam **36** (see Figs. 1, 5, 12 and 13) the cam ring is provided with auxiliary knitting cams **37** and **38** both of which are movable with respect to the cam ring. The cam **37** is carried by a horizontally movable plunger **37***a* which is operated by the usual mechanism, provided in this machine under the control of a pattern cam disc **80***d* on the shaft **80** to move this cam into and out of operative position. This specific mechanism forms no part of our present invention and will not be further described. In the normal operation of the machine, the knitting butts of all of the needles, after passing over the top of the shunt cam when the latter is in operative position, and cam **37** being retracted, will pass onward at that level to the main knitting station.

The cam **38** is in reality a part of the auxiliary knitting cam **37** and is provided with a downwardly extending leading face **38***b*. This cam **38** is carried by a slide **38***a* movable in vertical guides in the cam ring, and in its lowest position, the leading face **38***b* will form a continuation of the face **37***b* of the cam **37**, and will draw down the needles, so as to form a stitch and cast off the preceding stitch held in the hook, while in the upper or inoperative position, shown in Fig. 13 for example, the cam **38** will not draw a stitch or cast off a stitch previously held on the needle. This cam **38** is shown in detail in Fig. 10, and the mechanism for moving it into and out of operation is illustrated in Figs. 5, 9, 10 and 12. The slide **38***a* is provided with a pin **38***c*, which is engaged by a short curved arm **38***d* pivoted to the cam ring. The pin **38***c* is conveniently provided with a retracting spring **38***e* normally holding the cam in the uppermost position, although this spring is not absolutely necessary, as the needle butts would serve to raise the cam unless it was lowered into operative position and held, as hereinafter described.

The shaft **80** is provided with another cam disc **80***e*, the normal function of which is to control a feed finger for the introduction of a draw thread to provide for the separation of the individual stockings under the normal operation of the Komet machine. We conveniently provide on the underside of this disc **80***e* a downwardly extending curved cam **80***f* (see Figs. 1 and 12 for example) which at the proper time engages a projection **87***a* on one end of a lever **87** pivoted to a stationary support and having its opposite end pivotally connected to one end of a second lever **88**, the opposite end of which rests upon the pivoted arm **38***d*. It follows, therefore, that whenever the cam **80***f* engages the projection **87***a* (see Fig. 12) the remote end of lever **88** will be depressed carrying with it the pivoted arm **38***d* and the pin **38***c* and depressing the cam **38** into its lowest or stitch forming position. The cam **80***f* is shown in detail in Fig. 11 and its relation to the disc **80***e* is illustrated in Fig. 9. The length of this cam **80***f* determines the length of time that the cam **38** shall be held in its operative or stitch forming position, and in some instances, as hereinafter particularly pointed out, the cam **80***f* will be extended to substantially twice the length shown in full lines in Fig. 9 and as indicated in dotted lines in that figure. The vertical cam shaft **80** is provided, as shown in Fig. 1, with additional cam discs, which we have indicated at **80***b*, **80***c* and **80***g*. The first two of these in the normal operation of the machine control the usual binders and cutters, and the disc **80***g* normally controls a special feed finger for feeding the elastic thread during the formation of a plain knit top. These parts have no bearing on our present invention and will not be more particularly illustrated or described.

In Fig. 16 we have illustrated, in plan view, a thread feed finger **89** which feeds the draw thread in the normal operation of the machine, and is swung into and out of operative position by means of the cam disc **80***e* on the vertical cam shaft **80** previously referred to. The specific details shown in Fig. 16 form no part of our present invention and need not be more particularly described.

In Fig. 14 is illustrated a similar thread feed finger **34** for feeding the elastic thread during the formation of the top of the sock or anklet, and which swings on an axis concentric with the axis of movement of the feed finger **89**. The feed finger **89** is mounted on a vertical sleeve **89***a* through the center of which extends a shaft **34***a* to which the finger **34** is secured. The shaft **34***a* is provided with a pin **34***b* engaging a slot in a horizontal slide **34***c* which is in turn engaged by a cam projection **80***h* on the cam disc **80***g* on the shaft **80** hereinbefore referred to.

As the axes of movement of the feed fingers **34** and **89** are coaxial, and as both feed fingers are moved to the same feeding position, the feed finger **34** is preferably provided with means for tilting it to enable it to pass over the feed finger **89**. To this end the feed finger is secured in a clamp **34***d* mounted on a horizontal pivot with respect to the supporting collar **34***e* which secures it to the shaft **34***a* and has a projecting end **34***f* extending beyond the clamp **34***d*, which engages a stationary cam **34***a*. illustrated in detail in Fig.

15, so constructed as to effect the tilting of the feed finger 34 as it swings from its inoperative to operative position, and enable it to pass over the finger 89. Both of these fingers are provided with retracting springs 34*h* and 89*b* respectively, normally holding them in the inoperative position, and the finger 34 is also provided with a spring 34*i* which holds it in engagement with the cam 34*g*.

For greater clearness we will now describe the operation of the machine in knitting a sock or anklet, such as is illustrated in Fig. 26, provided with a tubular welt W, containing a plurality of rounds of elastic thread *b*, and a plain knit top T, having elastic thread 50 incorporated therein, in this instance in every fourth course under tension and united into the fabric at spaced points or wales in each course containing it, the leg L and top of the foot F of the stocking being formed in this instance of 6 x 3 rib, it being understood, however, that the leg and top of the foot may be formed of any other type of rib knitting, or may be formed of plain knitting with or without the introduction of an elastic thread, at the option of the knitter.

In the operation of the machine, the stocking is knit from the upper end of the top, where the welt is formed, to the toe of the stocking, where it terminates in a series of courses of plain knitting forming the looper courses for uniting the upper edge of the toe pocket with the opposed edge of the foot portion, in the usual manner. It is customary, in the operation of this machine, to run in a draw thread at this point before commencing the knitting of the next successive stocking. To this end the usual transfer cams are brought into operation to effect the transfer of every other needle from the lower cylinder to the upper cylinder, and two courses are knit in which half of the stitches are formed by the alternate needles in the upper cylinder and the remaining stitches by the intervening needles in the lower cylinder. At the same time that the first of these courses is commenced the cam disc 80*e* moves the draw thread feed finger 89 into operative position to feed the draw thread, which is preferably of a contrasting color, to the alternate needles in the lower cylinder only. This draw thread is fed during approximately one and a half courses.

To form the welt or selvage after the production of the preceding courses, which are in effect 1 x 1 rib, and with one set of loops on alternate needles in the upper cylinder, and the intervening loops on the intervening needles in the lower cylinder, the upper cam cylinder is automatically adjusted in a well known way so as not to affect the operation of the needles therein, which simply hold their loops throughout the formation of the welt. The body thread is then fed at the main knitting station by one of the thread feed fingers, as 33, to the needles in the lower cylinder only, forming circular plain knit courses, which obviously contain only half the usual number of stitches and which we refer to as welt courses to distinguish them from the regular courses knit on all the needles. A plurality of these welt courses are knit, the number being sufficient to form the tubular welt of desired size. We have found ordinarily that approximately ten to twelve welt courses are sufficient for a narrow welt, but the number is immaterial and may be varied, according to the size of the welt desired, the size of the body thread employed, the size of the loops and the number of coils of elastic thread which are to be inserted in the welt.

During the knitting of a second welt course, the feed finger 33*a* at the throat, which is provided with elastic thread under tension, by any suitable tension device 92 interposed between the supply of elastic thread and the feed finger 33*a*, is moved into action, and in so doing passes first into position to feed the elastic thread in the hooks of a plurality of the needles in the lower cylinder, sufficient to tie in the end of the elastic thread, and thereafter passes beyond this feeding position to a position where the elastic thread will be simply wound around the outside of the fabric being formed by the welt courses, without being knitted as indicated at *b* in Fig. 22, the final position of this thread feed finger being substantially the same as if it were employed to lay in an elastic thread during rib knitting between the plain and rib wales. It will be noted that as the elastic thread is wound around the outside of the fabric, it will be under tension, due to the tension device 92 through which it is drawn, and the fabric will be supported by the engagement of the alternate loops in the lower hooks of the needles in the upper cylinder, thus forming a wall or support around which the elastic thread may be wound under the desired tension. Any desired number of coils of the elastic thread, indicated at *b*, may be wound upon the outside of the welt courses as they are being formed, according to the size of the welt desired, but it has been found that with a narrow welt, comprising twelve of the said welt courses, four rounds of elastic thread will be sufficient. When the desired number of spirals or rounds *b* of the elastic thread have been wound around the welt courses, the feeding finger 33*a* for the elastic thread is withdrawn, and as it is retracted to its inoperative position, it will again pass through the feeding position in which it feeds the elastic thread to a plurality of the needles of the lower cylinder, thereby tying into the fabric the other end of the elastic thread. As the feeding of the elastic thread occurs at a point where the needles begin to move downwardly through the knitting wave, the feed finger 33*a* can be moved past the feeding position and again through the feeding position when returning to inoperative position, without interfering with the needles. After the elastic thread has been discontinued and its end secured, it may be caught by a suitable binder (not shown) and severed by the usual cutter with which such binders are ordinarily provided, while the knitting of the welt courses on the needles held in the lower cylinder will continue until the desired number has been knit.

The needles of the upper cylinder which have retained their loops, indicated at *a'* in Fig. 22, are then transferred downwardly into the grooves of the lower cylinder, according to the usual operation of the machine, and descend through their loops, while a course of body thread is fed to the hooks at the upper end of all the needles. The upper sliders are then disengaged from these needles which are drawn down by the lower sliders to cast off the previously held loops and leave loops which are now held in the hooks at the upper ends of said needles, thus restoring the machine to the condition for knitting plain fabric on all the needles of the entire circular series, and connecting the edges of the tubular welt W (Figs. 26 and 27) containing the series of elastic rounds or coils *b*, as clearly indicated in Fig. 27.

The elastic welt herein shown and described,

and the process of knitting it, are not specifically claimed herein as the welt itself forms the subject matter of the application of John H. Miller and Frank Evans for Improvements in hosiery, filed in the United States Patent Office on March 17, 1937 and given Serial No. 131,396, and the Process of knitting forms the subject matter of an application of the said John H. Miller and Frank Evans, filed in the United States Patent Office on August 21, 1937 and given Serial No. 160,246, which application is a division of application Serial No. 131,396.

After the completion of the welt as previously described, the feed finger 33a is drawn out of operation in the usual manner under the control of the pattern mechanism, leaving the feed finger 33 which feeds the body thread 51. We prefer to make one or two courses of plain knitting with the body thread on all the needles in the lower cylinder before the introduction of an elastic thread in the top of the stocking, but this is immaterial. As a matter of fact, we prefer to knit two plain knit courses after which the various pattern cams hereinbefore described are actuated for the purpose of throwing the elastic thread feed finger 34 into operation with the lower cylinder needles, and to make the necessary changes in the cams in the cam ring for the lower cylinder, in order to form the top of the sock or anklet with the elastic thread incorporated in spaced courses thereof, and united to the fabric of the top at spaced points in each of the courses containing it. There are three different ways in which the elastic thread may be so incorporated and united to the fabric any one of which can be accomplished in the operation of the machine described.

According to one method, the selected needles (in this case every fourth needle) which knit the wales at which the elastic thread is to be united to the fabric, are raised above the intervening needles by the cam 35 and the elastic thread, which is delivered to the feed finger 34 under the desired tension, by drawing it through any preferred form of tension device 93 so that it will be taken by the selected needles below their latches. This may be accomplished by feeding the thread below the latches directly to the selected needles or by laying the elastic thread on the latches, and subsequently elevating the needles so that the latches may be carried above the elastic thread. The intervening needles and the selected needles are then brought to the same level, either by drawing down the selected needles or elevating the non-selected needles, and the non-selected needles will obviously pass in front of the elastic thread. The body thread is then fed to the hooks of all the needles which draw stitches of the body thread, with the result that the elastic thread is cast off on the selected needles and firmly held by the surrounding body thread at the wales produced by the selected needles, and is floated on the back of the fabric between the selected needles, to form the annular self-supporting beads previously referred to herein.

According to another method of operation the elastic thread is fed into the hooks of the selected needles by the thread feed finger 34 and loops of the elastic thread are immediately drawn by the selected needles under the action of the auxiliary knitting cam, the selected needles casting off the loop of body thread held thereon. Thereafter, at the main knitting station, the body thread is fed to the hooks of all of the needles so that the selected needles will draw loops of body thread through the previously formed loops of the elastic thread. In this case the tension of the elastic thread will cause it to straighten out, and in this case also the elastic thread will be floated on the back of the fabric between the wales in which it is united to the fabric and form the self-supporting beads previously referred to.

According to a third method of operation of the machine, the elastic thread is fed by the thread feed finger 34 to the hooks of the selected needles which are prevented from drawing stitches until they arrive at the main knitting station, when the body thread is fed to all of the needles with the result that the selected needles draw stitches formed of both the body thread and the elastic thread and unite the elastic thread to the fabric at the wales formed by the selected needles, while the elastic thread is floated between the wales formed by the selected needles on the inner face of the fabric to form the horizontal self-supporting beads above referred to. In this case also the tension of the elastic thread will cause it to straighten out in the fabric and produce a slight distortion of the surrounding stitch elements formed by the body thread, but without impairing the general appearance of the fabric. These three modes of operation of the machine will now be described.

Assuming that the elastic thread is to be laid in without knitting, in accordance with the first mode of operation above described, and referring to Fig. 13, it will be necessary to throw out of operation the shunt cam 39 and to bring into operation intermittently the selecting cam 35. It will also be necessary that the portion of the auxiliary knitting cam 38 which effects the drawing of a stitch shall be in the raised position. In Fig. 19 we have shown the arrangement of the cams of the cam ring for the lower cylinder to carry out this mode of operation. By the operation of the parts illustrated in Fig. 7, the shunt cam is moved by the two grades 81b and 81c acting upon arm 39e and its connections, to the outermost inoperative position shown in dotted lines, and not shown in Fig. 19 for greater clearness. The position of the selecting cam 39e and its connections, shown in Figs. 9 and 11, is such that the cam 38 is in its uppermost position, and by the action of the cam 71a (Fig. 1) the lever 74 has been released so as to be operated by the cam 73, and through the ratchet wheel 66e imparts rotation to the pattern wheel 66, which as previously stated, is set to raise the selecting cam 35 and hold it raised during every fourth revolution of the machine. The inclined face 35a of the cam 35, as before stated, engages the special long butts 12b on the sliders of the selected needles, thereby raising their knitting butts 13 (or 13a) to a higher level than the butts of the non-selected needles, as clearly illustrated in Fig. 19. While in this elevated position the elastic thread will be fed by the finger 34 to the raised needles only, so that it will pass below the latches thereof. In the present instance the elastic thread is laid on the latches of the selected needles, but as before stated, this is not important. As the needle cylinder rotates in the direction of the arrow in Fig. 19, it will be seen that the needle butts of the unselected needles will engage the front face of the draw-down cam 36 and pass down and beneath said cam, while the butts of the selected needles will pass over the top of cam 36 and engage the forward face 37b of the draw-down cam 37 and pass down and

beneath said face, but as the movable cam 38 is in its raised position, the butts of the selected needles will not pass downward as far as the butts of the non-selected needles. All of the needles are raised to a common level by the riser cams, indicated at 90 and 91, bringing them to a common level before they reach the main knitting cams, which are of usual or any preferred construction, and are indicated at 17, 17a, 17b, 17c. It will be understood that as the non-selected needles are raised to the level of the selected needles, they will pass in front of the elastic thread. At the main knitting station or throat of the machine, all of the needles will take the main knitting thread 51 from one of the throat thread feed fingers, as the finger 33, and each needle of an entire series will draw a stitch of the body thread. As the selected needles draw their stitches, the elastic thread will pass over the closed latches thereof and be cast off, leaving the elastic thread secured in the fabric at each selected needle, in the manner clearly illustrated in Fig. 23, in which the elastic thread is indicated at 50 and the body thread at 51. 50b represents one of the wales at which the elastic thread 50 is united to the fabric and 50a represents the portions of the elastic thread which are floated on the inner face of the fabric between the wales formed by the selected needles. It will be understood that the elastic thread being fed under tension, as soon as the fabric is released from the needles, the tension of the elastic thread will draw the fabric together, producing vertical rib-like ridges, indicated at *t* in Figs. 26 and 27.

After a course containing the elastic thread has been knit, as above described, the projection 61a on the lever 61 will pass off of the projection 60a of the pattern wheel 60 and the selecting cam 35 will be drawn down to its inoperative position, indicated in dotted lines in Fig. 19, where it will remain during the formation of three succeeding courses of plain knitting (or such other interval, as may be imposed by the particular pattern wheel 60 or 60b in use). During these intervening courses the knitting butts 13 of all the needles will pass beneath the cam 36 and none of the needles will be raised, consequently none of them will receive the elastic thread, the portion of which united in the last wale of the preceding course containing it, will be carried around the cylinder. After the intervening courses have been completed, the next projection 60a on the pattern wheel 60 will again elevate the selecting cam 35 and produce another course of stitches in which the elastic thread will be incorporated at the selected needles, in the manner previously described. This sequence of events follows throughout the knitting of all of the courses of the plain knit top which may be of greater or less length and consequent number of courses, according to whether it is the top of a full length or three quarter sock or anklet, as the case may be. Upon the completion of the top, the pattern wheel 71 will have rotated to such an extent as to release the lever 77b from the cam projection 71a and operate the locking lever 76, so as to lock the lever 74 out of operative relation with the cam 73 on the wheel 72 of the main drive shaft, thus terminating, during the remainder of the knitting of the sock, and until another top is to be made, the alternate movements of the selecting cam 35 into and out of operative position. At the same time the pattern cam 80g (Fig. 14) is moved to such a position as to permit the retracting spring 34h to return the elastic feed finger 34 to inoperative position, where it likewise remains until another plain knit top is to be formed. At the same time the pattern cam 80d will have to move to such a position as to permit the auxiliary knitting cam 37 to be drawn so that the knitting butts of the needles, whether knitting a plain leg or a rib leg, will pass over the shunt cam and directly across it, level to the main knitting cam at the main knitting station where a single feed or plating feed is employed.

At the conclusion of the knitting of the top, the shunt cam 39 is returned to its normal position, as shown in Fig. 13, and the auxiliary knitting cam section is withdrawn from operative position, so that the knitting of the leg may continue as an integral part of the top, by plain knitting if desired, or by means of the usual transfer devices with which the machine is provided, certain of the needles may be transferred from the lower cylinder to the upper cylinder and any desired type of rib knitting may be carried out for the remainder of the leg. The knitting of the heel, foot and toe portions of the stocking will be carried out in accordance with the usual operation of the machine, the top of the foot being knit of the same type of fabric as that in the leg, and these portions of the stocking will not be further referred to. At the completion of the toe, the usual looping courses of plain knitting will be made, followed by the insertion of the draw thread, in the manner previously described, and the machine is ready to duplicate the preceding operation.

Assuming now that it is desired to secure the elastic thread in the fabric at spaced points in the spaced courses in which it is introduced by actually drawing a stitch of the elastic thread and casting off the stitch of body thread held on the selected needles, the setting of the cams in the cam ring for the lower cylinder will be exactly the same as that previously described and illustrated in Fig. 19, except that the cam 80f will be brought into operation to depress the auxiliary knitting cam section 38 to its lowest position, bringing its forward face 38b into alignment with the forward face 37b of the auxiliary cam section 37. This arrangement of the cams is clearly illustrated in Fig. 20. With this arrangement of the cams, and assuming that the elastic thread feed finger 34 has been moved into operative position, it will be seen that the selecting butts 12b of the sliders for the selected needles will ride up the cam 35 and raise the selected needles, as before, to receive the elastic thread, the needle butts 13 of the selected needles will pass down the draw-down face 37b of cam 37, and the drawdown face 38b of cam 38, thereby carrying the elastic thread into the hooks of the selected needles, causing each of them to draw a stitch of elastic thread and cast off the loop of body thread previously carried thereby. The needles will then be brought to the same level as previously described, by means of the riser cams 90 and 91, thereby bringing the non-selected needles forward of the elastic thread, and at the main knitting station all of the needles will receive the body thread as before from the thread feed finger 33, and passing through the knitting wave will draw stitches of body thread. In this case the selected needles will draw a stitch of body thread only at the main knitting wave through the previously held loop or stitch of elastic thread. This is clearly illustrated in Fig. 24, in which 50c represents the loops of elastic

thread drawn through the preceding loop 51*a* of body thread.

Obviously this construction unites the elastic thread into the fabric at each of the selected needles in each course in which the elastic thread is introduced. Fig. 24, however, shows in a diagrammatic manner what theoretically happens when the stitches are formed in the manner described. As a matter of fact, the tension of the elastic thread causes it to straighten out, as indicated in the dotted lines in Fig. 24, as soon as the fabric is released from the needles, so that it lies in a horizontal position substantially without deflection in the top of the stocking, and the floated portions between the wales formed by the needles which draw the loops of elastic thread form the self-supporting horizontal beads on the inner face of the fabric operating in the same manner as previously described, to support the leg of the sock upon the leg of the wearer.

At the conclusion of the formation of the top, the selecting cam 35 is returned to its inoperative position, as is the cam 38, and the cam 37 is also withdrawn to facilitate the production of the leg and remainder of the stocking, in the manner previously described. The elastic thread feed finger 34 is likewise returned to its inoperative position.

In carrying out this operation, if it is desired to feed the elastic thread at a higher point in the previously described operation, in order to insure its being received in the hook of the needle, this can readily be accomplished by adjusting the stationary cam 34*g* (Fig. 15) vertically by means of the set screw 34*j*, which secures it to a starting post as shown in Fig. 14.

In carrying out the third mode of operation for the formation of the elastic incorporated top, in which the elastic thread is fed to the selected needles only in plating relation with the body thread, the setting of the cams will be as indicated in Fig. 21. The shunt cam 39 will be out of operation as in both of the preceding modes of operation, and the needle selecting cam 35 will be alternately moved into and out of operative relation for each course in which the elastic thread is to be incorporated. In this case, however, the cam 88*d* controlling the auxiliary knitting cam element 37 is so constructed as to permit the withdrawal of this cam under the action of its spring 37*a* at the beginning of the knitting of the top. It will be understood that the disc cams 88*b*, 88*c*, 88*g*, 88*d* and 88*e* are detachably secured to the shaft 88 and held in place by a cap 88*i* and set screw 88*j*, so that these disc cams can be readily changed as desired, or individually adjusted upon the shaft 88, where a different operation of the parts controlled thereby is desired, without changing the other parts of the machine. It will also be understood that the cam element 38 will be in its uppermost or inoperative position. With this arrangement of the cams, as clearly shown in Fig. 21, the butts 12*b* of the selected needles will engage the selecting cam 35 and elevate these needles, which thereupon receive the elastic thread in their hooks from the thread feed finger 34 in the manner previously described. As the cylinder rotates, the knitting butts 13 of the non-selected needles will pass down the leading or forward face of the drawdown cam 36, while the knitting butts 13 of the selected needles will pass horizontally in front of the inoperative draw-down cam 37 and over the top of the cam 38 and on that level to the main knitting station. The non-selected needles will be raised by the riser cams 90 and 91, as before described, passing up in front of the elastic thread and bringing all of the needles to the same level. At the main knitting station or throat all of the needles receive the body thread 51 from one of the throat feed fingers, as the finger 33, and passing through the knitting wave draw stitches of the body thread. The selected needles, however, will draw stitches composed of both the body thread and the elastic thread, as clearly indicated in Fig. 25, thus uniting the elastic thread to the fabric at the spaced wales formed by the selected needles, as indicated at 59*b* in Fig. 25, for example, the portions of the elastic thread between the wales formed by the selected needles forming floats on the inside of the fabric forming parts of the self-supporting beads hereinbefore referred to.

Fig. 25, like Fig. 24, shows the theoretical formation of the stitch produced by the selected needles in the spaced courses containing the elastic thread. In this case, however, as in Fig. 24, as soon as the fabric is released from the needles the tension of the elastic thread 59 causes it to straighten out in the fabric, thereby producing a slight distortion of the surrounding portions of body thread, which, however, is not sufficient to be unduly noticeable in the fabric.

At the termination of the knitting of the top, the cam projection 71*a* will have passed out of engagement with the lever 71*b*, permitting the locking of the lever 74 in inoperative position and terminating the intermittent movement of the selecting cam 35 into and out of operation by the cam wheel 60. At the same time the projection 81*a* on the cam disc 81 will restore the shunt cam 39 to its operative position and the cam disc 88*g* will permit the spring 34*h* to restore the elastic thread finger 34 to its inoperative position.

In each of the operations above described, when the elastic thread feed finger 34 moves to inoperative position, the elastic thread is preferably caught and held in a binder (not shown) at the point indicated at X in Fig. 14, which binder will ordinarily be provided with a cutter for severing the thread. The binder thus holds the end of the elastic thread until the next plain knit top is to be formed. The same provision is made in connection with the draw-thread which, when the draw-thread feed finger 89 is moved to inoperative position, carries the thread into a binder located at the point marked at Y in Fig. 16, where it is held and severed in like manner. These binding and cutting mechanisms are of known form and operation, and form no part of our present invention.

It will be understood that we do not limit ourselves to the exact details of the mechanism for effecting the operation of the various parts of the machine herein described to produce the desired operations thereof, as modifications in the specific construction of such mechanisms may be made without departing from the spirit of our invention.

No claim is made herein to the fabric forming the top of the stocking in any of the forms described, nor to the process or method by which such fabrics are produced, these fabrics forming the subject matter of the application for Letters Patent of the United States of John H. Miller and Frank Evans, filed March 5, 1937 and given Serial No. 129,206 and the processes or methods of forming these fabrics, forming the subject

matter of an application for Letters Patent of the United States of said John H. Miller and Frank Evans filed August 6, 1937, and given Serial No. 157,707, which latter is a division of application Serial No. 129,206.

What we claim and desire to secure by Letters Patent is:

1. In a knitting machine of the type employing coaxial superimposed knitting cylinders, separate cam rings therefor, means for establishing relative rotation and also relative reciprocation between the cylinders and cam rings, needles provided with hook and latch at each end, and a slider for each needle in each cylinder provided with cam engaging butts, means for transferring alternate needles from the lower cylinder to the upper cylinder, means for throwing the sliders of the needles in the upper cylinder out of operation with the knitting cam of the upper cam ring to hold stitches on the lower ends of said needles, thread feeding means for feeding body thread to the intervening needles in the lower cylinder and knitting a series of successive welt courses, elastic thread feeding means for winding an elastic thread around the fabric while supported by the needles in the upper cylinder, and a tension device for said elastic thread.

2. In a knitting machine of the type employing coaxial superimposed knitting cylinders, separate cam rings therefor, means for establishing relative rotation and also relative reciprocation between the cylinders and cam rings, needles provided with hook and latch at each end, and a slider for each needle in each cylinder provided with cam engaging butts, means for transferring alternate needles from the lower cylinder to the upper cylinder, means for throwing the sliders of the needles in the upper cylinder out of operation with the knitting cam of the upper cam ring to hold stitches on the lower ends of said needles, thread feeding means for feeding body thread to the intervening needles in the lower cylinder and knitting a series of successive welt courses, elastic thread feeding means for winding an elastic thread around the fabric while supported by the needles in the upper cylinder, and a tension device for said elastic thread, means for transferring the needles in the upper cylinder to the lower cylinder to receive the body thread and knit a continuous course of plain knit stitches to complete the welt and enclose the coils of elastic thread.

3. In a knitting machine of the type employing coaxial superimposed knitting cylinders, separate cam rings therefor, means for establishing relative rotation and also relative reciprocation between the cylinders and cam rings, needles provided with hook and latch at each end, and a slider for each needle in each cylinder provided with cam engaging butts, means for transferring alternate needles from the lower cylinder to the upper cylinder, means for throwing the sliders of the needles in the upper cylinder out of operation with the knitting cam of the upper cam ring to hold stitches on the lower ends of said needles, thread feeding means for feeding body thread to the intervening needles in the lower cylinder and knitting a series of successive welt courses, elastic thread feeding means for winding an elastic thread around the fabric while supported by the needles in the upper cylinder, and a tension device for said elastic thread, said elastic thread feeding means being movable into and out of operative position across the needle circle to knit the ends of elastic thread into portions of separate welt courses.

4. In a knitting machine of the type employing coaxial superimposed knitting cylinders, separate cam rings therefor, means for establishing relative rotation and also relative reciprocation between the cylinders and cam rings, needles provided with hook and latch at each end, and a slider for each needle in each cylinder provided with cam engaging butts, means for transferring alternate needles from the lower cylinder to the upper cylinder, means for throwing the sliders of the needles in the upper cylinder out of operation with the knitting cam of the upper cam ring to hold stitches on the lower ends of said needles, thread feeding means for feeding body thread to the intervening needles in the lower cylinder and knitting a series of successive welt courses, elastic thread feeding means for winding an elastic thread around the fabric while supported by the needles in the upper cylinder, and a tension device for said elastic thread, means for transferring the needles from the upper cylinder through the loops held thereon into position to receive the body thread and with the needles in the lower cylinder to knit a continuous course of plain knitting to complete the welt and enclose the coils of tensioned elastic thread therein.

5. In a knitting machine of the type employing coaxial superimposed knitting cylinders, separate cam rings therefor, means for establishing relative rotation and also relative reciprocation between the cylinders and cam rings, needles provided with hook and latch at each end, and a slider for each needle in each cylinder provided with cam engaging butts, the cam ring for the lower cylinder being provided with a shunt cam adjacent to the main knitting cams, means for throwing it out of and holding it out of operative position during the plain knit courses of the top, a selecting cam below the shunt cam, special selecting butts on sliders in the lower cylinder for spaced selected needles, pattern control mechanism for throwing said selecting cam into operative position for a single course intermittently during the formation of the top to raise selected needles, an auxiliary elastic thread feed finger beyond the main knitting cams for feeding elastic thread to the selected needles only, tension means for the elastic thread, an auxiliary draw down cam for the unselected needles, a separate auxiliary drawdown cam for the selected needles, riser cams for raising all the needles to bring the unselected needles in front of the elastic thread prior to the main knitting station, and means at the main knitting station for feeding body thread to all the needles.

6. In a knitting machine of the type employing coaxial superimposed knitting cylinders, separate cam rings therefor, means for establishing relative rotation and also relative reciprocation between the cylinders and cam rings; needles provided with hook and latch at each end and a slider for each needle in each cylinder provided with cam engaging butts, the cam ring for the lower cylinder being provided with a shunt cam adjacent to the main knitting cams, means for throwing it out of and holding it out of operative position during the plain knit courses of the top, a selecting cam below the shunt cam, special selecting butts on sliders in the lower cylinder for spaced selected needles, pattern control mechanism for throwing said selecting cam into operative position for a singe course inter-

mittently during the formation of the top to raise selected needles, an auxiliary elastic thread feed finger beyond the main knitting cams for feeding elastic thread to the selected needles only, tension means for the elastic thread, an auxiliary draw down cam for the unselected needles, a separate auxiliary drawdown cam for the selected needles having its lower portion movable vertically into and out of stitch forming position, riser cams for raising all the needles to bring the unselected needles in front of the elastic thread prior to the main knitting station, and means at the main knitting station for feeding body thread to all the needles.

7. In a knitting machine of the type employing coaxial superimposed knitting cylinders, separate cam rings therefor, means for establishing relative rotation and also relative reciprocation between the cylinders and cam rings, needles provided with hook and latch at each end, and slider for each needle in each cylinder provided with cam engaging butts, the cam ring for the lower cylinder being provided with a shunt cam adjacent to the main knitting cams, means for throwing it out of and holding it out of operative position during the plain knit courses of the top, a selecting cam below the shunt cam, special selecting butts on sliders in the lower cylinder for spaced selected needles, pattern control mechanism for throwing said selecting cam into operative position for a single course intermittently during the formation of the top to raise selected needles, an auxiliary elastic thread feed finger beyond the main knitting cams for feeding elastic thread to the selected needles only, tension means for the elastic thread, an auxiliary drawdown cam for the unselected needles, movable into and out of operative position, a separate auxiliary drawdown cam for the selected needles having its lower portion movable vertically into and out of stitch forming position, riser cams for raising all the needles to bring the unselected needles in front of the elastic thread prior to the main knitting station, and means at the main knitting station for feeding thread to all the needles.

8. In a knitting machine of the type employing coaxial superimposed knitting cylinders, separate cam rings therefor, means for establishing relative rotation and also relative reciprocation between the cylinders and cam rings, needles provided with hook and latch at each end, and a slider for each needle in each cylinder provided with cam engaging butts, the cam ring for the lower cylinder being provided with a shunt cam adjacent to the main knitting cams, means for throwing it out of and holding it out of operative position during the plain knit courses of the top, a selecting cam below the shunt cam, special selecting butts on sliders on the lower cylinders for spaced selected needles, pattern control mechanism for throwing said selecting cam into operative position for a single course intermittently during the formation of the top to raise selected needles, an auxiliary elastic thread feed finger beyond the main knitting cams for feeding elastic thread to the selected needles only, tension means for the elastic thread, an auxiliary drawdown cam for the unselected needles movable into and out of operative position, a separate auxiliary drawdown cam for the selected needles having its lower portion movable vertically into and out of stitch forming position, pattern control mechanism operating in timed relation with the pattern control mechanism for the selecting cam for lowering the vertically movable part of the auxiliary drawdown cam to cause the selected needles to draw a stitch of elastic thread and clear the body thread loop held thereon, riser cams for raising all the needles to bring the unselected needles in front of the elastic thread prior to the main knitting station, and means at the main knitting station for feeding thread to all the needles.

9. In a knitting machine of the type employing coaxial superimposed knitting cylinders, separate cam rings therefor, means for establishing relative rotation and also relative reciprocation between the cylinders and cam rings, needles provided with hook and latch at each end, and a slider for each needle in each cylinder provided with cam engaging butts, the cam ring for the lower cylinder being provided with a shunt cam adjacent to the main knitting cams, means for throwing it out of and holding it out of operative position during the plain knit courses of the top, a selecting cam below the shunt cam, special selecting butts on the sliders in the lower cylinder for spaced selected needles, pattern control mechanism for throwing said selecting cam into operative position for a single course intermittently during the formation of the top to raise selected needles, an auxiliary elastic thread feed finger beyond the main knitting cams for feeding elastic thread to the selected needles only, tension means for the elastic thread, an auxiliary drawdown cam for the unselected needles, movable into and out of operative position, a separate auxiliary drawdown cam for the selected needles having its lower portion movable vertically into and out of stitch-forming position, pattern control mechanism for moving the auxiliary drawdown cam out of operative position to permit the selected needles to pass directly to the main knitting cams, riser cams for raising the unselected needles in front of the elastic thread carried by the selected needles, and means at the main knitting station for feeding body thread to all of the needles to permit the selected needles to draw stitches of body thread and elastic thread in plated relation.

10. In a knitting machine of the type employing coaxial superimposed knitting cylinders, separate cam rings therefor, means for establishing relative rotation and also relative reciprocation between the cylinders and cam rings, needles provided with hook and latch at each end, and a slider for each needle in each cylinder provided with cam engaging butts, the cam ring for the lower cylinder being provided with a shunt cam adjacent to the main knitting cams, means for throwing it out of and holding it out of operative position during the plain knit courses of the top, a selecting cam below the shunt cam, special selecting butts on sliders in the lower cylinder for spaced selected needles, means operating continuously during the formation of the top to intermittently move the selecting cam into and out of operative position for a single course, locking means for locking said continuously operating means out of operation and pattern control mechanism for moving said locking means into and out of operative position, an auxiliary elastic thread feed finger for feeding elastic thread to said selected needles, tension means for the elastic thread, separate drawdown cams for the selected and unselected needles, and riser cams for raising all of the needles and bringing the unselected needles in front of the elastic thread prior to the main knitting station, and a body

thread feed finger for all the needles at the main knitting station.

11. In a knitting machine of the type employing coaxial superimposed knitting cylinders, separate cam rings therefor, means for establishing relative rotation and also relative reciprocation between the cylinders and cam rings, needles provided with hook and latch at each end, and a slider for each needle in each cylinder provided with cam engaging butts, the cam ring for the lower cylinder being provided with a shunt cam adjacent to the main knitting cams, means for throwing it out of and holding it out of operative position during the plain knit courses of the top, a selecting cam below the shunt cam, special selecting butts on sliders in the lower cylinder for spaced selected needles, a pattern wheel provided with projections spaced apart a distance corresponding to a plurality of revolutions of the cylinders and having peripheral portions corresponding with a single revolution of the cylinders, operative connections between said pattern wheel and said selecting cam, operative connections between said pattern wheel and the main driving shaft for the cylinder for imparting motion to said wheel including an operating lever and a cam on a rotary part connected with said driving shaft, locking means for engaging said lever and locking it out of operative relation with said cam, and pattern mechanism provided with a timing cam projection, operative connections between said projection and said locking mechanism, an auxiliary elastic thread feed finger for feeding elastic thread to the selected needles only, tension means for the elastic thread, a separate auxiliary drawdown cam for the unselected needles, riser cams for bringing the unselected needles in front of the elastic thread prior to the main knitting station, and means for feeding body thread to all the needles at the main knitting station.

12. In a knitting machine of the type employing coaxial superimposed knitting cylinders, separate cam rings therefor, means for establishing relative rotation and also relative reciprocation between the cylinders and cam rings, needles provided with hook and latch at each end, and a slider for each needle in each cylinder provided with cam engaging butts, the cam ring for the lower cylinder being provided with a shunt cam adjacent to the main knitting cams, means for throwing it out of and holding it out of operative position during the plain knit courses of the top, a selecting cam below the shunt cam, special selecting butts on sliders in the lower cylinder for spaced selected needles, pattern control mechanism for throwing the selecting cam into operative position for a single course intermittently to raise selected needles, an auxiliary elastic thread feed finger for feeding elastic thread to the selected needles only, tension means for the elastic thread, an auxiliary drawdown cam for the unselected needles, a drawdown cam for the selected needles having an upper portion movable into and out of operative position and having a lower portion movable vertically into and out of stitch forming position, pattern control mechanism for moving the upper portion of said auxiliary drawdown cam into and out of operative position, riser cams for raising the unselected needles in front of the elastic thread prior to the main knitting station, and means for feeding body thread to all of the needles at the main knitting station.

13. In a knitting machine of the type employing coaxial superimposed knitting cylinders, separate cam rings therefor, means for establishing relative rotation and also relative reciprocation between the cylinders and cam rings, needles provided with hook and latch at each end, and a slider for each needle in each cylinder provided with cam engaging butts, the cam ring for the lower cylinder being provided with a shunt cam adjacent to the main knitting cams, means for throwing it out of and holding it out of operative position during the plain knit courses of the top, a selecting cam below the shunt cam, special selecting butts on sliders in the lower cylinder for spaced selected needles, pattern control mechanism for throwing the selecting cam into operative position for a single course intermittently to raise selected needles, an auxiliary elastic thread feed finger for feeding elastic thread to the selected needles only, tension means for the elastic thread, an auxiliary drawdown cam for the unselected needles, a drawdown cam for the selected needles having an upper portion movable into and out of operative position, and having a lower portion movable vertically into and out of stitch forming position, separate pattern control mechanism for moving the lower portion of said drawdown cam into and out of stitch forming position, riser cams for raising the unselected needles in front of the elastic thread prior to the main knitting station, and means for feeding body thread to all of the needles at the knitting station.

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