Dec. 22, 1942. R. E. DAVIS 2,306,207

KNITTING MACHINE

Filed Aug. 2, 1935 5 Sheets-Sheet 1

Fig. 1.

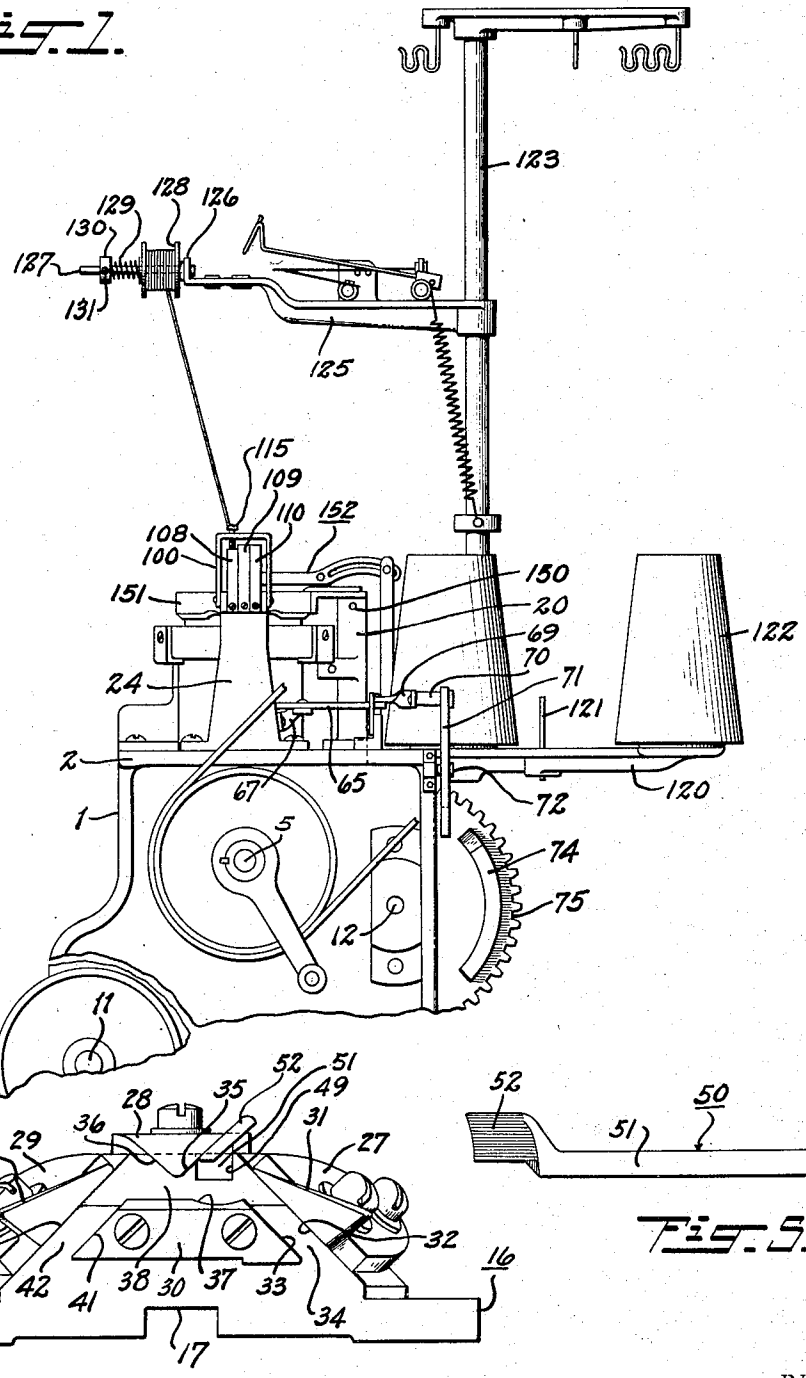


Fig. 4.

Fig. 5.

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Dec. 22, 1942. R. E. DAVIS 2,306,207

KNITTING MACHINE

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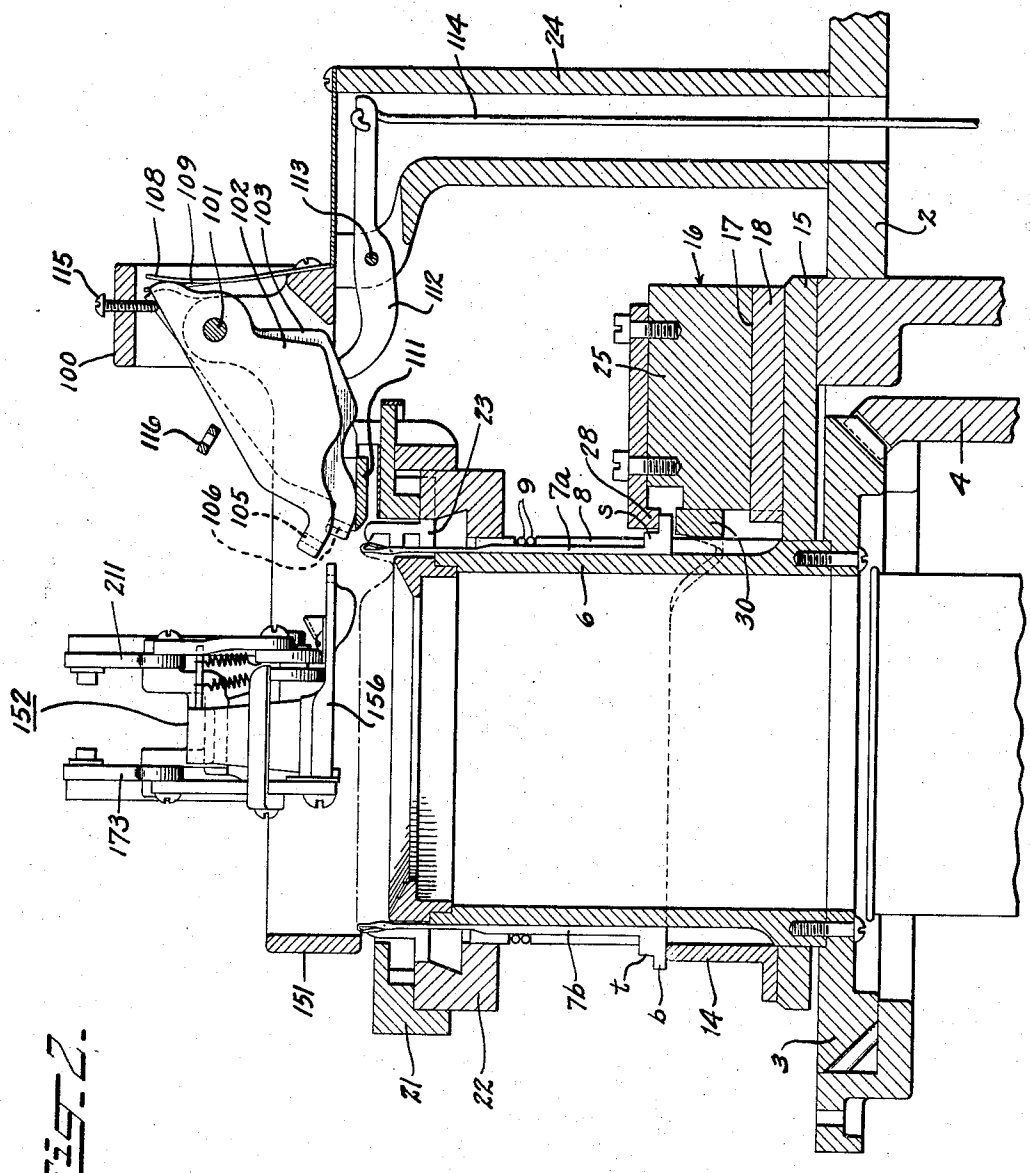


Fig. 7.

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Dec. 22, 1942. R. E. DAVIS 2,306,207

KNITTING MACHINE

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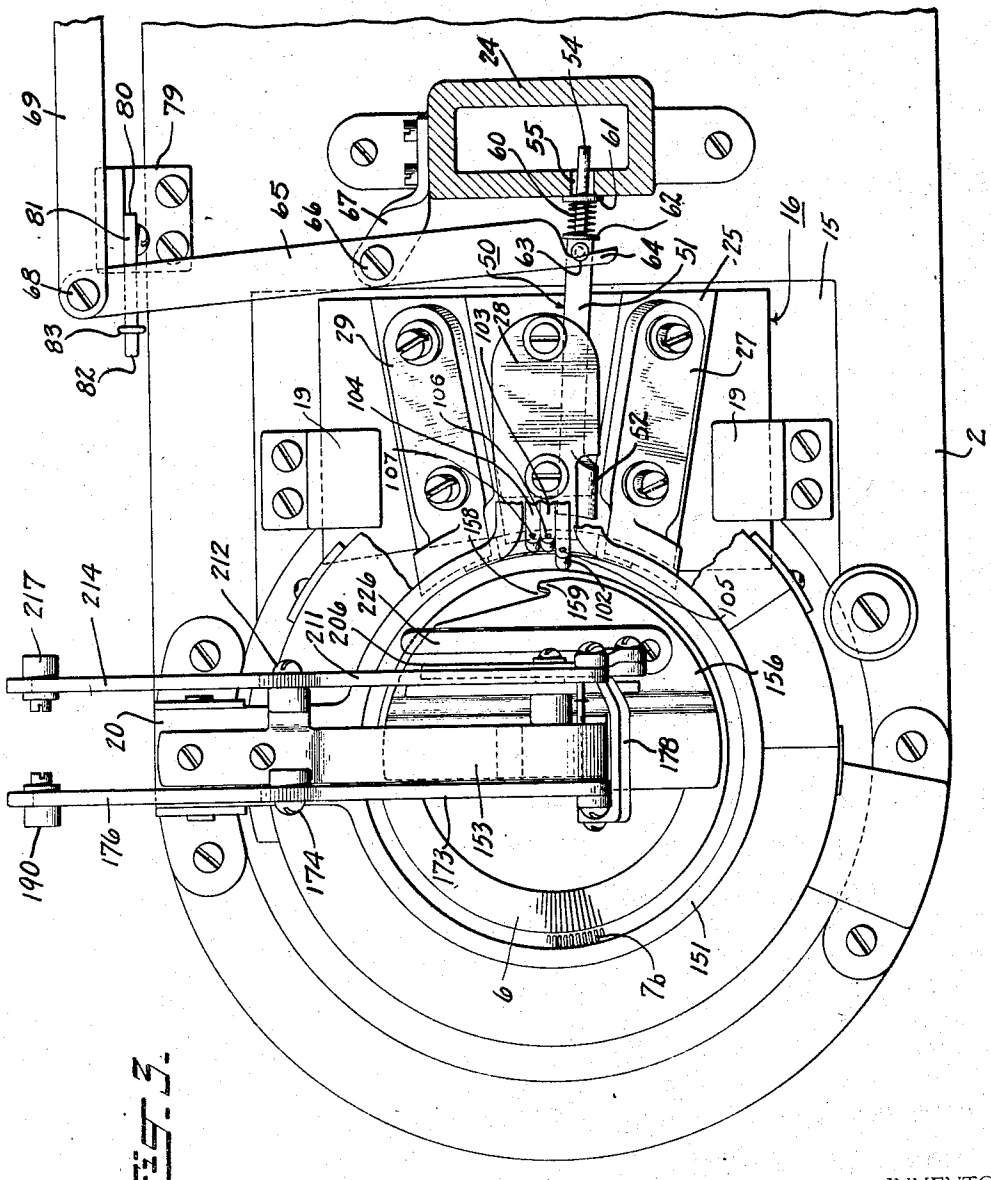


Fig. 3.

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Dec. 22, 1942. R. E. DAVIS 2,306,207

KNITTING MACHINE

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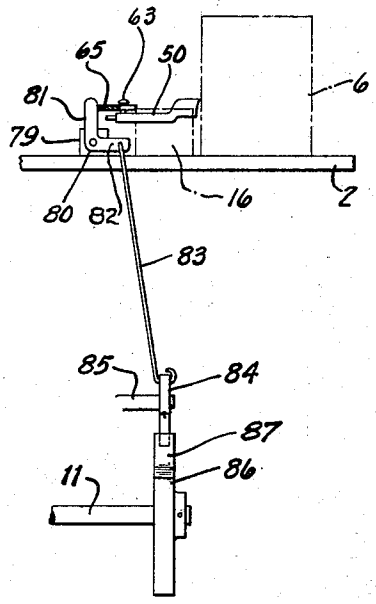


Fig. 6.

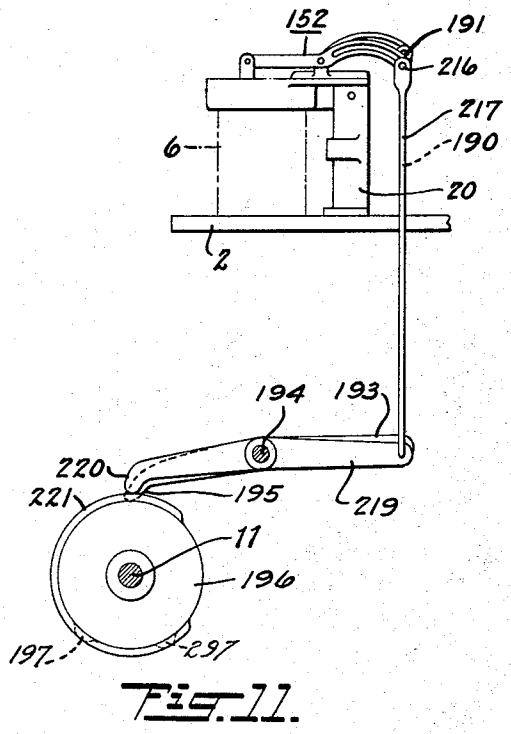


Fig. 11.

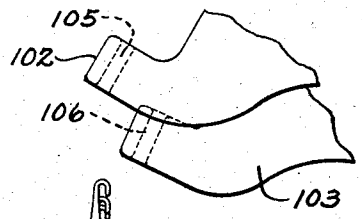
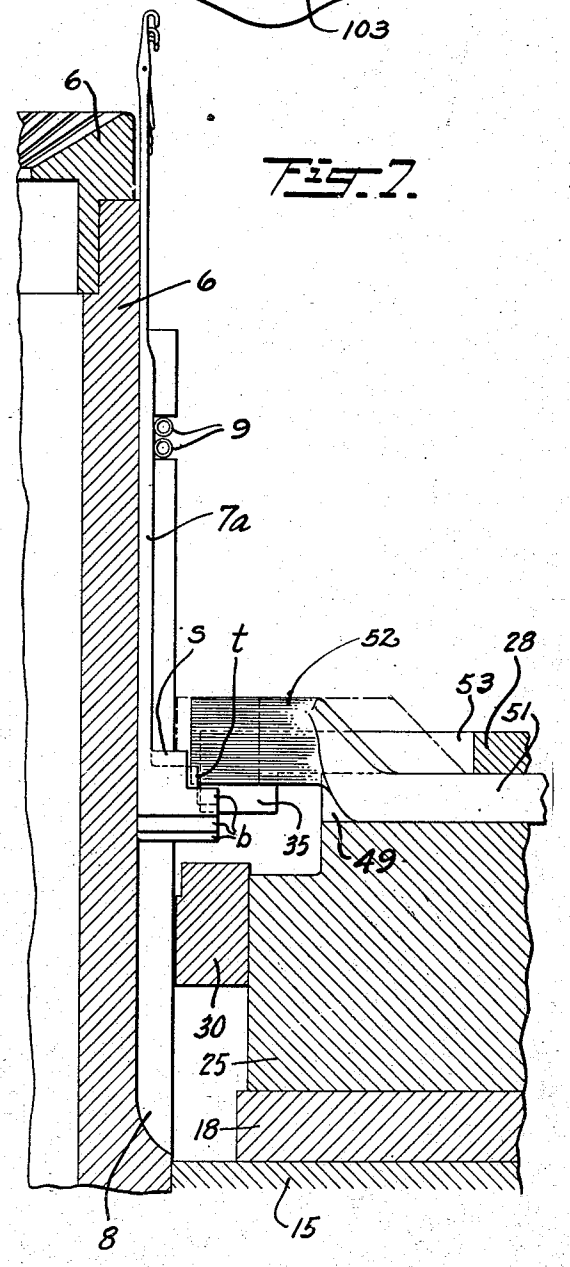


Fig. 7.



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KNITTING MACHINE

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Fig. 8.

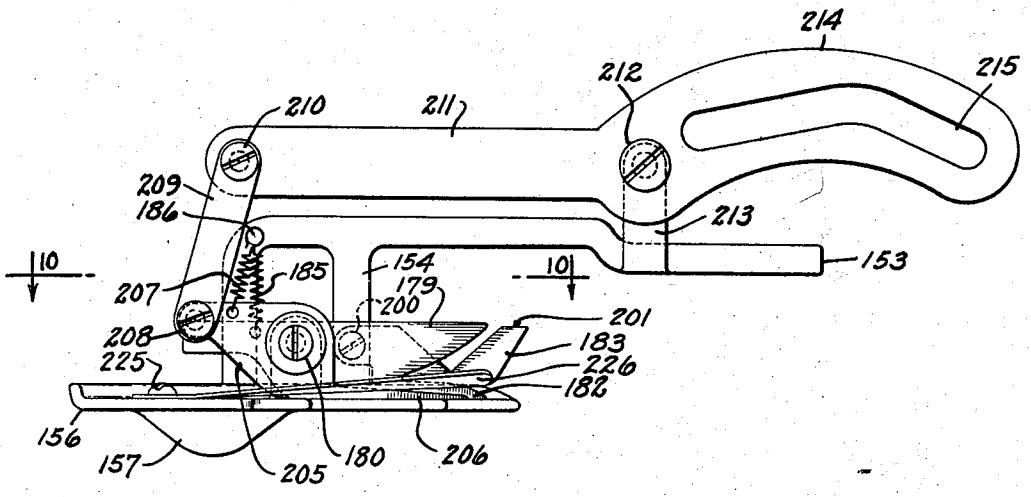
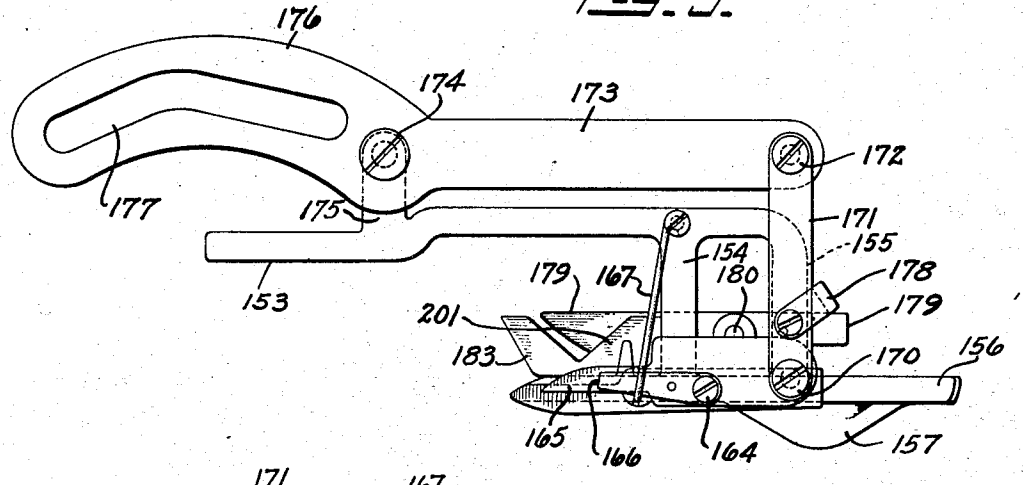


Fig. 9.



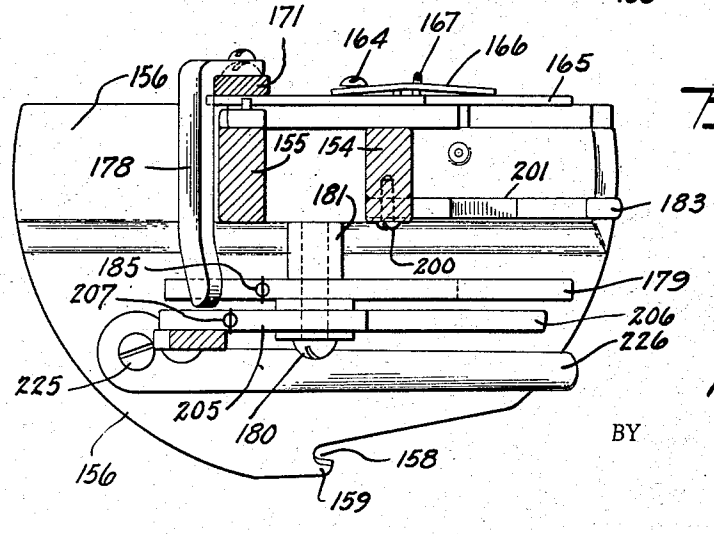


Fig. 10.

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Patented Dec. 22, 1942 2,306,207

UNITED STATES PATENT OFFICE

2,306,207

KNITTING MACHINE

Robert Evan Davis, Fort Payne, Ala., assignor to W. B. Davis & Son, Inc., Fort Payne, Ala., a corporation of Alabama

Application August 2, 1935, Serial No. 34,328

15 Claims. (Cl. 66—40)

This invention relates to knitting machines, and particularly to circular knitting machines especially adapted to knit an elastic thread, in combination with an inelastic thread.

A machine, constructed according to the present invention, is especially adapted for knitting articles of apparel having a tubular, highly elastic, form-fitting portion which is constituted by the addition to the usual plain-knit fabric of an elastic thread, which is knitted into the fabric at spaced stitches in each of a plurality of spaced courses and under sufficient tension so that when the form-fitting portion is completed the said spaced stitches are drawn toward one another to cause the finished fabric to have the appearance and the general characteristics of the well-known "rib fabric."

A feature of the invention consists in a provision of shouldered needles and a cooperating cam arrangement for throwing down all except selected needles prior to reaching the knitting point, and a suitable feeding arrangement whereby elastic thread may be fed to the selected needles only, whereby the elastic thread is knitted into spaced wales of the fabric in addition to the fabric-forming thread, and preferably in plating relation therewith.

A further feature of the invention consists in a provision of a control mechanism for the cam arrangement controlled by the driving mechanism for the machine, for controlling the incorporating of the elastic thread into the selected courses, and for controlling the number and the arrangement of courses into which the elastic thread is knitted.

A further feature consists in the provision of a thread finger at the feeding point for feeding the elastic thread to the selected needles above the remaining needles, in such a manner that the elastic thread is not knit by any needles other than the selected needles.

A further feature consists in a provision of a rotatable spool and a friction drag for the spool, whereby the elastic thread may be fed to the selected needles under a predetermined controlled tension.

Another feature of the invention consists in the provision of a binder mechanism which includes a binder arranged to bind the elastic thread after the desired number of courses of elastic thread have been knitted, and to hold the elastic thread throughout the operation of knitting the remainder of the hose until the first elastic-carrying course of the next succeeding hose is knitted.

Various other features and advantages of the invention will be apparent from the following particular description and from an inspection of the accompanying drawings.

In the accompanying drawings, there is shown for the purposes of illustration a circular knitting machine of the Banner type, to which the several features of the present invention are particularly applicable, but it is within the contemplation of the invention to apply these features either singly or in combination to other types of machines to which these features may be suited. For the purpose of simplifying the illustration of the invention, only certain portions of the machine have been shown, and certain details have been omitted in order to simplify the showing; for the disclosure of the further details, reference may be made to the patent to Hemphill #933,443, granted September 7, 1909.

Although the novel features which are believed to be characteristic of this invention will be particularly pointed out in the claims appended hereto, the invention itself, as to its objects and advantages, and the manner in which it may be carried out, may be better understood by referring to the following description taken in connection with the accompanying drawings forming a part thereof, in which:

Fig. 1 is a fragmentary front elevational view of the top portion of a machine constructed according to the present invention.

Fig. 2 is a vertical cross-section taken through the upper portion of the machine, certain elements being omitted for the purpose of clarity.

Fig. 3 is a fragmentary top plan view of the upper portion of the machine with certain portions being shown in section and certain portions broken away to show the construction.

Fig. 4 is a front elevational view of the knitting cam.

Fig. 5 is a side elevational view of the auxiliary cam forming an element of the knitting cam.

Fig. 6 is a diagrammatic view taken from the rear of the machine, showing the cam lock-out mechanism.

Fig. 7 is an enlarged fragmentary view of a portion of the machine illustrating the cooperation between the knitting cam and the needles.

Fig. 8 is an enlarged side elevational view of the top plate and binders.

Fig. 9 is an opposite side elevational view of the same.

Fig. 10 is a view of a horizontal section taken along the line 10—10 of Fig. 8.

Fig. 11 is a diagrammatic side elevational view

showing the actuating mechanism for the binders.

Supported on a main frame 1 is a horizontal table 2 on which is mounted a rotatable bevel gear 3 driven by a cooperating bevel gear 4 carried on a main drive shaft 5. Secured to and supported on the bevel gear 3 is the usual needle cylinder 6, in which is carried a series of latch needles 7a and 7b, slidable in grooves 8 and retained by circular springs 9.

All of the needles 7a and 7b are provided with the usual butts b, half of which are long butts and the other are short butts (only the long butt needles being seen in the drawings). Certain of the needles, for example, every fourth needle, are formed with short shoulders s, and the remainder of the needles are formed with long shoulders t, the purpose of which will hereinafter appear.

The main shaft 5 is driven from a suitable source of power, and is connected by the usual drive mechanism (not shown) to shafts 11 and 12 which carry numerous control mechanisms hereinafter described. For the purpose of illustration, the drive mechanism has been chosen so that the shaft 12 is rotated one-fourth of a revolution for each revolution of the needle cylinder. The shaft 11 is rotated one revolution for each article knitted.

Supported on the table 2 is a plate 15 on which is slidably mounted a knitting cam block 16 having a slotted opening 17 cooperating with guide members 18 and 19, fixed to the plate 15 for the purpose of guiding the knitting cam block 16. Also supported on the plate 15 is a ring cam 14 for supporting the needles 7a and 7b during the rotation of the cylinder 6, in a known manner.

Upstanding from the table 2 is the standard 20 and the hollow standard 24, the former of which serves to support the usual sinker cap 21 and the sinker head 22 carrying a series of sinkers 23 for cooperation with the needles 7.

The knitting cam 16 (Fig. 4) comprises a cam block 25 to which is secured a side cam 27, a center cam 28, a second side cam 29, and a bottom cam 30. The side cam 27 is formed with an upper cam surface 31 and a lower cam surface 32, which latter surface cooperates with a cam surface 33 on the cam 30, to constitute an inclined groove 34. The center cam 28 is formed with angularly-arranged surfaces 35 and 36, which cooperate with the top surface 37 of the cam 30, to constitute a generally horizontal groove 38. The cam 29 is formed with an upper surface 39 and a lower surface 40, which latter surface cooperates with the adjacent surface 41 of the bottom cam 30, to constitute an inclined groove 42.

Slidable in a horizontal way 49, formed in the cam block 25, is an auxiliary cam 50 constituted by an elongated portion 51, formed integral with and terminating at one extremity in an inclined blade 52, slidable in an open notch 53 formed in the center cam 28. The auxiliary cam has three positions of adjustment, namely "retracted" (see Fig. 3), wherein the base of the blade 52 abuts the end of the notch 53 (Fig. 7); "extended," wherein the end of the blade 52 abuts the needle cylinder 6; and "intermediate" (see Fig. 7), wherein the blade lies in the path of the long shoulders t, but out of the path of the short shoulders s.

The outer extremity of the cam 50 is reduced, and extends through an opening 55 formed in the standard 24 (Fig. 3). A coil spring 60, compressed between washers 61 and 62, bearing respectively against the standard 24 and the shoulder formed on the cam 50, serves to urge the cam 50 toward the extended position. Upstanding from the portion 51 adjacent the shoulder, is a pin 63 with which cooperates a reduced end 64 of a control lever 65, which is pivotally supported by a pivot member 66, to a bracket 67 secured to the standard 24. The lever 65 is pivotally connected at 68 to a link 69, which in turn is connected to a pivot rod 70 (Fig. 1) connected pivotally to one end of a lever 71 which is oscillatably supported by a pivot pin 72 and which engages at its other end a control cam 74, carried on a gear wheel 75 mounted for rotation on the shaft 12.

The auxiliary cam 50 is normally urged into extended position by the spring 60. However, upon suitable rotation of the shaft 12, the cam 74 engages the end of the lever 71 and moves the latter to actuate the associated control members and move the control lever 65 in a counter-clockwise direction (Fig. 3) to move the auxiliary cam into intermediate position.

A lock-out mechanism (Figs. 3 and 6), for rendering the above-described control mechanism inoperative and for maintaining the auxiliary cam 50 in retracted position, includes a crank 80, pivoted in a bracket 79 fixed to the table 2, which crank has an arm 81 adapted to engage the lever 65 at a point near the outer end thereof, and which has a second arm 82 to which is connected a pull rod 83. The pull rod 83 is connected to a lever 84 mounted on a shaft 85, and having its other end adapted to ride on a drum 86 carried on a shaft 11. Detachably secured to the drum 86 is a cam 87 whereby, upon suitable rotation of the shaft 11, the lever 84 is moved angularly to draw the pull rod 83 down, and thus rotate the crank 80 in a clockwise direction (as viewed in Fig. 6), to thus rotate the lever 65 in a direction to draw the cam 50 to the left. Thus, the cam 75 and the associated lock-out mechanism serve as a master control for the auxiliary cam 50.

The standard 24 (Figs. 1 and 2) supports on its upper end a doubly-bent yoke 100 in which is mounted a pivot member 101, which pivotally carries a desired number of thread fingers 102, 103 and 104 having thread openings 105, 106 and 107, respectively. The fingers are normally urged into the lower or feeding position (as shown in Fig. 2), by leaf springs 108, 109 and 110, in which position the fingers 103 and 104 rest on a supporting plate 111. The finger 102 is prevented from dropping to the lower position assumed by the other fingers 103 and 104, by reason of a stop screw 115 threaded through the top of the yoke 100 and adapted to engage the top portion of the finger 102, whereby the feeding position of the finger 102 is established slightly above that of the other fingers 103 and 104, for a purpose which will hereinafter appear.

The base of each of the fingers 102, 103 and 104 is positioned to be engaged by a lift lever 112 (Fig. 2) mounted on a pivot 113 and actuated by a pull rod 114 extending through the hollow standard and controlled from a thread-change cam (not shown) carried on the shaft 11. The rotation of the thread-change cam actuates the rods 114 and the levers 112 to lift the fingers selectively out of feeding positions into non-feeding positions.

Adjacent the fingers is the usual thread guide

116 (Fig. 2) adapted to direct the thread to the several openings 105, 106 and 107.

Extending from the table 2 (Fig. 1) is an extension 120 supporting the usual spindles 121, on which the usual thread bobbins 122 may be supported. Extending upwardly from the table extension 120 is a standard 123 supporting a thread-guiding and tensioning mechanism including a horizontal arm 125.

The arm 125 is provided with an upturned end 126 in which is supported a shaft 127, on which is rotatably mounted a light spool 128, preferably formed of aluminum. Bearing against the spool is a coil spring 129 which bears at its other end against a collar 130 fixed on the shaft 127 by a set screw 131. The frictional resistance to rotation of the spool, which is provided by the spring 129, may be varied at will by adjusting the position of the collar 130 on the shaft 127; thus the tension on the thread which is being unwound from the spool 128 may be controlled.

Carried on a pivot 150 (Fig. 1) mounted in the standard 20, is the usual latch ring 151 to which is secured a binder assembly 152, comprising a bracket 153 having depending arms 154 and 155 which are suitably attached to a top plate 156 having a substantially semi-circular shape. The top plate 156 is provided with a depending projection 157 and an open notch 158 formed in the periphery of the plate 156 adjacent the thread fingers 102, 103 and 104, and providing a hook 159, the purpose of which elements appears hereinafter.

Pivotally supported on a pivot screw 164 (Fig. 9) threaded into the diametral edge of the plate 156, is a cutter 165 urged into tight sliding contact with the diametral edge of the plate by a leaf spring 166 and cooperating with a wire guide 167. The cutter 165 is pivotally connected by a screw 170 to a link 171, which in turn is connected by a pivot screw 172 to an operating lever 173 pivoted by a screw 174 on an upstanding projection 175 integral with the bracket 153. The other end of the lever 173 is of arcuate form, and has formed therein an elongate arcuate slot 177 for a purpose which permits raising the latch ring, as will be understood.

Carried on the link 171 is a cross bar 178 adapted to bear against one end of a binder 179 which is pivoted on a screw 180 threaded into an upstanding projection 181 integral with the top plate 156, and having a foot portion 182 adapted to lie flat against the top of the plate 156 when the binder 179 is in closed position. The binder 179 is normally maintained flat against the top plate by a coil spring 185 connected at one end to the binder 179, and at the other end to a spring pin 186.

The cutter 165 and the binder 179 are actuated simultaneously through the rocking movement of the lever 173 about its pivot 174, which movement is accomplished by the movement of a pull rod 190 (Fig. 11) connected by a pivot 191, at one end, to the end of the lever 173, and at the other end to a rocking lever 193 which is carried rotatably on a shaft 194, and has at its other end a nose 195 adapted to ride on a cam or drum 196 mounted on the shaft 11 and having a suitable cam 197 for rocking the lever 193, to thereby rock the lever 173.

Pivoted on a screw 200 (Figs. 8 and 10) threaded into the projection 154, is a gravity-actuated binder 201 having an upwardly-extending nose 183 for guiding thread into position and for raising the binder, which binder is adapted to secure the ends of the thread or threads during the operation of the cam-actuated binder 179.

Pivoted on the screw 180 is a second cam-actuated binder 205, having a foot portion 206 extending along and adapted to lie flat on the top plate 156. The foot portion 206 is adapted to lie below the level of the binder 179 when the latter is in open position and the binder 205 is in closed position. The other end of the binder is attached to a spring 207 which is anchored to the spring pin 186 for normally maintaining the binder 205 in closed position. The binder 205 also is connected by a pivot screw 208 to a link 209, which in turn is connected to a screw 210 to an operating lever 211. The operating lever 211 is pivoted on a screw 212 threaded into an upstanding projection 213 formed on the bracket 153, and the outer end 214 of the lever 211 is of arcuate shape, and is provided with an arcuate slot 215 in which a pivot member 216 (Fig. 11) is adapted to slide. Connected to the lever 211 by the pivot member 216 is a pull rod 217 which is pivotally connected to one end of a lever 219 rockable on the shaft 194, and the other end of the lever 219 is provided with a nose 220 which bears upon the cam 196 and is adapted to ride up on to a rise 221.

Secured to the top plate 156 (Figs. 8 and 10) by a screw 225 is a guide member 226 which is twisted upwardly away from the top plate 156 to a position wherein it engages the elastic thread and guides it under the binder when the finger 102 is lifted into non-feeding position.

The operation of the machine is as follows:

In elastic fabric thread is fed from the bobbins 122 in the usual manner, through the thread-guiding and tensioning mechanism, and through the thread-guide 116 to the openings 106 and 107 of the thread fingers 103 and 104. In forming a hose, customarily, body thread will be fed to one finger, and heavier heel- and toe-forming thread will be fed to another finger. An elastic thread, which may be either covered or uncovered, is fed directly from the spool 128 through another thread-guide 116 to the opening 105 in the thread finger 102, the spring 129 bearing upon the spool 128 to provide a predetermined tension on the elastic thread.

The main drive shaft 5 is driven by the drive means (not shown), to rotate the bevel gear 4, which in turn drives the bevel gear 3, to thus rotate the needle cylinder 6 in the usual manner. The main drive shaft 5 also operates through the driving mechanism (not shown), to rotate the shafts 11 and 12 and the control cams carried thereby.

When a hose is started, the shaft 11 and the cam 86, carried thereby, are in such angular position that the lever 84 bears upon the cam 87 to thereby actuate the lock-out mechanism and maintain the crank 80 in its position against the lever 65, which in turn maintains the auxiliary cam 50 in its retracted position.

As the needle cylinder is rotated, the needles are successively moved into engagement with the cam block 16 (Figs. 4 and 7), and the butt *b* of each needle rides up along the cam surface 31 (Fig. 4) into feeding position, whereafter the needle is carried along horizontally until the butt *b* strikes the cam surface 35, which throws the needle down into the groove 38, wherein it rides until it engages the cam surface 40 which guides the butt *b* down along the groove 42 to move the needle down through the knitting movement, whereafter the butt *b* is engaged by

the upper surface of the cam ring 14 and raised to its initial position.

After a certain number of plain-knit courses are knit, the lever 84 (Fig. 6) rides off the cam 87, and thus permits the auxiliary cam 50 to be moved under the influence of spring 60 into its extended position wherein the blade 52 bears against the needle cylinder 6, and lies in the path of both the short shoulders *s* and the long shoulders *t*. As the needle cylinder continues to rotate, the needles are actuated by the cam 16 in substantially the manner above-described, except that after the needles are lifted by the butts *b* riding up on the surface 31, the needles are all thrown down a short distance by the blade 52 engaging the shoulders *s* and *t*, respectively, prior to the butts *b* being engaged by the cam surfaces 35 and 40, to move all of the needles through the knitting movement.

When the said desired number of plain courses have been knit, the shaft 12 (Fig. 1) has rotated sufficiently to bring the cam 74 on the gear 75 into a position to bear against the end of the lever 71 and rock the same to operate the associated linkage and rotate the lever 65. This retracts the auxiliary cam 50 against the force of the spring 60 a sufficient amount so that the blade 52 (Fig. 4) lies in the path of only the long shoulders *t*, and is not engaged by the short shoulders *s* as the needles are carried by the cam 16. Thus, as the needles are carried into engagement with the cam 16, the butts ride up on the surface 31 in the usual manner, thus raising all of the needles, and thereafter the long shoulders *t* are engaged by the blade 52 and thrown down, but the needles having the short shoulders *s* continue to move horizontally a short distance, whereafter the butts of all of the needles are engaged by the surface 35, and the needles moved through the knitting movement in the usual manner.

The action of the cams upon the needles is illustrated in Fig. 7, wherein only three needles are shown. The butt *b* of the leading (rear-most) needle is engaged by the cam surface 35, forcing the needle downwardly into the knitting movement. The long shoulder *t* of the next needle is engaged by the blade 52, forcing this needle downwardly into position so that the butt *b* will be engaged by the cam surface 35, and the trailing uppermost needle in Fig. 7 needle is in the position to which it has been raised by the cam surface 31 (Fig. 4), with the short shoulder *s* clearing the end of the blade 52.

The thread finger 102 is so positioned that it feeds the elastic thread to the spaced short-shoulder needles during the time that these needles are raised above the long-shoulder needles, and thus the elastic thread is not fed to the long-shoulder needles. However, since all of the needles are moved through the knitting movement successively in the same manner, and at the same heights respectively at each point, the fabric thread is fed by the thread finger 103 to all of the needles, and thus the elastic thread and the fabric thread are knitted simultaneously by the short-shoulder needles preferably in plating relation, and only the fabric thread is knitted by the long-shoulder needles, thus the elastic thread is floated on the back of the fabric between the spaced short-shoulder needles.

At the completion of the last-described course, the gear 75 has been moved sufficiently so that the end of the lever 71 rides off the cam 74, thus actuating the associated members to release the auxiliary cam 50 and permit it to be urged into extended position by the spring 60.

The machine then continues to knit plain courses of inelastic, or body thread, only, and the elastic thread is not caught by the needles, since all of the needles are thrown down by the auxiliary cam 50 prior to reaching the feed point for the elastic thread.

During the knitting of the plain courses, in which the elastic thread is not included, the elastic thread extends from the feed finger 102 to the last needle by which it was knit into the aforedescribed elastic-carrying course. As the said needle is carried around in its path by the cylinder, the elastic thread is engaged by the hook 159, and is held in the notch 158, out of the way of the needles. Thus the elastic thread may be carried around in the cylinder during the knitting of the plain courses without being picked up by any of the needles and knit into the fabric at an undesired point, and hence the elastic thread need not be severed at the end of each elastic-carrying course, but may extend continuously through the entire section of the garment.

After the desired number of plain courses are knit, the cam 74 again actuates the associated linkage to move the auxiliary cam 50 into its intermediate position and again produce a course in which the elastic is knitted in at spaced wales and floated between such spaced wales.

When the desired number of courses have been knit and the end of the elastic-carrying portion of the hose has been reached, the shaft 11 has rotated to bring the drum 86 into a position wherein the cam 87 engages the end of the lever 84, to rock the lever and actuate the associated members to rotate the crank 80 in a clockwise direction (as shown in Fig. 6), to maintain the lever 65 in its rotated position, and thus retain the auxiliary cam 50 in its retracted position.

At this time the thread-feed cams (not shown) have been rotated to such a position that the pull rod 114 actuates the lever 112 to lift the thread finger 102 out of feeding position, and at the same time the binder-operating cam drum 196 (Fig. 11) reaches a position wherein the noses 195 and 220 of the levers 193 and 219, respectively ride on their respective cams 297 and 221, to actuate the associated mechanism and rock the levers 173 and 211, to force the binders 205 and 179 against the surface of the top plate, and simultaneously to actuate the cutter 165, to sever the elastic thread, whereafter the cam drum 196 operates to rotate the lever 173 and open the binder 179, but the binder 205 remains in closed position to secure the end of the elastic thread.

The machine now continues to knit plain fabric throughout the remainder of the leg portion, and then the heel is formed in the usual manner by operation of widening and narrowing picks (not shown). When the heel and the toe are to be formed, it is generally desirable to operate the binder 179 and the cutter 165, to sever the body thread, raise the feed finger 103, and to actuate the feed finger 104 to feed a heavier thread to the needles, in a manner which is well-known, whereafter the heavier thread is bound and severed, and the body thread again fed to the needles. During the opening and closing of the binder 179, the gravity binder 201 holds the fabric thread which has just been knitted, and the binder 205 remains in closed position to secure the elastic thread, and thus all of the threads are maintained in operating position

until the hose is finished and a new hose started. The binder **205** grips the elastic thread so tightly that it resists any tendency for the elastic thread to snap back toward the feed finger **102**, due to the tension on the elastic thread and the inherent elasticity thereof. When the machine is operated to start the next hose, and the first elastic-carrying course is started, the binder **205** is opened to permit the elastic thread to be caught by the raised needles and by the control mechanism knit into the fabric in the manner above-described.

From the foregoing it will be seen that the present invention provides an improved knitting machine by which it is possible to knit a highly elastic thread, such as uncovered rubber or covered rubber, for example, "Lastex," into a plain-knit fabric composed of relatively inelastic thread, and under sufficient tension so that the spaced stitches into which the elastic thread is knitted are drawn toward one another to cause longitudinally parallel ridges in the fabric in simulation of fabric knit on a ribber.

An example of such fabric is disclosed and claimed in by co-pending application Serial No. 28,463 filed June 26, 1935. The present invention, however, is not limited to a machine for knitting the specific fabric aforementioned, but certain features of the invention are capable of broader application, as will be apparent to those skilled in the art.

The provision of the shouldered needles and the cam arrangement disclosed in the foregoing provides a simple, sure and readily adjustable arrangement for controling the needles, to provide a float-stitch knitting operation. The arrangement is such that it does not interfere in any way with the plain-knitting operation of the needles, and such plain-knitting may be carried out in a satisfactory manner with a machine modified according to the present invention as well as with a machine not so modified. It will be apparent that, although the present invention provides a very satisfactory needle-controlling arrangement for producing a float-stitch knitting operation, yet only a few and simple changes in the existing knitting machines are necessary to construct a machine according to applicant's invention. Therefore, it is possible to apply applicant's invention to existing machines without incurring the large expense of redesigning or rebuilding the latter.

The novel control arrangement for the auxiliary cam which applicant has provided permits rapid and easy variation in the number and spacing of the elastic-carrying courses. This may be done in various ways, as will be apparent, such as by changing the detachable cam carried on the gear wheel, or by varying the driving ratio of the driving mechanism. The variation in the number of elastic-carrying courses, or the length of the elastic-carrying section of the article, may readily be varied by changing the cam which controls the lock-out mechanism which renders the auxiliary cam-controlling mechanism inoperative. From the foregoing description, it will be seen that variation in the several cams may readily be made by removing the cams from their respective supporting members, and replacing them by longer or shorter cams or by a greater or lesser number of cams.

The arrangement for handling elastic thread also is simple, and may readily be applied to existing machines without considerable change therein. The several elements constituting the novel thread-handling arrangement ensure the elastic thread being fed to the needles at a predetermined constant, and readily controllable tension, which tension may simply and quickly be varied by the setting of the friction-drag arrangement above-described. The feeding arrangement for the elastic thread is such that it is fed only to the desired raised needles and in such a manner that there is no possibility of the other needles picking up the elastic thread and knitting it into the fabric at undesired points. Furthermore, the notch provided in the top plate ensures the elastic thread being maintained in such a position, during the knitting of the courses which do not carry the elastic thread, that the latter is not picked up by any of the needles, but is maintained in readiness to be knitted by the selected needles at the beginning of the next elastic thread course.

The specially designed binder for securing the elastic thread during the knitting of the portions of the article which do not carry the elastic thread ensures against the latter snapping out of operative position due to the tension thereon, and to its inherent elasticity, thus overcoming one of the well-known difficulties in knitting elastic thread, namely handling the thread in such a manner as to overcome the undesired displacement of the elastic thread, due to its tendency to return to its untensioned condition.

While certain novel features of the invention have been disclosed and are pointed out in the annexed claims, it will be understood that various omissions, substitutions and changes may be made by those skilled in the art without departing from the spirit of the invention.

Although the thread-handling features have been disclosed in combination with a novel cam arrangement for raising selected needles to receive a thread not fed to the remaining needles, it should be obvious that the former may be employed in connection with other types of needle-selecting arrangements. For example, the needles may be selected by raising them with jacks, or by bending them inwardly away from the remaining needles, by depressing the remaining needles, or in other ways.

What is claimed is:

1. A circular knitting machine comprising, in combination, a rotatable needle cylinder, a series of needles carried thereby, cam means for actuating said needles, means for throwing down all except selected needles prior to engagement by said cam means to draw a stitch, a feed-finger mounted adjacent said needles, means positioning said finger for feeding a thread to said selected needles only, a rotatable spool for supplying thread to the said feed finger, friction means cooperating with said spool to maintain the thread under predetermined uniform tension, a top plate mounted above said cylinder and having an open slot adapted to receive the thread from said finger when said finger is not feeding to said selected needles, a binder on said top plate adapted to engage said thread when said finger is in non-feeding position, and means for actuating said binder.

2. In a knitting machine, in combination, a series of needles, means for feeding an inelastic thread to said needles, means for moving said needles through a knitting movement to knit a plurality of courses of plain-knit fabric, needle-selecting means operative during the knitting of non-consecutive courses of fabric for bringing selected spaced needles of said series into a posi-

tion to receive a thread independently of the remaining needles, means for feeding an additional and elastic thread, under predetermined tension, to said selected needles only during the knitting of said non-consecutive courses, and means operative upon the completion of a predetermined number of courses for rendering said needle-selecting means and said elastic thread-feeding means inoperative.

3. In a knitting machine, in combination, a series of needles, means for moving said needles through a knitting movement to knit a plurality of courses of fabric, means for feeding an inelastic thread to all of said needles, means for feeding an elastic thread in the hooks of spaced needles of said series only during the knitting of non-consecutive courses of fabric, and means for maintaining a predetermined tension on said elastic thread while it is fed, and means for guiding said elastic thread out of the path of said spaced needles during the knitting of the courses intermediate the said non-consecutive courses.

4. In a knitting machine, in combination, a needle cylinder, a plurality of needles carried by said cylinder, a stitch-forming cam including a surface for depressing all of said needles, driving means for actuating said cylinder to move said needles past said cam for actuation thereby, means including an auxiliary cam abutting said needle depressing surface for depressing spaced needles of said series below the remainder of said needles prior to the initial stitch-knitting depression of the remainder of the needles by the stitch-forming cam, means normally urging said auxiliary cam into the path of said spaced needles, and means actuated by said driving means for retracting said auxiliary cam out of the path of said needles.

5. In a circular knitting machine, in combination, a rotatable needle cylinder, a series of needles carried by said cylinder, a plurality of thread-feed fingers mounted adjacent said cylinder, means for knitting thread from one of said fingers, means for knitting thread from another of said fingers in plating relation with the thread from said first finger during the knitting of non-adjacent courses, and a top plate mounted above said cylinder and having an open slot in its circumferential portion for receiving thread extending between said second finger and said needles during the knitting of the courses intermediate said non-adjacent courses and constituting means for mantaining said second thread out of the path of said needles during the knitting of said intermediate courses.

6. A circular knitting machine comprising, in combination, a needle cylinder, a series of needles carried thereby, means for rotating said cylinder, means for actuating said needles, means for feeding a thread to said needles, means for feeding a second thread to selected needles of said series during each of a plurality of non-consecutive revolutions of said cylinder, a top plate mounted above said cylinder, and means on said top plate for engaging said second-named thread and maintaining it out of the path of said selected needles during the revolutions of said cylinder in which said second thread is not fed to said selected needles.

7. In a circular knitting machine, in combination, a needle cylinder, a series of needles carried thereby, means for rotating said cylinder, cam means engageable by said needles for effecting a stitch-forming movement thereof, means for feeding thread to said needles, needle-selecting means operative during certain of the revolutions of said cylinder for positioning selected needles in a raised position relative to the remaining needles, means for feeding a thread to said selected needles, and a top plate mounted above said cylinder and having an open slot therein for receiving said second thread and maintaining the same out of the needle path during the revolutions of said cylinder in which said needle-selecting means is inoperative.

8. In a circular knitting machine, in combination, a needle cylinder, a series of needles in said cylinder, means for feeding both an inelastic thread and an elastic thread to at least certain of said needles, a thread cutter, a binder operative with said thread cutter, means for opening and closing said binder for binding and cutting said threads, a second binder operable independently of said first binder for securing said elastic thread during the opening and closing operation of said first binder, and means for actuating said second binder.

9. In a circular knitting machine, in combination, a top plate, a binder, means pivotally mounting said binder for movement between open position and closed position contacting said plate, cam means for actuating said binder, a cutter and a gravity-actuated binder pivotally mounted on said plate on one side of said first binder, a third binder, means pivotally mounting said third binder on said plate on the other side of said first binder, for movement between open position and closed position, and cam means for actuating said third binder.

10. In combination with a circular knitting machine constructed and arranged to knit hose with an elastic thread under tension in the cuff portion thereof, a binder comprising a pair of independently movable thread clamps, one for a regular thread and the other for the elastic thread, a shear action for severing the several threads, and means for opening and closing the clamps and the shear action, respectively, for clamping and cutting off the several threads, the regular thread passing over the elastic thread clamp so as not to disturb the elastic thread as the regular thread is withdrawn from under the regular thread clamp during the knitting of the machine.

11. In a knitting machine, in combination, a needle cylinder, a series of needles carried thereby, a main stitch-forming cam, driving means for revolving said cylinder to move said needles past said cam for actuation thereby, an auxiliary cam associated with said main cam and movable between inactive position wherein said auxiliary cam is operative to throw down spaced needles of said series prior to normal stitch-forming movement thereof, actuating means controlled by said driving means for moving said auxiliary cam into active position only during non-consecutive revolutions of said needle cylinder, and locking means controlled by said driving means and operable on said actuating means for rendering said actuating means inoperative for a predetermined number of revolutions of said needle cylinder.

12. In a circular knitting machine, in combination, a needle cylinder, a series of needles carried by said cylinder, means for rotating said cylinder, a plurality of thread-feed fingers mounted adjacent said cylinder, at least one of which is adapted to feed an elastic thread, means for moving said fingers between feeding and non-

feeding positions, means for maintaining said elastic thread feed fingers in non-feeding position for predetermined revolutions of said cylinder, a top plate mounted above said cylinder, a main binder carried by said top plate and adapted to engage the threads extending between said needles and said fingers when said fingers are in non-feeding position, means for operating said main binder, an auxiliary binder mounted adjacent said main binder and operable independently thereof to engage said elastic thread and means for operating said auxiliary binder to secure said elastic thread when said main binder is opened during the period said elastic thread feed finger is in non-feeding position.

13. In a circular knitting machine, in combination, a needle cylinder, a series of needles carried by said cylinder, driving means for rotating said cylinder, cam means for moving said needles through a stitch-forming movement, means for feeding an inelastic thread to all of said needles, a first binder for securing said inelastic thread at the end of a knitting operation, means controlled by said driving means for actuating said binder, means for selecting spaced needles of said series, means for feeding an elastic thread to said selected needles only, lockout means controlled by said driving means for rendering said needle-selecting means inoperative, a second binder operable independently of said first binder for securing said elastic thread, and means controlled by said driving means for actuating said second binder to secure said elastic thread during the operation of said lockout means.

14. In a knitting machine, in combination, a series of needles, a needle cylinder carrying said needles, a knitting cam, drive means for moving said cylinder to carry said needles past and into engagement with said knitting cam, an auxiliary cam movable into and out of the path of spaced needles of said series, actuating means controlled by said drive means for moving said auxiliary cam into the path of said spaced needles during non-consecutive revolutions of said cylinder, and lockout means controlled by said drive means for rendering said control means inoperative during a predetermined number of revolutions of said cylinder.

15. In a knitting machine, a needle cylinder, a series of needles carried in said cylinder, said series including a group of long butt needles and a group of short but needles, each group comprising a plurality of spaced needles having relatively long shoulders and the remainder having relatively short shoulders, a stitch forming cam device including a cam block, side cams and a center cam, driving means for actuating said cylinder to move said needles past said cam device, an auxiliary cam slidable in said cam block on the leading side of said center cam, said auxiliary cam being slidable from a position lying in the path of all of said shoulders, through a position in the path of said long shoulders only, to a position out of the path of all of said shoulders, and means controlled by said driving means for actuating said auxiliary cam.

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Disclaimer

2,306,207.—*Robert Evan Davis*, Fort Payne, Ala. KNITTING MACHINE. Patent dated Dec. 22, 1942. Disclaimer filed June 23, 1950, by the assignee, *The Davis Company*.

Hereby enters this disclaimer to claims 8, 9, 10, 12, and 13 of said patent.

[*Official Gazette July 25, 1950*]