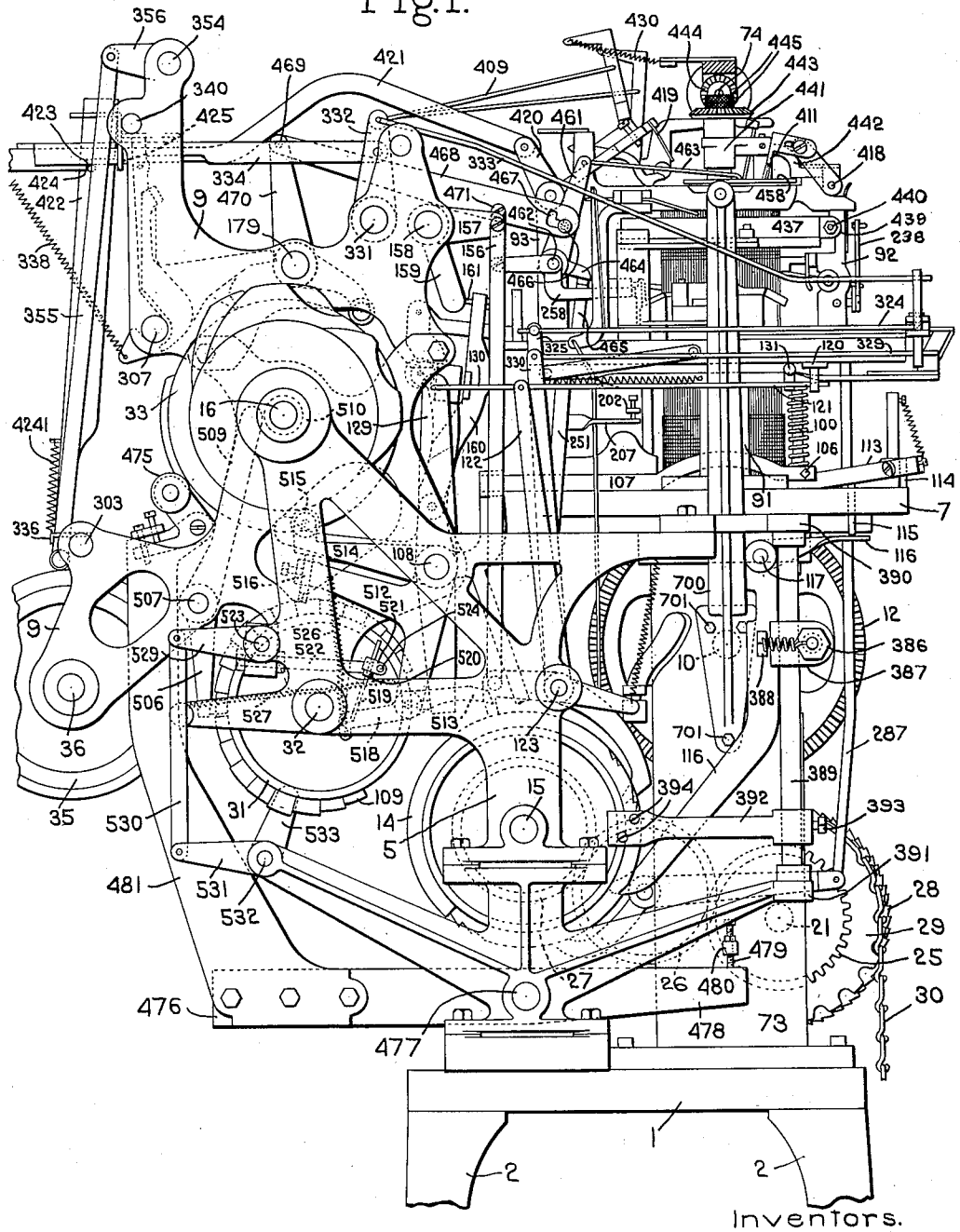
Jan. 30, 1934. P. P. LA MONTAGNE ET AL 1,945,227

KNITTING MACHINE

Filed July 22, 1930 19 Sheets-Sheet 1

Fig. 1.



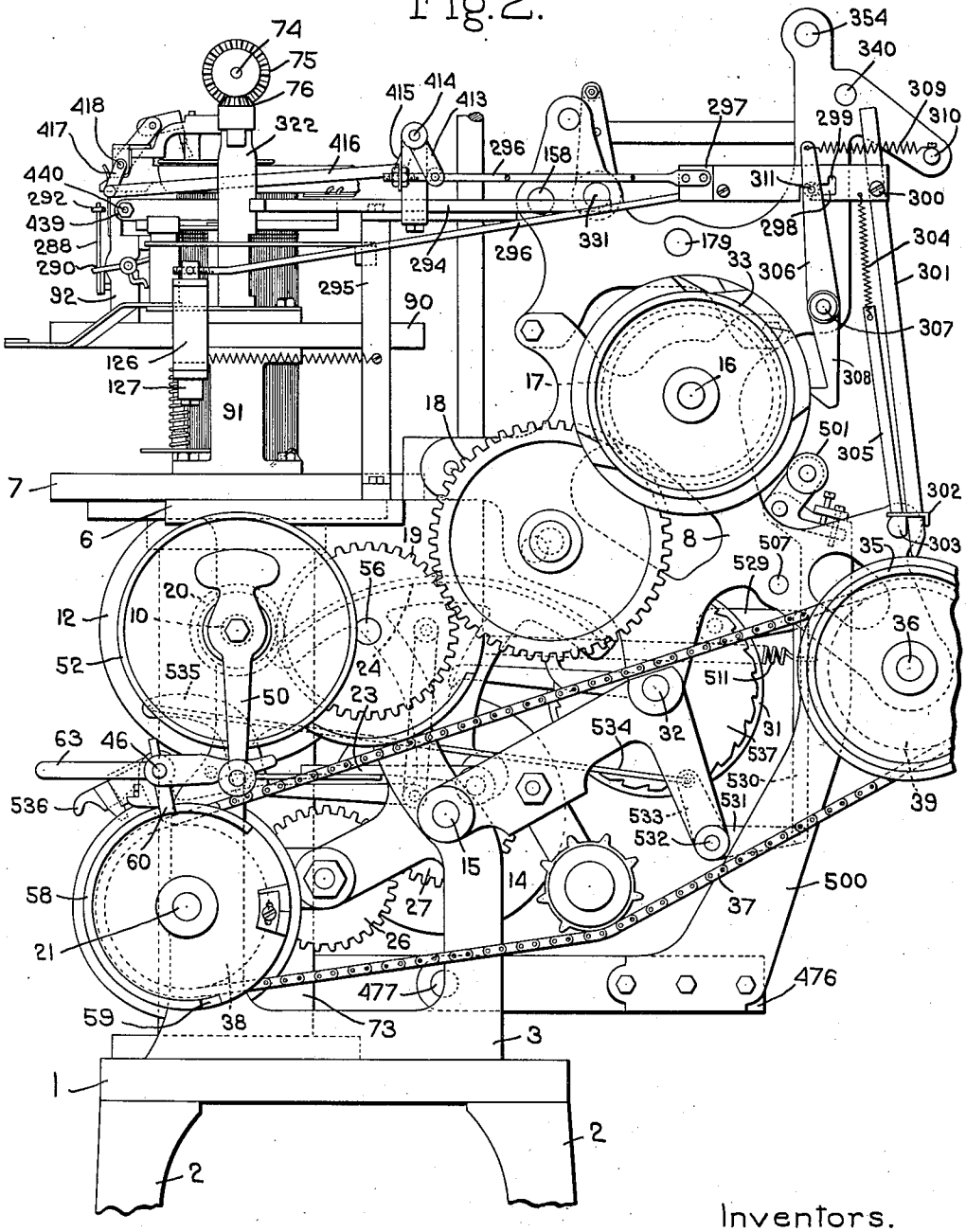
Inventors.
Patrick P. La Montagne
George H. Froemming
by Heard Smith & Tennant.
Attys.

Jan. 30, 1934. P. P. LA MONTAGNE ET AL 1,945,227

KNITTING MACHINE

Filed July 22, 1930 19 Sheets-Sheet 2

Fig. 2.



Inventors.
Patrick P. LaMontagne
George H. Froemming
by Heard Smith & Tennant.
Attys.

Jan. 30, 1934. P. P. LA MONTAGNE ET AL 1,945,227

KNITTING MACHINE

Filed July 22, 1930 19 Sheets-Sheet 3

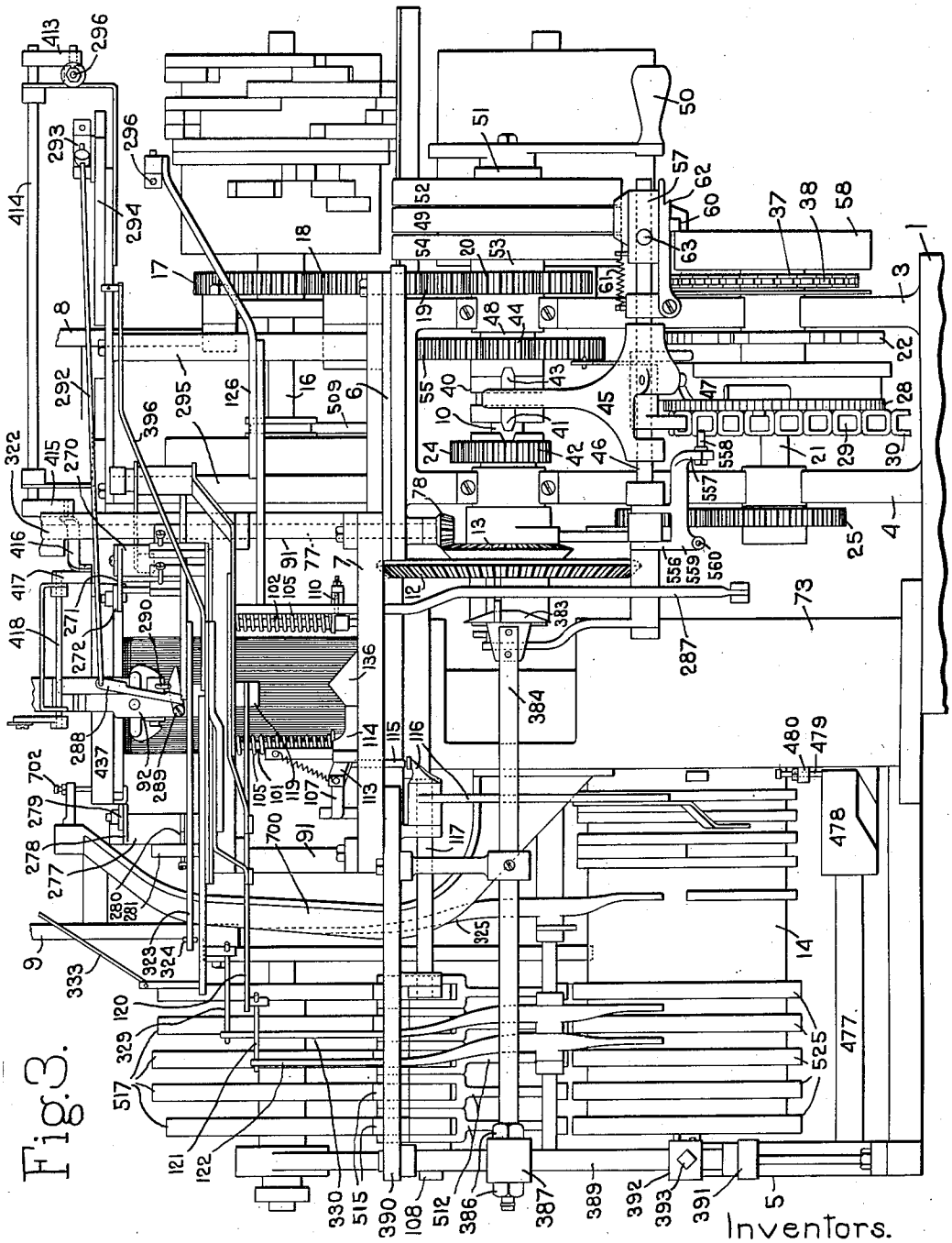


Fig. 3.

Inventors.
Patrick P. LaMontagne
George H. Froemming
by Heard Smith & Tennant.
Attys.

Jan. 30, 1934. P. P. LA MONTAGNE ET AL 1,945,227

KNITTING MACHINE

Filed July 22, 1930 19 Sheets-Sheet 4

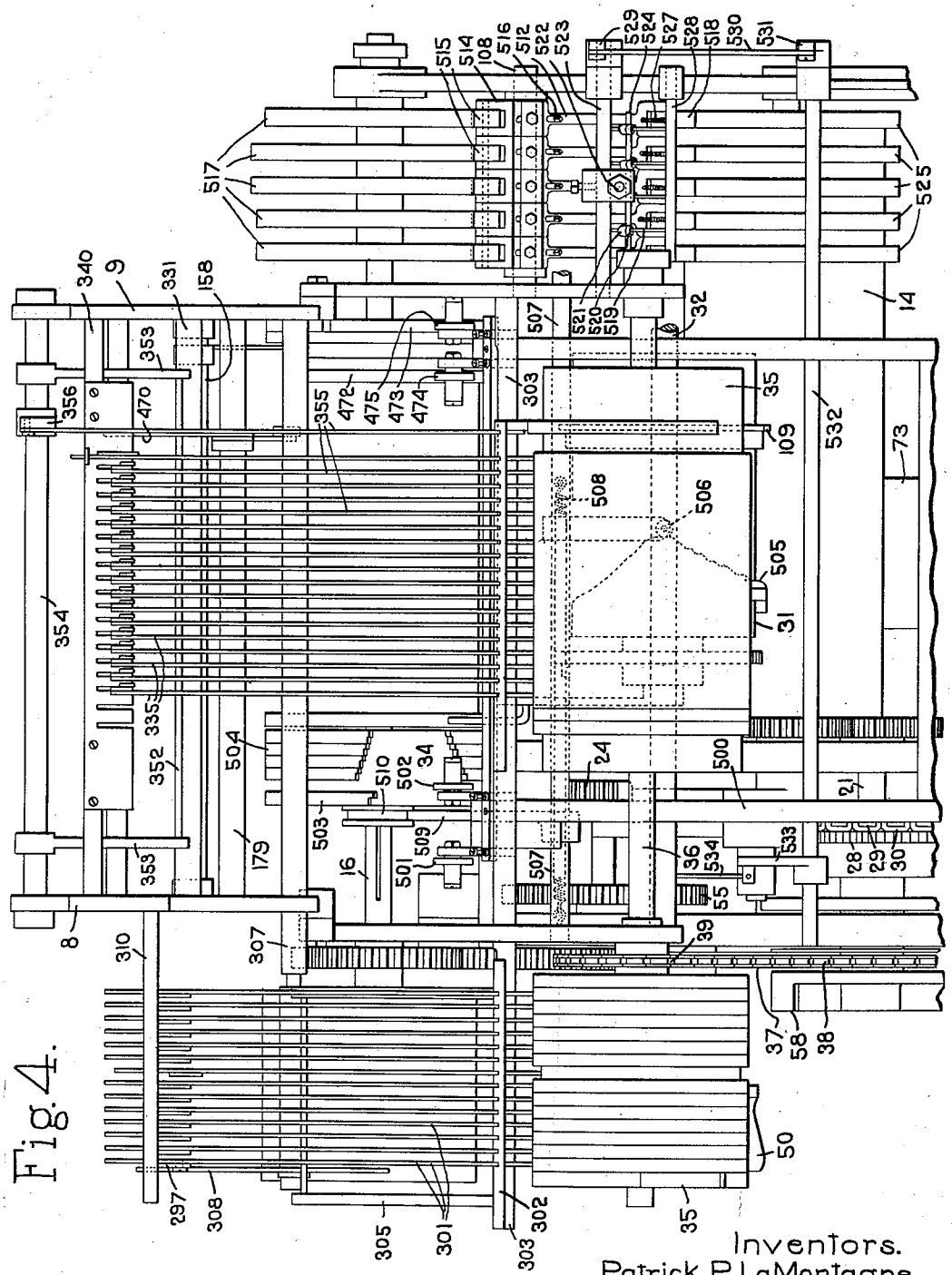


Fig. 4.

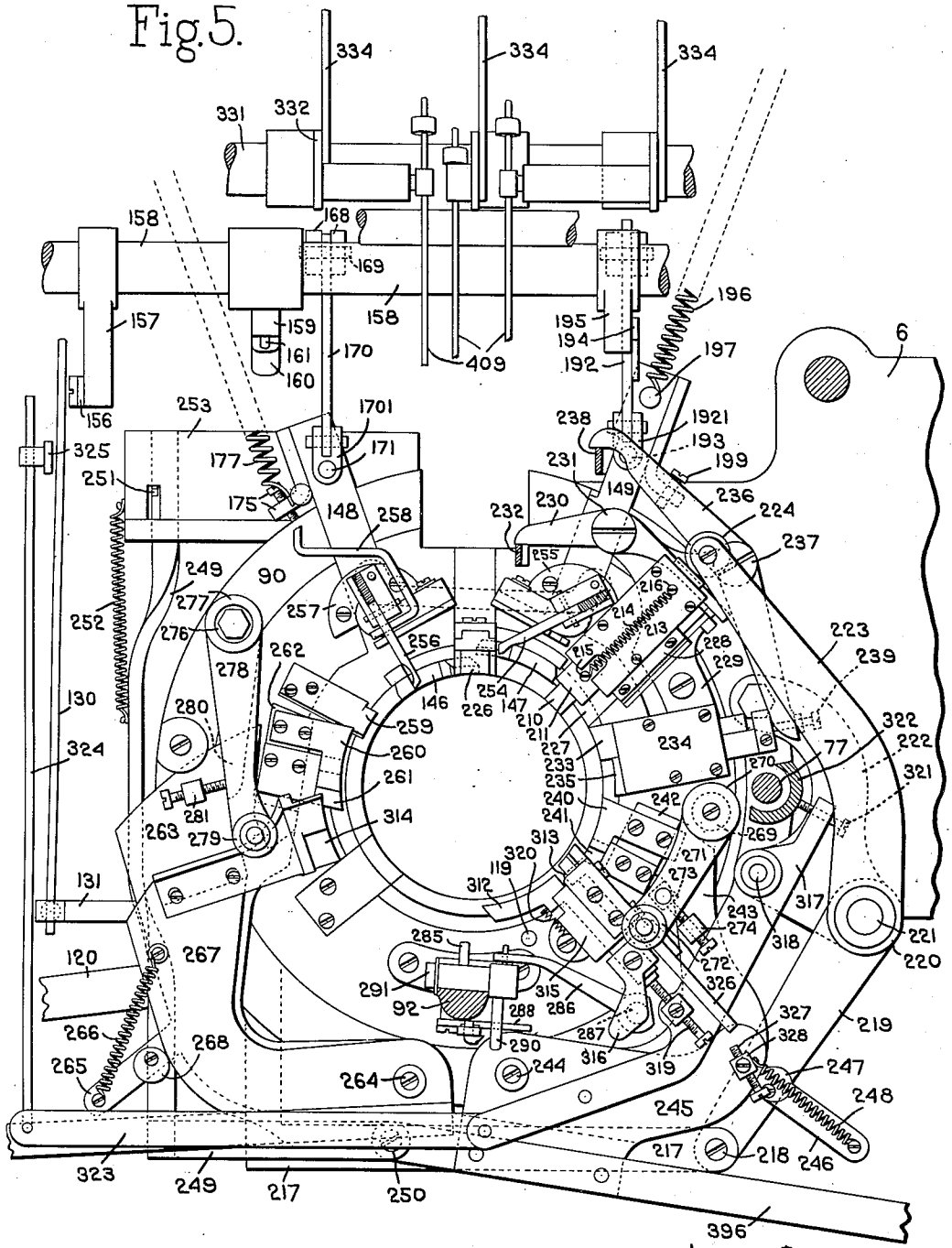
Inventors.
Patrick P. LaMontagne
George H. Froemming
by Heard Smith & Tennant.
Attys.

Jan. 30, 1934. P. P. LA MONTAGNE ET AL 1,945,227

KNITTING MACHINE

Filed July 22, 1930 19 Sheets-Sheet 5

Fig.5.



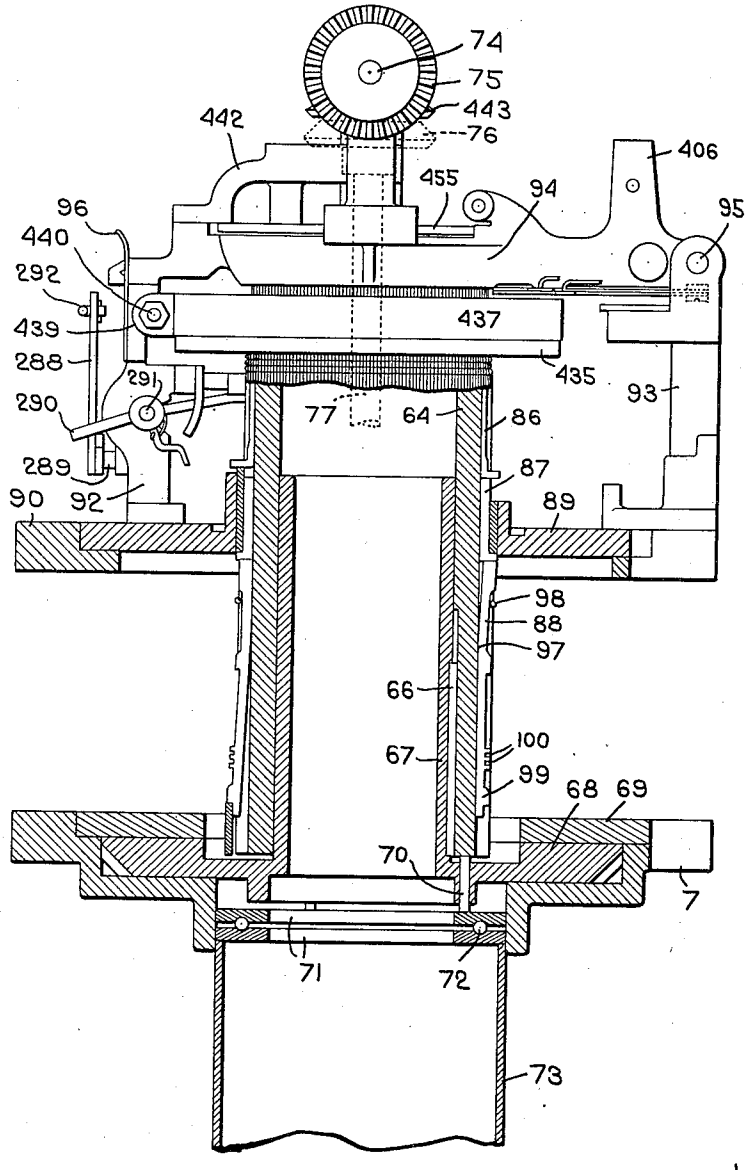
Inventors.
Patrick P. LaMontagne
George H. Froemming
by Heard Smith & Tennant.
Attys.

Jan. 30, 1934. P. P. LA MONTAGNE ET AL 1,945,227

KNITTING MACHINE

Filed July 22, 1930 19 Sheets-Sheet 6

Fig.6.



Inventors.
Patrick P. LaMontagne
George H. Froemming
by Heard Smith & Tennant.
Attys.

Jan. 30, 1934. P. P. LA MONTAGNE ET AL 1,945,227

KNITTING MACHINE

Filed July 22, 1930 19 Sheets-Sheet 7

Fig. 7.

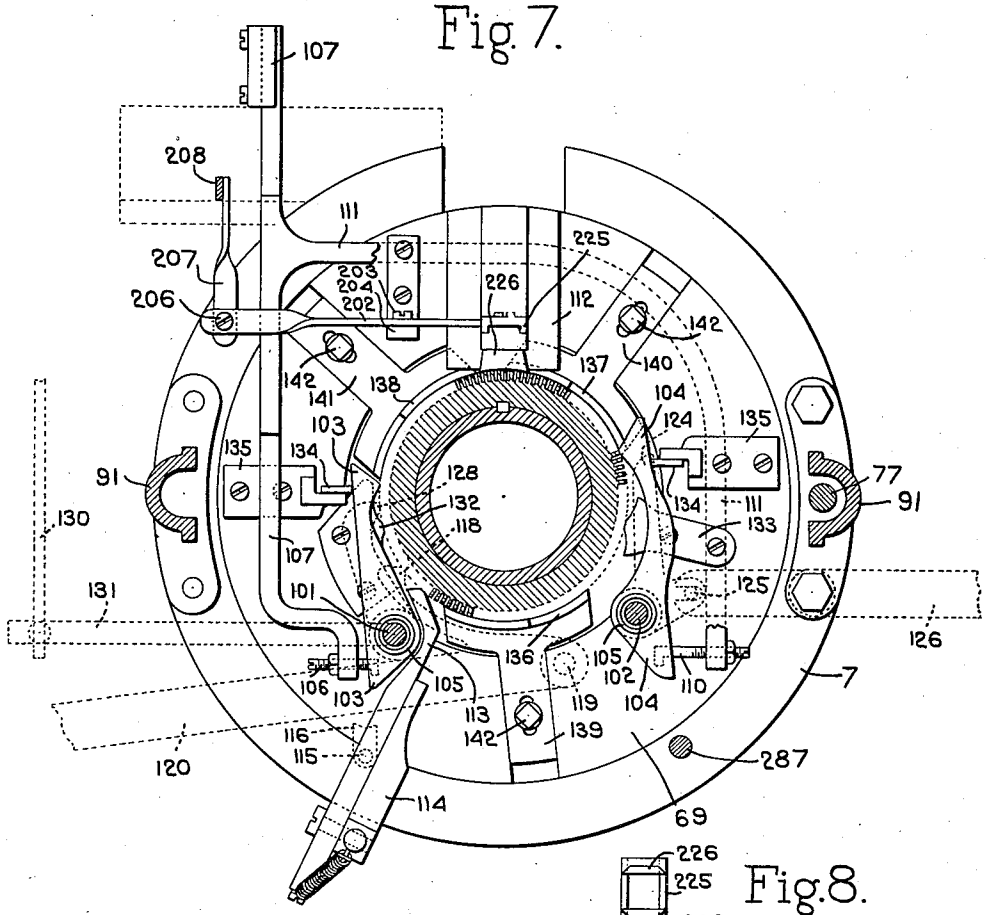
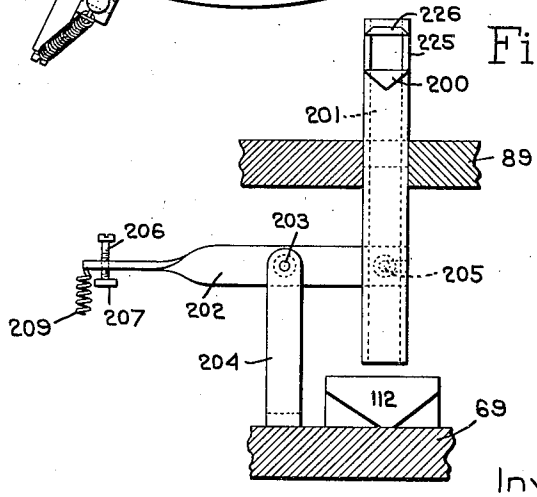


Fig. 8.



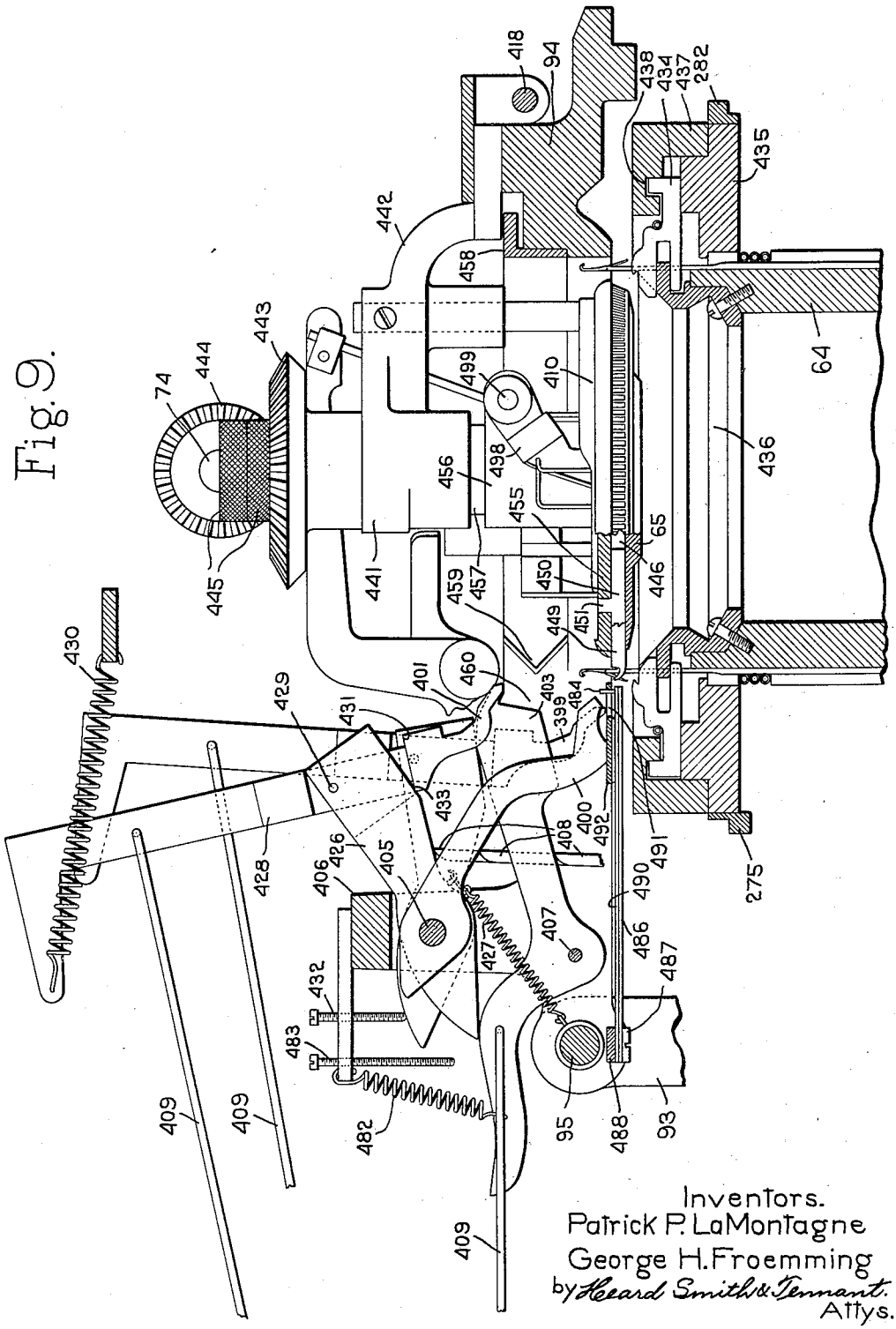
Inventors.
Patrick P. LaMontagne
George H. Froemming
by Heard Smith & Tennant.
Attys.

Jan. 30, 1934. P. P. LA MONTAGNE ET AL 1,945,227

KNITTING MACHINE

Filed July 22, 1930 19 Sheets-Sheet 8

Fig. 9.



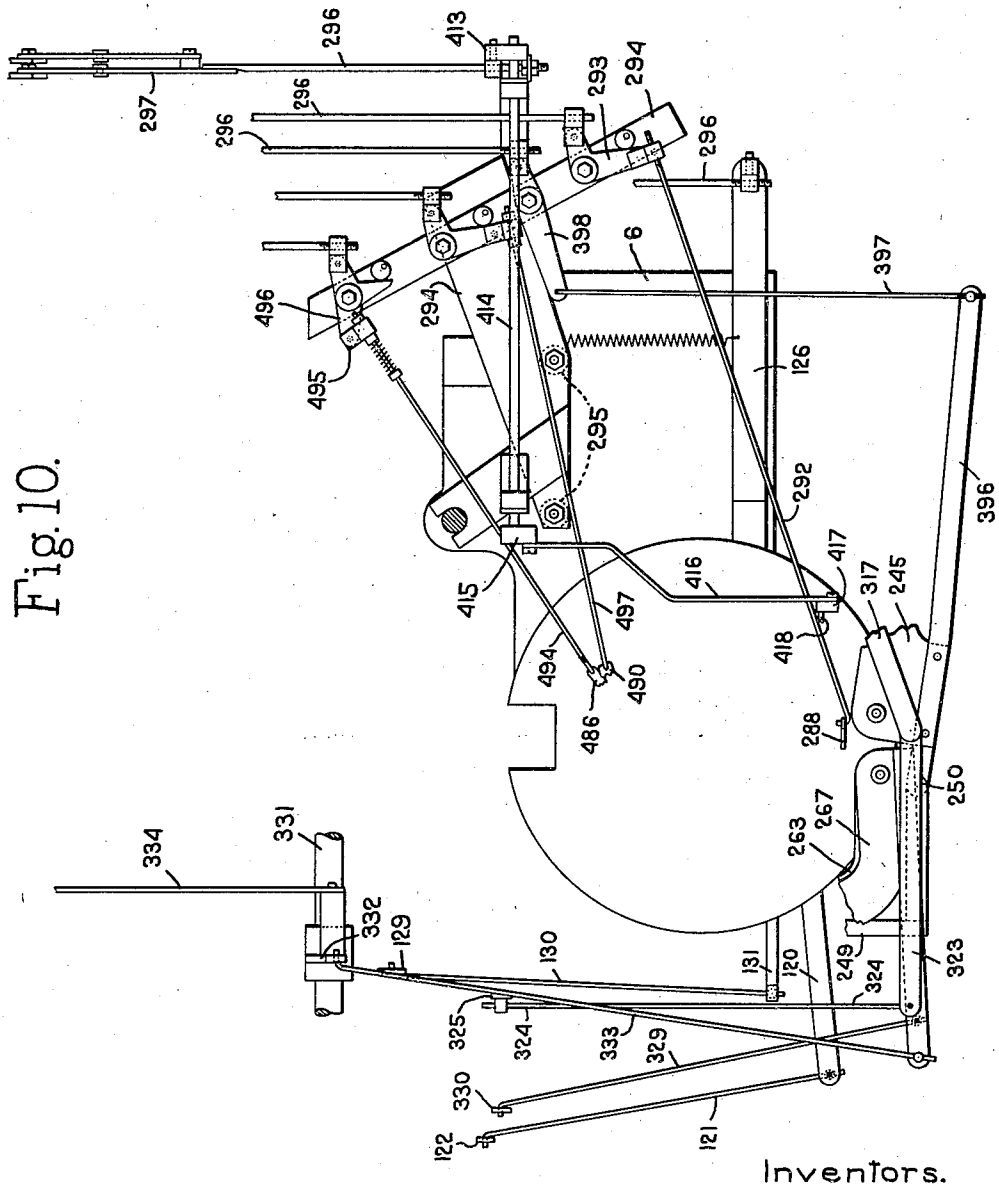
Inventors.
Patrick P. LaMontagne
George H. Froemming
by Heard Smith & Tennant.
Attys.

Jan. 30, 1934. P. P. LA MONTAGNE ET AL 1,945,227

KNITTING MACHINE

Filed July 22, 1930 19 Sheets-Sheet 9

Fig. 10.



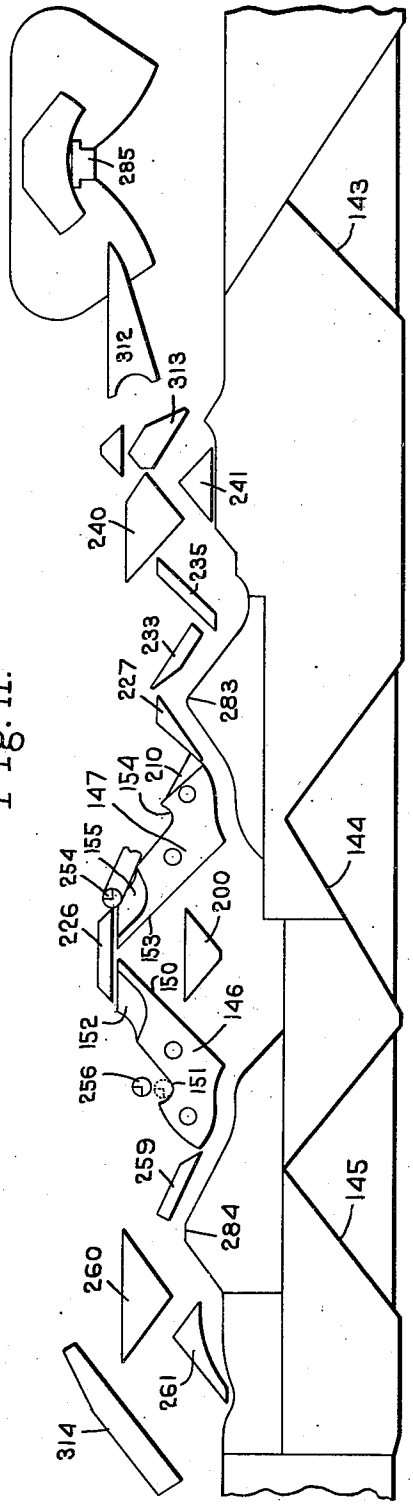
Inventors.
Patrick P. LaMontagne
George H. Froemming
by Heard Smith & Tennant.
Attys.

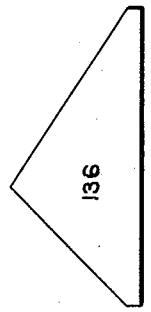
Jan. 30, 1934. P. P. LA MONTAGNE ET AL 1,945,227

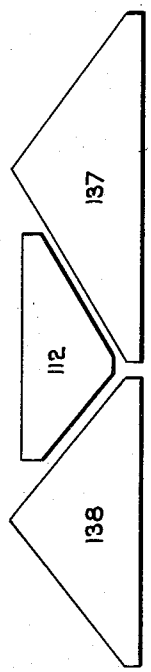
KNITTING MACHINE

Filed July 22, 1930 19 Sheets-Sheet 10

Fig. 11.







Inventors.
Patrick P. LaMontagne
George H. Froemming
by Heard Smith & Kennant.
Attys.

Jan. 30, 1934. P. P. LA MONTAGNE ET AL 1,945,227

KNITTING MACHINE

Filed July 22, 1930 19 Sheets-Sheet 11

Fig. 12.

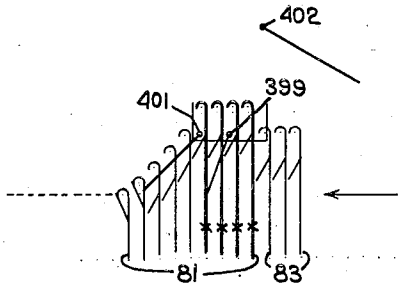


Fig. 13.

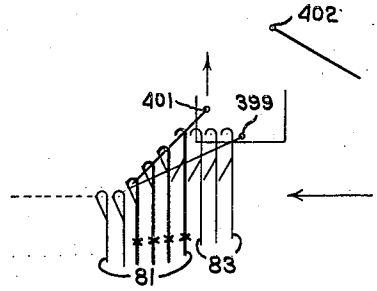


Fig. 14.

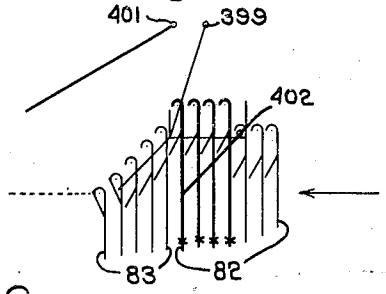


Fig. 15.

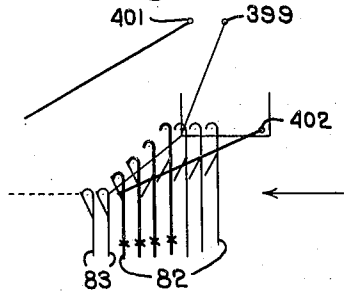


Fig. 16.

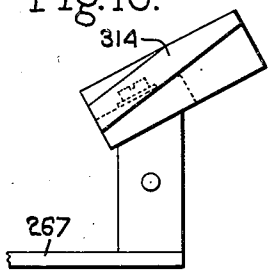


Fig. 17.

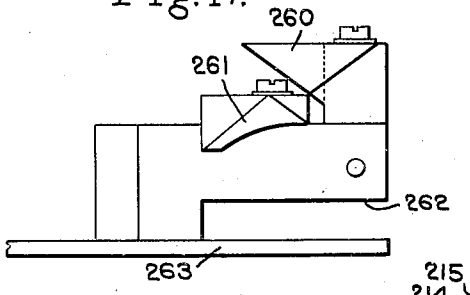


Fig. 18.

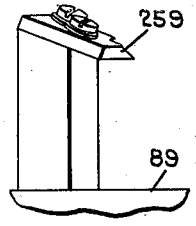


Fig. 19.

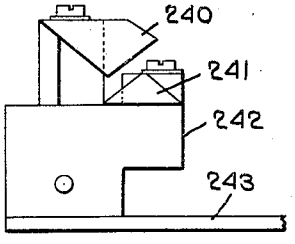
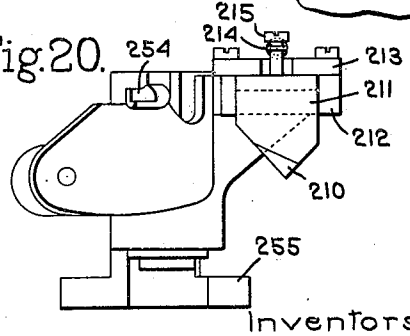


Fig. 20.



Inventors.
Patrick P. LaMontagne
George H. Froemming
by Heard Smith & Tennant.
Attys.

Jan. 30, 1934. P. P. LA MONTAGNE ET AL 1,945,227

KNITTING MACHINE

Filed July 22, 1930 19 Sheets-Sheet 12

Fig.21.

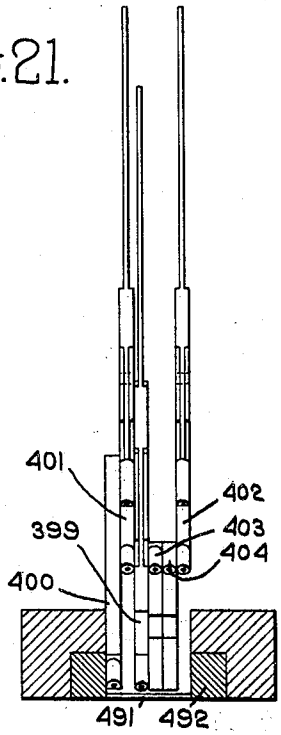
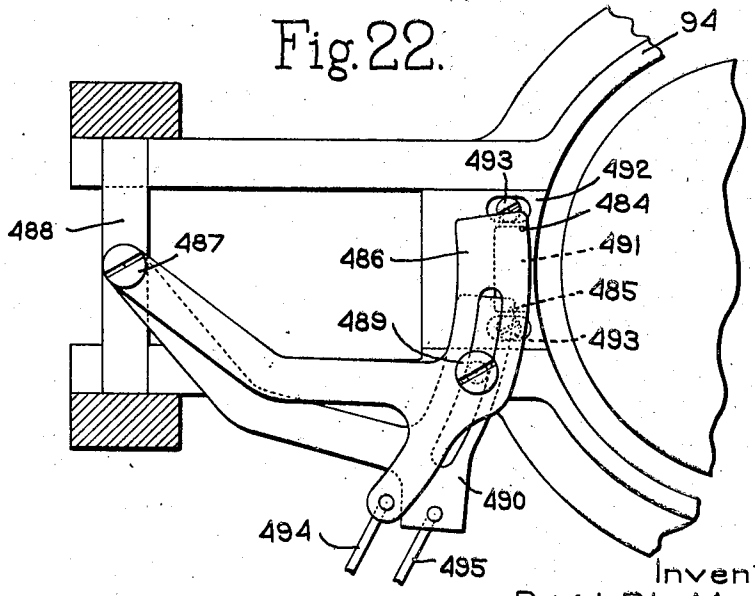


Fig.22.



Inventors.
Patrick P. La Montagne
George H. Froemming
by Heard Smith & Tennant.
Attys.

Jan. 30, 1934. P. P. LA MONTAGNE ET AL 1,945,227

KNITTING MACHINE

Filed July 22, 1930 19 Sheets-Sheet 13

Fig. 23.

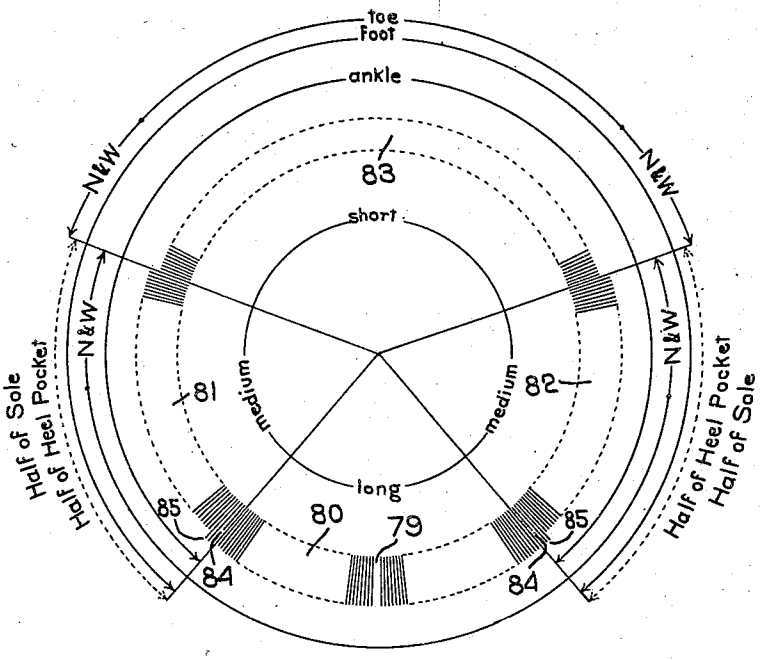
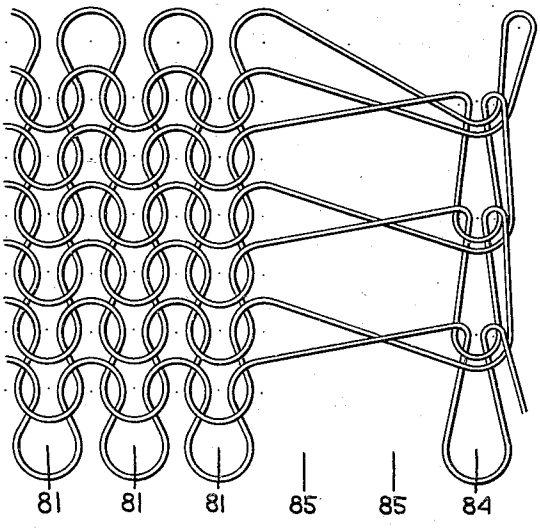


Fig. 24.



Inventors.
Patrick P. LaMontagne
George H. Froemming
by Heard Smith & Tennant.
Attys.

KNITTING MACHINE

Filed July 22, 1930 19 Sheets-Sheet 14

Fig. 25.

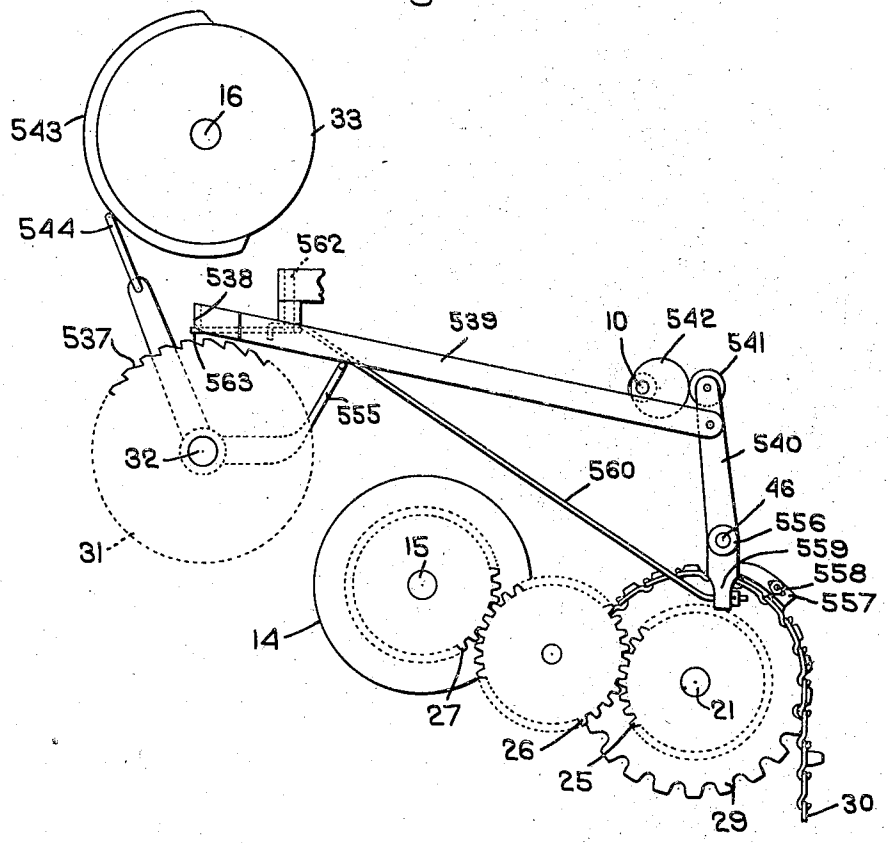
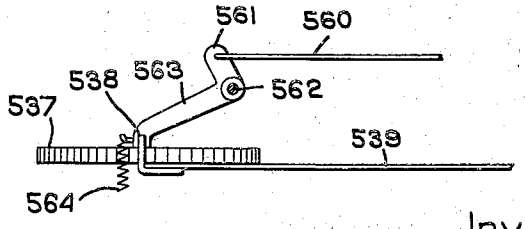


Fig. 26.



Inventors
Patrick P. LaMontagne
George H. Froemming
by Heard Smith & Tennant.
Attys.

Jan. 30, 1934. P. P. LA MONTAGNE ET AL 1,945,227

KNITTING MACHINE

Filed July 22, 1930 19 Sheets-Sheet 15

Fig. 27.

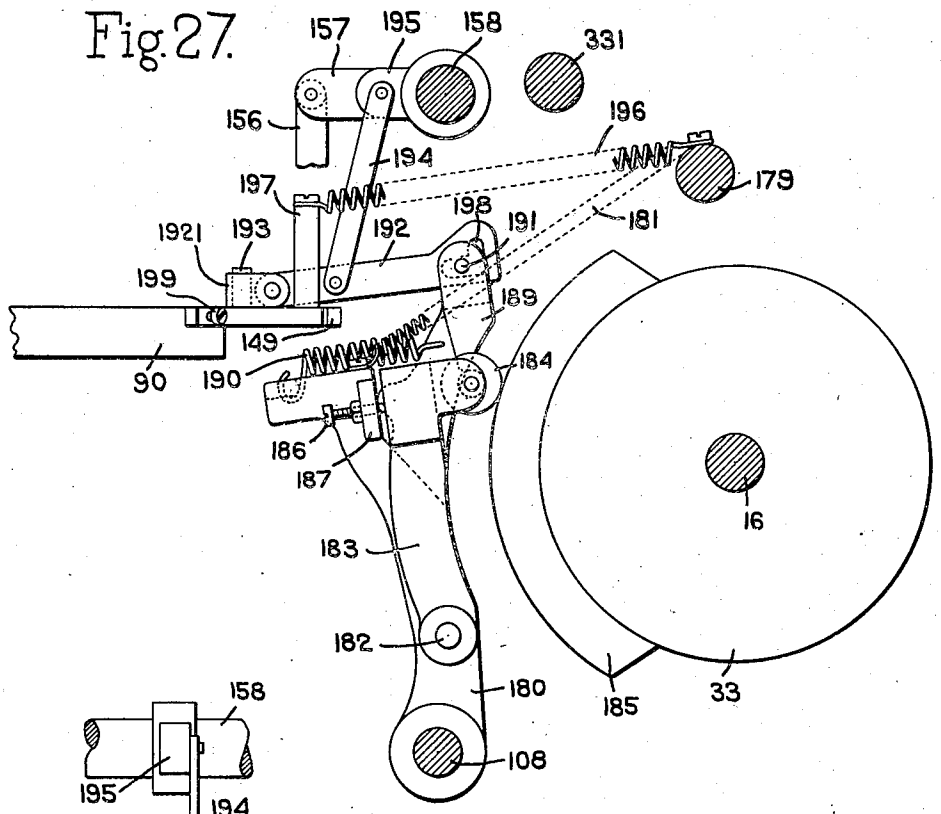
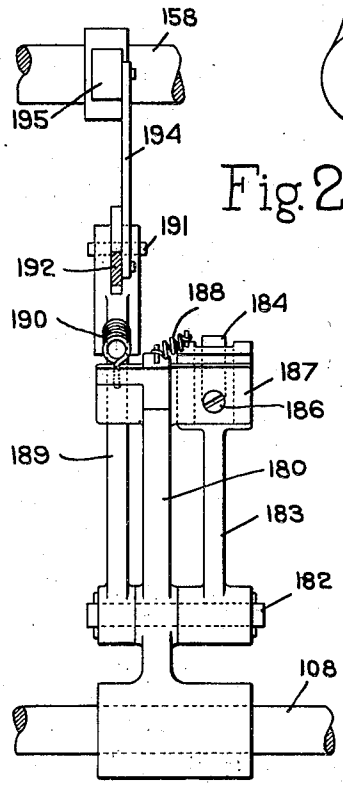


Fig. 28.



Inventors.
Patrick P. LaMontagne
George H. Froemming
by Heard Smith & Tennant.
Attys.

Jan. 30, 1934. P. P. LA MONTAGNE ET AL 1,945,227

KNITTING MACHINE

Filed July 22, 1930 19 Sheets-Sheet 16

Fig. 29.

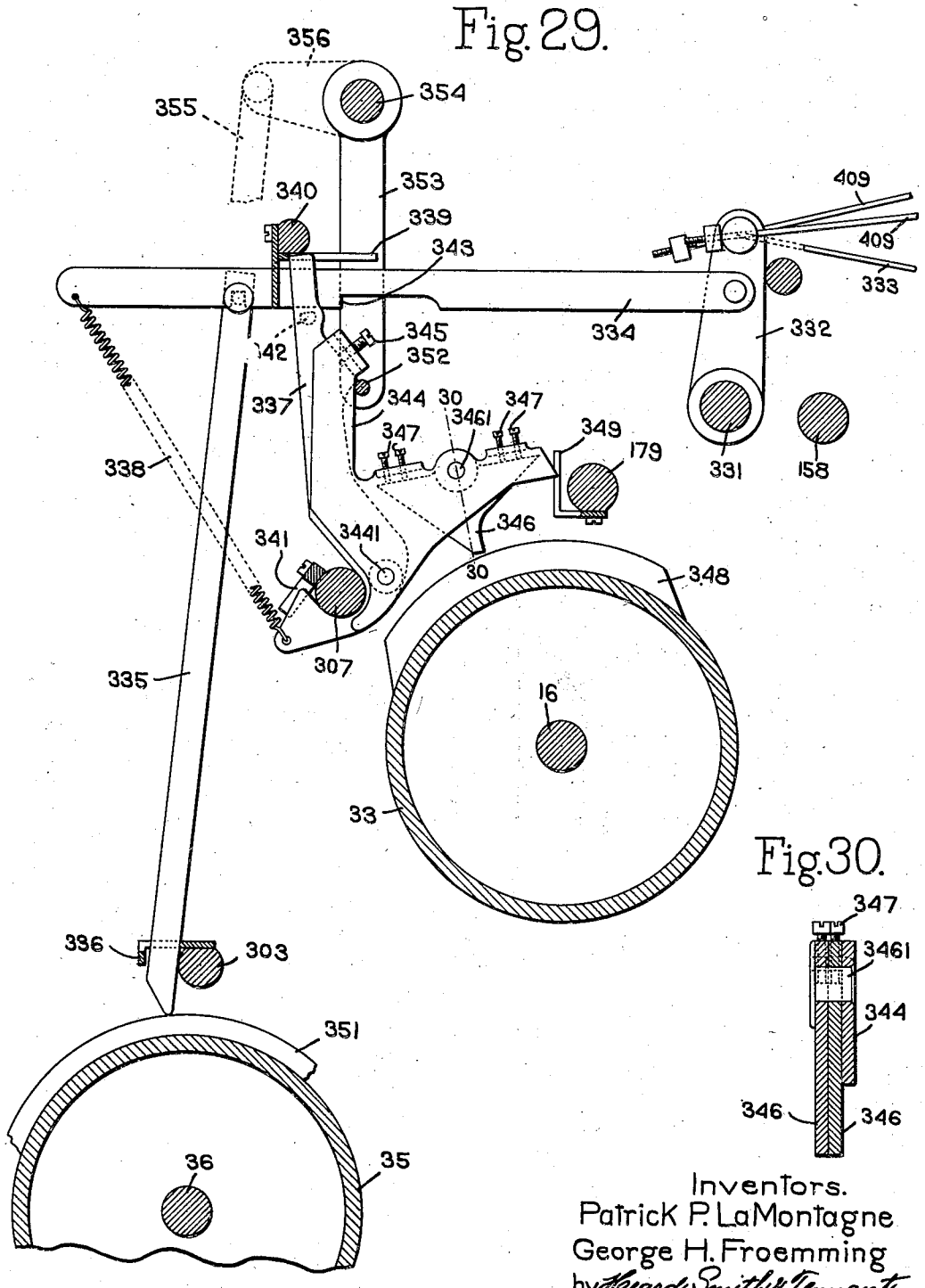


Fig. 30.

Inventors.
Patrick P. LaMontagne
George H. Froemming
by Heard Smith & Tennant.
Attys.

KNITTING MACHINE

Filed July 22, 1930 19 Sheets-Sheet 17

Fig.31.

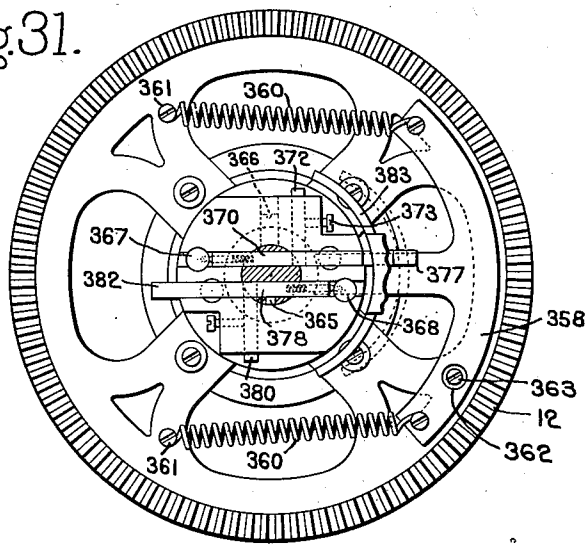


Fig.32.

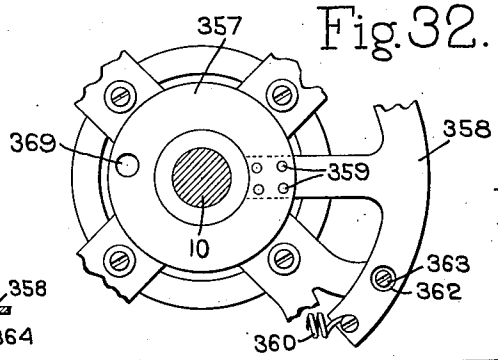


Fig.33.

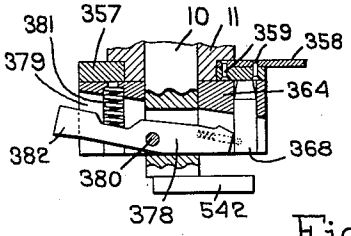


Fig.34.

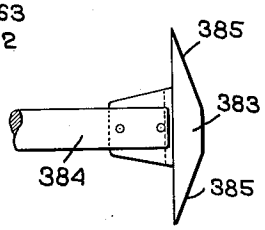
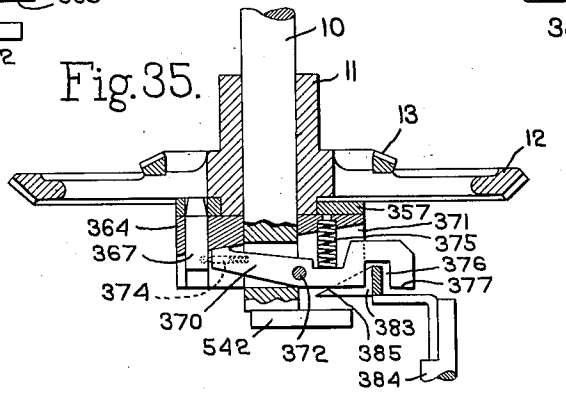


Fig.35.



Inventors.
Patrick P. LaMontagne
George H. Froemming
by Heard Smith & Tennant.
Attys.

Jan. 30, 1934. P. P. LA MONTAGNE ET AL 1,945,227

KNITTING MACHINE

Filed July 22, 1930 19 Sheets-Sheet 18

Fig.36.

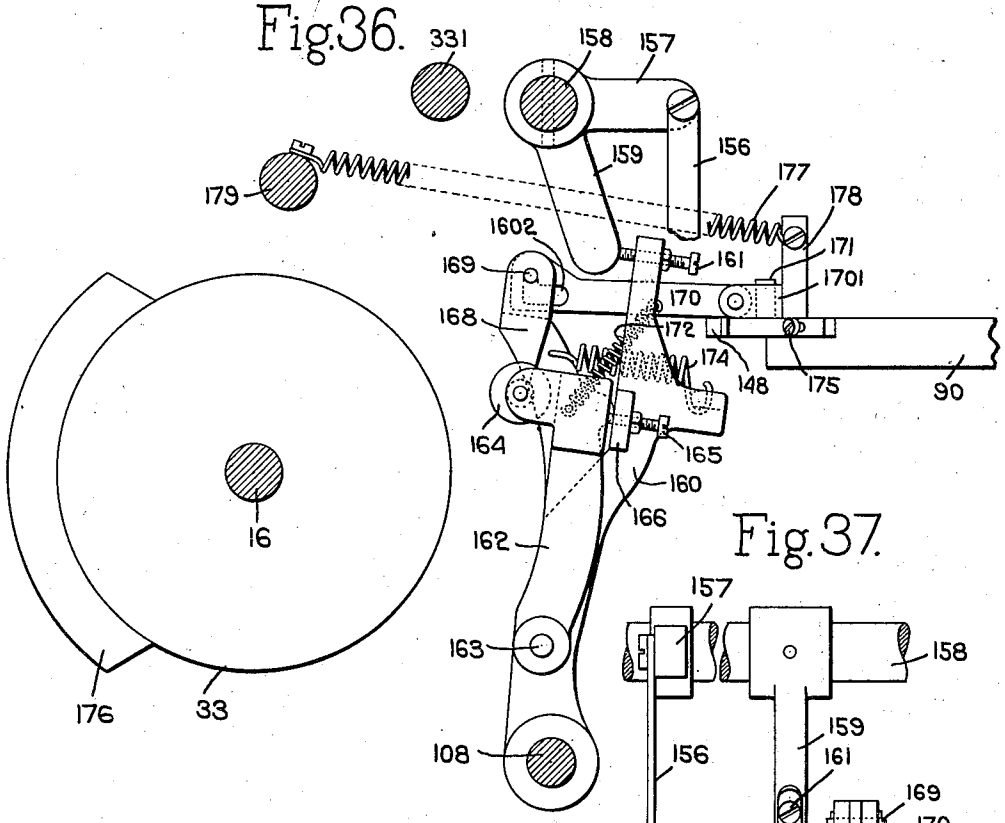
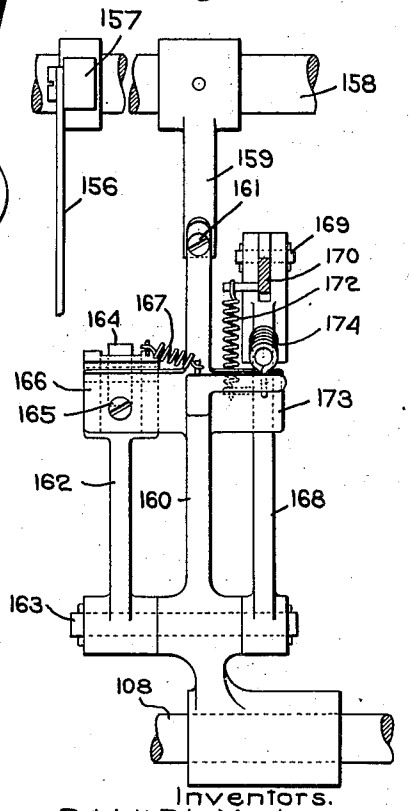


Fig.37.



Inventors.
Patrick P. LaMontagne
George H. Froemming
by Heard Smith & Tennant.
Attys.

Jan. 30, 1934. P. P. LA MONTAGNE ET AL 1,945,227

KNITTING MACHINE

Filed July 22, 1930 19 Sheets-Sheet 19

Fig.38.

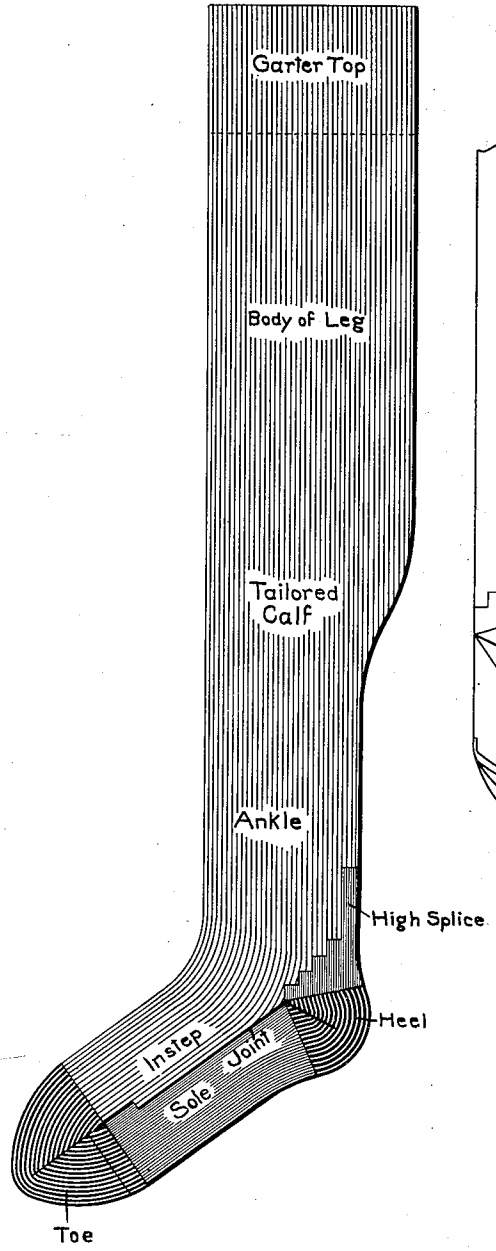


Fig.39.

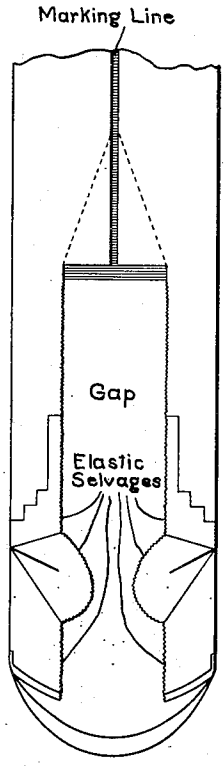


Fig.40.

Inventors.
Patrick P. LaMontagne
George H. Froemming
by Heard Smith & Tennant.
Attys.

Patented Jan. 30, 1934 1,945,227

UNITED STATES PATENT OFFICE

1,945,227

KNITTING MACHINE

Patrick P. La Montagne and George H. Froeming, Kankakee, Ill., assignors to La Montagne Machine Company, Kankakee, Ill., a corporation of Illinois

Application July 22, 1930. Serial No. 469,710

42 Claims. (Cl. 66—48)

This invention relates to a knitting machine of the circular type in which the knitting needles are reciprocated in a needle cylinder and in which the needle cylinder and the cam cylinder for controlling the operation of the needles are rotated and oscillated relatively to each other to enable round and round or to and fro work to be performed as required. In the preferred form of the invention, the needle cylinder is rotated and oscillated with respect to a fixed cam cylinder. While the machine is in many respects of broader application, it is more particularly designed for the knitting of a complete shaped or tailored stocking having the advantages of a full-fashioned stocking but capable of being produced far more economically and rapidly.

The invention has for its further object to provide means for knitting a complete stocking web beginning at the top so as to provide the desired garter top; a stocking web in which the toe pocket section is formed on the front of the web thus doing away with a seam across the top of the toe; a stocking web in which the web from the calf to the end of the toe is knit by to and fro knitting with a gap extending throughout the length of this section of the web at the back, thus providing the required shape.

The invention has for its further object to provide means for knitting such a stocking web in which both edges of the gap throughout their length are formed with an elastic selvage, thus rendering unnecessary any breaking of the yarn when the edges of the web are seamed or looped together.

The invention has for its further object to provide means for knitting the foot section of the web thus knit to and fro with sole sections and an instep section formed of different yarns and with a novel, durable joint of pleasing appearance between the sole and instep sections.

The invention has for its further object to provide means for knitting such a stocking web with a minimum waste of yarn and in which the only yarn wasted is that employed in the portion of the calf section cut away to tailor the web into the desired shape to fit the leg.

The invention has for its further object to provide in such a machine means for varying the length of stitch wherever required and particularly so as to provide different lengths of stitch in the knitting of the instep or sole sections of the foot.

The invention has for its further object to provide means for knitting with to and fro work the heel in two separate sections separated by the gap at the back of the web and with separate yarns fed to each of the heel sections.

The invention has for its further object to provide various novel mechanisms including means for operating and controlling a plurality of yarn guiding fingers, duplicatable mechanisms for operating and controlling various elements of the machine, means for absorbing the shock of the rotary shift in position of the needle cylinder with respect to the cam cylinder, means for preventing a yarn held out of action from being wrapped around the mechanism of the machine when a rotary shift of the needle cylinder takes place, means to prevent the severed ends of yarns held out of action from being knit into the web, means for controlling the length of stitch under all required conditions, various pattern-controlled mechanisms and other features giving the machine a high degree of flexibility and enabling it to perform a wide variety of work rapidly and efficiently.

These and other objects and features of the invention will appear more fully from the accompanying description and drawings and will be particularly pointed out in the claims.

The invention in some respects is an improvement upon the machine shown in the patent to La Montagne, No. 1,893 589, granted January 10, 1933, and embodies features disclosed in the patent to La Montagne, No. 1,695,734, granted December 18, 1928. Features of construction and operation not specifically described herein will be familiar to those skilled in the art and it is therefore unnecessary here to illustrate and describe various details of a knitting machine with which the present invention is not particularly concerned.

The drawings illustrate a preferred form of the invention as arranged for the knitting of a complete web for a woman's stocking beginning at the top and ending at the toe and, when complete, requiring only the tapering of the calf section and the seaming up of the edges of the web to produce a finished stocking shaped to the leg of the wearer.

In the drawings:

Fig. 1 is a side elevation looking toward the left of the machine.

Fig. 2 is a side elevation looking toward the right of the machine.

Fig. 3 is a view in front elevation of the main portion of the machine.

Fig. 4 is a view in rear elevation of the main portion of the machine.

Fig. 5 is a top plan view of the main portion

of the machine with the dial and its supports removed.

Fig. 6 is a view chiefly in central, vertical cross section taken through the cylinder.

Fig. 7 is a top plan view looking toward the lower bed plate and on a section taken below the upper bed plate.

Fig. 8 is a front elevation of the cam for forcing the pattern jacks inward, of the center cam with the means for raising and lowering it, and of the leveling cam.

Fig. 9 is a view in front elevation and partially in vertical section of the upper portion of the machine.

Fig. 10 is a schematic view showing various operating connections for operating various elements of the machine.

Fig. 11 is a development of the cams, pickers, dropper, etc., for controlling the needles, pattern jacks and restoring jacks.

Figs. 12 to 15, inclusive, are diagrammatic views illustrating in general the positions of the needles, yarn guiding fingers, and yarns in the formation of the joint between the instep and sole sections of the foot.

Fig. 16 is an elevation of one of the depressing cams and its mounting.

Fig. 17 is an elevation of a set of cams for preventing the needles from taking yarn during to and fro knitting and their mountings.

Fig. 18 is a view in elevation of a fixed cam and its mounting.

Fig. 19 is a view in elevation of another pair of cams similar to those shown in Fig. 17 and their mounting.

Fig. 20 is a view in elevation of a picker and a cam for raising the needles and their mountings.

Fig. 21 is a view in elevation and partially in vertical cross section looking toward the left of the machine showing the yarn guiding fingers and the throat.

Fig. 22 is a bottom plan view of a portion of the construction shown in Fig. 9 to show the mechanism for directing certain of the yarns into presenting position.

Fig. 23 is a diagrammatic view of a circular series of needles illustrating the preferred arrangement of the series of different length butt needles.

Fig. 24 is an enlarged detail showing the preferred construction of web with elastic selvage.

Fig. 25 is a view in side elevation showing the connections for intermittently driving the drum 31 from the main shaft under the control of the pattern drum 14 and of a cam on the drum 33.

Fig. 26 is a top plan view of a portion of the construction shown in Fig. 25.

Fig. 27 is a detail chiefly in side elevation of a mechanism for operating one of the stitch cams.

Fig. 28 is a rear elevation of a portion of the construction shown in Fig. 27.

Fig. 29 is a view principally in side elevation of a mechanism controlled by the drum 35 and operated by the drum 33 such as is employed in operating certain elements of the machine.

Fig. 30 is a detail in cross section taken on the line 30—30 of Fig. 29.

Fig. 31 is a side elevation looking toward the right showing the clutch connection between the driving shaft and the hub carrying the bevelled gears for driving the cylinder and dial.

Fig. 32 is a similar side elevation of a detail of the construction shown in Fig. 31.

Fig. 33 is a transverse section of a portion of the construction shown in Fig. 31 illustrating one of the clutching mechanisms.

Fig. 34 is a front elevation of a detail of the clutch operating arm.

Fig. 35 is a transverse cross section of the construction shown in Fig. 24.

Fig. 36 is a detail chiefly in side elevation of a mechanism for operating another one of the stitch cams.

Fig. 37 is a view in rear elevation of a portion of the mechanism shown in Fig. 36.

Fig. 38 is a side view of a preferred form of stocking such as is made by use of the machine.

Fig. 39 is a rear view of the main portion of a stocking web of a preferred construction knit by the machine and from which a stocking such as shown in Fig. 38 is formed.

Fig. 40 is a side elevation of the stocking web shown in Fig. 39 ready for tailoring and for seaming and looping.

The frame of the machine is shown as comprising the stand 1, supported from the floor by suitable legs 2. From this stand extends upward at the right the side frame 3, the intermediate frame 4, and, at the left, the skeletonized side frame 5. The frames 3 and 4 support the table 6 and from this table 6 extends laterally toward the left the bed plate 7, in which is mounted the cam cylinder. The frame 8 is supported from this table 6 and the side frame 3 and shafts extending from the side frame 5 to the frame 8 support the frame 9.

The main driving elements from which movement is imparted to the various instrumentalities concerned with the knitting operation and from which the various mechanisms are automatically controlled are: First; the main shaft 10 journalled in the frames 3 and 4. Second; the hub 11 carrying the bevelled gears 12 and 13 for revolving and reciprocating the needles according as round and round or to and fro knitting is required. Third; the pattern drum 14 with its shaft 15 journalled in the frames 3, 4 and 5 which automatically controls various operations and elements to be described and which is driven by separate mechanisms as required. Fourth; the drum shaft 16 journalled on the frames 5, 8 and 9 and driven by the train of intermediate gears 17, 18 and 19 from the pinion 20 on the main shaft 10. Fifth; the shaft 21 journalled in the frames 3 and 4 and driven by the rack wheel 22 secured thereto from the pawl 23, operated by the sector gear 24 (see Figs. 2 and 3) as in the aforesaid patents. This shaft 21 also at times drives the pattern drum shaft 15 by means of a train of gears, including the gear 25, on the shaft 21, the intermediate gear 26 journalled in the frames 3 and 4, and the gear 27 on the shaft 15. Sixth; the ratchet wheel 28 and attached sprocket wheel 29 loose on the shaft 21 and carrying the pattern chain 30 operated and controlled as in the aforesaid Patent No. 1,695,734. Seventh; the drum 31 with its shaft 32 journalled in the frames 5, 8 and 9 and driven from the main shaft under the control of both the pattern chain 30 and a drum 33 on the shaft 16. Eighth; the sliding drum 34 keyed to the shaft 16 and shifted thereon by the drum 31. Ninth; the selector drum 35 secured to the shaft 36 which is journalled in the frames 8 and 9 and driven from the shaft 21 through the chain 37 and sprockets 38 and 39. This selector drum is in effect an extension or enlargement of the

pattern drum 14 because it is geared by the sprocket chain 37 and sprockets 38 and 39 to the shaft 21, while this shaft in turn is geared by the gears 25, 26 and 27 to the shaft 15 of the pattern drum 14.

While the hub 11 with its gears 12 and 13 is rotarily shiftable on the main shaft 10, as hereinafter set forth, it is clutched to the shaft during the operation of the machine. The mechanism for rotating the main shaft 10 at different speeds and for oscillating the shaft when to and fro or reciprocating knitting is required (see Fig. 3) may be, and is shown as, of the same construction as in the aforesaid Patent No. 1,695,734. A clutch collar 40 is splined to the shaft 10 and is provided with tenons 41 adapted to engage depressions in the hub of the gear 42, and with tenons 43 adapted to engage depressions in the hub of the pinion 44. This collar 40 is shifted laterally by the slide 45 mounted on the rod 46 under the control of the cam 47 on the shaft 21. The pinion 44 is fast on a sleeve forming a journalled bearing for the shaft 10, and in turn journalled in a bushing 48 mounted on the side frame 3. This sleeve has fast thereto the pulley 49. A hand crank 50 is secured to the hub 51 of the pulley 49 and a loose pulley 52 is journalled on this hub. When, therefore, the clutch collar 40 is engaged with the pinion 44 and the driving belt is on the pulley 49, the bevelled gears 12 and 13 will be driven directly. A sleeve 53 is journalled on the bushing 48 and carries the pinion 20 and the pulley 54. The pinion 20 is connected by a gear train including the gears 19 and 55 on the shaft 56 to the pinion 44. Consequently, with the driving belt on the pulley 49 and the clutch collar 40 in engagement with the pinion 44, the speed of the drive will be determined by the gear train. The gear 42 is loosely mounted on the shaft 10 and meshes with the sector gear 24 which in turn is oscillated from the gear 55 (see Fig. 3) on the shaft 56 at a speed determined by whether the pulley 49 or 54 is driven by the belt. Consequently, if the clutch collar 40 be shifted to the left to engage the loose gear 42, that gear will be locked to the shaft 10 and the hub 11 with the bevelled gears 12 and 13 will be oscillated to effect reciprocating or to and fro knitting at the required speed. This mechanism for rotating or oscillating the main shaft and the bevelled gears 12 and 13 at the required speed is set forth in detail in the aforesaid Patent No. 1,695,734 and is familiar to those skilled in the art.

The right hand end of the rod 46 forms a slide bearing for a belt shipper 57 and the right hand end of the shaft 21 has secured thereto a drum 58 having a peripheral cam flange 59 acting upon a depending lug 60 of the belt shipper to shift the belt, not shown, from one to the other of the pulleys. The belt shipper is held against the face of the flange 59 by a spring 61. A latch 62 for locking the belt shipper with the belt on the loose pulley and a handle 63 for manually moving the belt shipper are provided. This mechanism may be as illustrated in detail in the aforesaid patent.

The knitting needles, which may be of the usual pivoted latch type, are mounted in grooves on the exterior surface of the needle cylinder 64 and with the needles are associated in the grooves of the cylinder pattern jacks (see Fig. 6) of a type similar to those shown in the patent to Grothey, No. 1,678,385, July 24, 1928. The needle cylinder is mounted to rotate and to oscillate with respect to the actuating cams which are relatively fixed. So also the transfer implements (see Fig. 9), which may be of the type shown in the patent to Scott, No. 1,282,958, October 29, 1918, are mounted in radial grooves on the top surface of the interior dial 65 which rotates and oscillates with respect to the relatively fixed dial cams. The needle cylinder 64 is keyed at 66 to an extended hub 67 of the bevelled gear 68 having a bearing seat in the bed plate 7 and held in place by the cam ring 69. This gear 68 meshes with and is driven by the bevelled gear 12 on the hub 11. The knitted web descends through a central opening formed in the hub 67 and gear 68. The needle cylinder 64 (see Fig. 6) is supported upon hardened steel pins 70 which rest on bearing rings 71 separated by ball bearings 72. These bearing rings in turn rest upon the top of the tubular column 73 mounted for vertical movement in the stand 1. Consequently, by raising or lowering the tubular column 73, the length of the stitch may be varied as and when desired.

The interior dial 65 (see Fig. 9) in which the transfer implements are mounted, has its vertical shaft geared to the transverse shaft 74 and this shaft is driven by a bevelled gear 75 thereon meshing with a pinion 76 on the vertical shaft 77 which at its lower end (see Fig. 3) carries the bevelled gear 78 meshing with the bevelled gear 13 on the hub 11 so that the dial is rotated and oscillated with the needle cylinder all in a familiar manner.

The machine in the preferred form illustrated is particularly designed for knitting continuously a stocking web beginning at the top and ending at the toe upon a single circular series of needles. By beginning at the top and knitting round and round work, it is alone possible to form with the co-action of the needles and the transfer implements the so-called "garter top" or inturned welt which is essential to a high grade stocking.

In Figs. 38, 39, and 40 of the drawings is illustrated one preferred type of stocking web as knit by the machine and a completed stocking formed therefrom. The legends on these figures, together with the description which follows, will make clear the construction of the web and stocking.

Such a preferred form of web beginning at the top comprises the following sections: First; a leg section which is knit continuously with round and round knitting on the circular series of needles. This leg section in turn comprises (*a*) the garter top or inturned welt section, (*b*) a section of the desired size for the body of the leg, (*c*) a section for the calf which is tailored or shaped by cutting therefrom a portion of the web in finishing the stocking. Second; an ankle section knit as a continuation of the leg section but by to and fro knitting on a segment of the circular needles. This ankle section may comprise (*a*) an upper ankle section of plain knitting and (*b*) a lower ankle section presenting at the back a suitable spliced area such as that required for a high spliced heel. Third; heel pocket sections knit as a continuation of the web by to and fro knitting on separated segments of needles at the back of the series. Fourth; a foot section knit as a continuation of the web by to and fro knitting and presenting at the side of each edge an area formed by different yarn than is used in the rest of the foot so that the completed stocking has a sole formed from one yarn, for example, cotton, and the instep is formed from another

yarn, for example, silk. Fifth; a toe pocket section knit as a continuation of the web by to and fro knitting on a segment of the needles at the front of the series so as to eliminate any transverse seam at the front of the web or in the completed stocking at the top over the toes.

A gap is thus left in the web, by the to and fro knitting, extending throughout the ankle, heel pocket, and foot sections at the back of the web enabling these sections, when seamed together, to conform to the size of the ankle and foot. An important feature of the invention resides in the formation throughout this entire gap of a selvage at each edge thereof. These selvage edges extend through the heel pocket sections and thus there is no continuous flotation of yarn across the gap separating these sections to be cut away and wasted. Furthermore, this invention provides for the formation of an elastic selvage throughout which is of great importance because it renders unnecessary breakage of the yarn at the edges with its danger of injury to the web preparatory to the seaming operation.

A circular series of knitting machine needles and the arrangement for knitting a web having the foregoing sections are illustrated in Fig. 23. This series is shown as divided into segments with the needles in the different segments distinguished by the lengths of their butts by which the operation of the needles is controlled in the machine. Needles having three lengths of butts are preferably employed and are herein distinguished as long butt needles, short butt needles and medium butt needles.

Before proceeding to a description of the preferred form of mechanism illustrated for knitting the stocking web, the general nature of the operations performed may be stated as follows: The leg section is first knit by round and round knitting upon the entire circular series of needles, the garter top or inturned welt being formed in the well known manner. Preferably one or more needles may be omitted at 79 in the middle of the back or the center of the segment 80 of long butt needles to form a marking line for the back seam.

The segment 80 of long butt needles is then thrown out of action casting off the stitches and the needles of this segment thereafter remain out of action, leaving a gap at the back of the web and thereby reducing the web to a width which when seamed together will produce an ankle and foot section of desired size.

The calf section is tailored to give the proper shape by cutting out a generally triangular section of the web above the gap. When the calf section has been completed and after the long butt needles 80 are thrown out of action, the round and round knitting is preferably continued for a few courses, floating the yarn across the gap to form a small holding section to prevent the knitted web, above the gap, from ravelling back when the web is held or stretched preparatory to removing the required portion of knit web to tailor or shape the calf section.

After the knitting of the entire leg section, including the calf section, is completed, and preferably after the small holding section, just referred to, has been completed, the entire remainder of the web is knit by to and fro knitting. In this to and fro knitting the ankle section is first knit, as indicated in the diagram, upon the entire segment of needles remaining in action including the segments 81 and 82 of medium butt needles at opposite sides of the series and the intermediate segment 83 of short butt needles at the front of the series.

In the formation of the elastic selvage at each edge of the gap in the web, the segments 81 and 82 each preferably includes a short butt needle 84 at the gap end of the segment and immediately adjacent one or more, preferably two, long butt needles. The operation of these needles in forming the elastic selvage will appear later.

The lower portion of the ankle section is also spliced as required by throwing in yarns during the to and fro knitting at each side of the gap so as to produce a spliced area at each side of the gap. This area may present at its edge in the knitted web any desired configuration, thus producing any desired type of spliced or high spliced heel. As will appear, the splicing yarn is so knit into the web that no fringes, cut ends of yarn, or other unsightly construction appears at the edges of the spliced areas.

It will be noted that the holding section constituted by the yarn floating across the gap during the latter part of the round and round knitting extends to the beginning of to and fro knitting and that consequently the length of the holding section depends upon the period in which the long butt needles 80 are thrown out of action. So also the length of the spliced area in the ankle section depends upon the period in which the splicing yarns go into action during the to and fro knitting and while this spliced area must extend at least through the lower portion of the ankle section, its upper limit may be located at any point upon the conclusion of the courses of round and round knitting so that the length of the holding section may vary as desired.

At the conclusion of the knitting of the ankle section with its spliced area, the segment 83 of short butt needles at the front of the series is thrown out of action retaining the stitches and the heel pocket is then formed in two separated sections by to and fro knitting upon the two segments 81 and 82 of the medium butt needles remaining in action. During the formation of the heel pocket sections, the needles at the front of each segment 81 and 82 are operated to perform the narrowing and widening operation. During the to and fro knitting for the heel pocket sections, two yarns are used, one for the segment 81 and the other for the segment 82, thereby eliminating continuous floating of the yarn across the gap at the back where the segment 80 of long butt needles is out of action.

It will be noted that the to and fro knitting employed in the knitting of the ankle section is across the front of the web, while the knitting of the heel pocket sections is across the back of the web. This is accomplished by automatically shifting the hub 11, with respect to the driving shaft 10, 180° at the beginning of the heel pocket sections.

At the conclusion of the knitting of the heel pocket sections, the segment 83 of the short butt needles, which are holding their stitches is restored into action, the hub 11 is again shifted 180° with respect to the driving shaft 10 and to and fro knitting is continued at the front of the web on the segments 81 and 82 of medium butt needles and the segment 83 of short butt needles to knit the foot section in the same manner as the ankle section.

The invention enables the foot section to be knit with different types of yarn and particularly enables the upper or instep portion of the

foot section to be knit with one type of yarn, such, for example, as silk, while the sole or lower portion of the foot section is knit with another type of yarn, such as cotton, thus giving the desired appearance to the instep and the desired strength to the sole. In the preferred form of the invention, means to be described later in detail are provided for automatically presenting the required different kinds of yarn to these segments. The silk yarn, which is preferably that used in forming the body of the stocking, is thrown in to form the instep on the segment 83 of the needles and cotton yarns are thrown in to form the sole sections on the segments 81 and 82.

Another feature of the invention resides in the formation of a strong, durable joint of pleasing appearance between the instep and sole sections. For this purpose the yarns are controlled at the time of change from one to the other so that throughout the line of joint and over a space of a plurality of needles, for example, four, these yarns are alternately knit in and alternately float at the interior of the web. Preferably also, as the joint between the instep and sole section at each side approaches the toe section, it is shifted transversely further into the instep section so as to produce the so-caled guarded toe. Preferably also, before the knitting of the toe section is actually begun, the instep or silk yarn is cut out and the entire web formed with the cotton yarn for a few courses. Throughout the entire foot section the elastic selvages are formed at the gap.

At the conclusion of the knitting of the foot section, the segments 81 and 82 of medium butt needles are thrown out of action, retaining the stitches and to and fro knitting continues on the segment 83 of short butt needles which are now alone in action with the usual narrowing and widening operation performed upon the needles of this segment at each edge and thus the toe pocket section is knit at the front of the web.

At the conclusion of the knitting of the toe pocket section, it is usually desirable to restore the segments 81 and 82 of medium butt needles to action and knit on them and also on segment 83 of short butt needles a few courses of to and fro knitting, which are subsequently ravelled out when the web is stitched and looped together.

The construction and operation of the mechanism for selecting and controlling the movements of the needless is shown as on the principle of that disclosed in the patent to Grothey, No. 1,678,385, above referred to. Each groove in the needle cylinder 64, with the possible exception of the grooves where the needles are omitted at 79, contains a needle 86, a restoring jack 87, and a pattern jack 88. (See Fig. 6). The cams which act directly upon the pattern jacks to raise and lower the same are carried by the cam ring 69 mounted in the bed plate 7. The cams and devices, which act upon the restoring jacks and upon the needle butts, are carried by the plate or cam ring 89, mounted in the upper bed plate 90, which is supported from the bed plate 7 by the posts 91. As in the aforesaid Patent No. 1,695,734, the post 92 secured to the cam ring 89 and the brackets 93 secured to the bed plate 90 support the latch ring 94 pivoted at 95 to the top of the bracket 93 and releasably held by the catch 96 to the top of the post 92.

The cams and devices for acting upon the needle butts, upon the butts of the restoring jacks, and upon the butts of the pattern jacks are shown developed in Fig. 11. The pattern jacks 88 (see Fig. 6) rock upon a fulcrum point 97, at their inner edge and are held in place by the usual spring band 98. These jacks have at their lower ends the butts 99 to cooperate with the cams carried by the cam ring 69. Above the butts 99 these jacks are provided with an outer straight edge which is broken away or cut in to form notches or depressions of various lengths and position such as 100. Consequently a selector acting upon this straight edge will hold the jacks in the grooves with the butt 99 out of engagement with the cams, but when the selector is positioned opposite a notch, according to the desired control, the lower end of the jack may swing outwardly to cause its butt to cooperate with the cams. The selector mechanism for controlling the pattern jacks is shown as to its chief elements in Fig. 7. Two vertical posts 101 and 102 extend between the cam ring 69 and the cam ring 89 and upon these posts are mounted respectively the selector blades 103 and 104. These blades are moved downward by the helical springs 105. The blade 103 is moved upward against its spring by a screw 106 extending beneath it from the end of lever 107, fulcrumed on the shaft 108 supported in the side frames 5, 8 and 9. This lever has two extensions (see Fig. 1) from it, one of which cooperates with the step cam 109 on the drum 31, and the other with a step cam on the pattern drum 14, so that under the control of one or the other of these step cams the selector blade 103 may be moved to any desired vertical position. In similar manner, the selector blade 104 is operated by a screw 110 extending beneath it from the end of an arm 111 carried by the lever 107.

A cam 112 (see Fig. 11) secured to the cam ring 69 at the rear acts upon the outer faces of the pattern jack butts as they pass in either direction to force the lower ends of the pattern jacks inward.

Another selector blade 113 is pivotally mounted on a bracket 114, secured to the bed plate 7, and is controlled by a pin 115 which is actuated by a lever 116 fulcrumed at 117 (see Fig. 1) in a bracket beneath the bed plate 7, the lever 116 having an extension to cooperate with a cam on the pattern drum 14.

An upper selector blade 118 is fulcrumed on a stud 119 depending from the cam ring 89 and has an extension 120 which is connected by a rod 121 (see Figs. 1 and 10) to a follower lever 122 fulcrumed on the shaft 123 in the frames 4 and 5 and controlled by the pattern drum 14. This upper selector blade 118 is rocked on its fulcrum to force the upper ends of the pattern jacks inward and consequently the lower ends outward.

Another upper selector 124 similar in action to the one just described is fulcrumed on the post 102 provided with a pin 125 engaging a slot in the end of a lever 126 fulcrumed at 127 on the under side of the upper bed plate 90. This lever is connected by a rod 296 (see Figs. 2 and 10) to suitable mechanism controlled by the drums 33 and 35 to be described.

A cam 128 secured to the upper end of the post 101 having its effective end forward of the effective end of the selector blade 103 acts against the upper ends of the pattern jacks to force them inward and consequently to force the lower ends outward. The mechanism for operating the cam 128 includes a bell crank lever 129 (see Figs. 1 and 10) fulcrumed on the shaft 108, one end of the bell crank being actuated from a suitable cam on the rotating drum 33, the other end being con-

nected by a rod 130 to an extension 131 from the post 101.

A restoring cam 132 secured to cam ring 69 acts forward of the cam 128 to force the lower ends of the pattern jacks inward when the cylinder is rotating in one direction. Another restoring cam 133 secured to the cam ring 69 acts forward of the cam 124 to force the lower ends of the pattern jacks inward when the cylinder is rotating in either direction. Vertical guides 134 secured to the brackets 135 mounted on the cam ring 69 serve to maintain the active ends of the selector blades 103 and 104 in vertical paths.

The cams for raising the pattern jacks when the lower ends of the pattern jacks are outward are shown as three in number 136, 137 and 138 (see Figs. 7 and 11), and are carried by slides 139, 140 and 141 mounted in radial grooves in the cam ring 69 and held in the required adjustment by bolts 142.

It will thus be seen that there is presented by the mechanism thus described a very flexible arrangement for selecting as required by the different sections of the knitted web the needles required in the various operations, both during round and round and during to and fro knitting. Any pattern jack which under the control of the selecting mechanism is left with its lower end projecting outward as it passes one or the other of the cams 136, 137 and 138 is raised thereby, thus raising the restoring jack and the needle above it in its groove. This arrangement with the control of the needles by the various cams and devices acting upon the needle butts enables all the desired operations readily and automatically to be performed as desired.

The restoring jacks 87 which act to move the pattern jacks downward in their grooves are controlled by cams carried by the cam ring 89 and shown at 143, 144 and 145 in the development in Fig. 11, these cams being located respectively above the cams 136, 137 and 138 which raise the pattern jacks.

The cams and devices for operating the needles by their butts are shown in the upper portion of the development of Fig. 11, and for the most part in the plan view in Fig. 5. A number of novel features are here employed in order to enable the machine to knit the desired character of web. The machine in knitting the ankle and foot must have a relative to and fro or reciprocatory movement between the needle cylinder and cams of a very much greater angle than usually employed in knitting to and fro work. When knitting to and fro work in the formation of the ankle, foot and toe pocket sections of the stocking, the knitting takes place at the front of the web, while in the knitting of to and fro work to form the heel pocket, which is knit in two separated sections, the to and fro work takes place at the back of the web.

In order that the stitch cam shall function properly at the stitching point during both round and round and to and fro knitting of the extent and character here described, it is necessary to make the stitch cam in two parts, to provide means for holding one part out during round and round knitting and means for alternately moving the two parts in and out during reciprocating knitting. For this reason two stitch cams 146 and 147 are provided and mounted respectively upon the generally radially movable slides 148 and 149 mounted in the bed plate 90 and cam ring 89. The stitch cam 146 presents the cam surface 150 for depressing the needle butts when the needles are moving toward the left, viewing Figs. 5 and 11, the pocket 151 to receive the end of the picker when depressed, and the pocket 152 to receive the picker when elevated. The stitch cam 147 is provided with generally similar cam surfaces and pockets 153, 154 and 155. The needles to be raised by the pickers are in all cases selected and raised into the path thereof by the pattern jacks.

In order to move the stitch cam 146 as required in the knitting operation the slide 148 upon which it is mounted is controlled by suitable connections both from the pattern drum 14 and from the drum 33. A thrust bar 156 (see Fig. 1) operated by suitable cams on the pattern drum 14 is pivotally connected at its upper end to an arm 157 secured to the shaft 158 extending transversely at the back of the machine and journalled in the side frames. This shaft has secured to it a depending arm 159. An arm 160 journalled on the shaft 108 is provided at its upper end with an adjusting screw 161 abutting the arm 159. An arm 162 is journalled on the shaft 163 mounted in the arm 160, is bifurcated at its upper end and has journalled therein a roll 164. The arm 162 is held yieldingly against a screw 165 in an extension 166 from the arm 160 by the spring 167 (shown in Fig. 37 but omitted in Fig. 36). An arm 168 also journalled on the shaft 163 carried by the arm 160 is bifurcated at its upper end and carries a pin 169 engaging a slot 1602 in a link 170 that is pivoted to a block 1701 swivelled on a post 171 carried by the slide 148. The slot 1602 in the link 170 is of such a shape that the link may be disengaged manually from the pin 169 in order to make adjustments or repairs, it normally being held in engagement with the pin by the spring 172. The arm 168 is held in contact with an extension 173 of the arm 160 by the spring 174. A stop screw 175 on the cam slide 148 limits the inward movement of the stitch cam. A spring 177 secured at one end to a post 178 on the slide 148 and at the other end to the shaft 179 functions to withdraw the stitch cam from knitting position at the proper time.

During round and round knitting the mechanism described remains in the position shown in Fig. 36, the thrust bar 156 on a high part of the cam on the drum 14 having rocked the shaft 158 to bring the arm 159 against the screw 161 thereby holding the stitch cam in knitting position, and keeping the roll 164 out of engagement with the cam 176 on the drum 33.

When, however, to and fro knitting takes place and the stitch cam 146 has to be moved in and out as the direction of reciprocation changes, the control of the slide 148 carrying the stitch cam is transferred to the cam 176 on the drum 33 which, it will be remembered, is always rotated in one direction by the geared connection to the main shaft. At this time the thrust bar 156 is lowered or drops on to a low part of the cam on the drum 14, thus rocking the shaft 158 to take the arm 159 away from engagement with the screw 161 allowing the spring 177 to withdraw the stitch cam from knitting position and allow the roll 164 to be acted on by the cam 176 to move the stitch cam in and out.

The other stitch cam 147 and its slide 149 are controlled in a similar manner, but in this case it will be remembered that the slide 149 is not to be moved in during round and round knitting. An arm 180 (see Figs. 27 and 28) is fulcrumed on the shaft 108 and is connected to the shaft 179 by a spring 181. Journalled on the shaft 182 mounted

in the arm 180 is the follower arm 183 carrying in its bifurcated end the roll 184 engaging the cam 185 on the drum 33. The arm 183 is held against the screw 186 in a lateral extension 187 from the arm 180 by a spring 188 (shown in Fig. 28 but omitted in Fig. 27). An arm 189 is also journalled on the shaft 182 carried by the arm 180 and is held in contact with a lateral extension on the arm 180 by the spring 190. The arm 189 has its upper end bifurcated and carrying a pin 191 extending through an L-shaped slot 198 in a link 192. This link is pivoted to a block 1921 swivelled on a post 193 on the cam slide 149 and the position of the pin 191 in the slot 198 is controlled by the link 194 which connects the link to the arm 194 secured to the shaft 158. A spring 196 secured at one end to a post 197 on the slide 149 and at the other end to the shaft 158 acts to keep the slide with its stitch cam out of knitting position.

During round and round knitting the mechanism described will be in the condition shown in Fig. 27 with the stitch cam 147 withdrawn and, while the roll 184 is being acted on by the cam 185, no movement is imparted to the slide because the pin 191 is riding in the lower part of the slot 198 in the link 192. When, however, the thrust bar 156 is lowered, as when to and fro knitting is to take place, the shaft 158 is rocked and through the arm 195 and the link 194 lowers the link 192 and the vertical part of the slot 198 in the link 192 is locked onto the pin 191. The cam 185 acting on the roll 184 now, in conjunction with the spring 196, moves the slide 149 in and out through the connections described.

It will be observed that both of the stitch cams when moved inward by the cams on the drum 33 are thus moved through a yielding connection. In the case of the stitch cam 146, the arm 168 is moved inward by the follower roll 164 through the medium of the interposed spring 174 (see Fig. 36) until the stop 175 engages the bed plate 90 and the stitch cam is in knitting position, and in the case of the stitch cam 147, the arm 189 is moved inward by the follower roll 184 through the medium of the interposed spring 190 (see Fig. 27) until the stop 199 engages the bed plate 90. Thus in both cases the stitch cams are moved yieldingly into position which is advantageous in case of any improper operation or in case the stitch cams should meet any obstruction when moved into knitting position.

The cam ring is provided with the usual fixed raising cams 283 and 284 at either side of the stitch cams.

The center cam 200 located between the stitch cams is required during a portion of the round and round knitting and also during to and fro knitting. This cam 200 (see Figs. 7 and 8) is mounted on a vertical slide 201, which is guided on an upright 225 supported from the cam ring 89. A lever 202 fulcrumed at 203 on a post 204 secured to the plate 69 has a pin and slot connection 205 with the slide 201 and at its other end carries an adjustable screw 206 resting upon the offset end 207 of a thrust bar 208. A spring 209 connects the lever 202 to a fixed portion of the machine and thus holds it in contact with the thrust bar. The thrust bar is operated by suitable cams on the pattern drum 14.

A fixed cam 226 is located at the top of the upright 225 to act as a levelling cam during the formation of the heel and toe.

When round and round knitting is performed, the stitch cam 147 is withdrawn and consequently a cam is provided to raise the needles sufficiently to carry the latches through the loops before they reach the stitch cam 146. For this purpose the cam 210 is provided and remains in action, excepting when the stitch cam 147 is in action. This cam (see Fig. 20) is conveniently carried by a radial slide 211, mounted in a slideway formed in a projecting portion 212 of the support for the adjacent picker. A cover plate 213 holds the slide in place. A spring 214 connecting a stud 215 on the slide to a stud 216 on the cover plate acts to retract the cam. The cam is moved into position and held therein by a thrust bar of the usual type, not shown, operated by the pattern drum 14, which operates an angular arm 217 loosely pivoted at 218 to the lever arm 219 projecting from a sleeve 220 fulcrumed on the post 221 carried by a bracket 222 bolted to the bed plate 90. A lever arm 223 secured to the sleeve 220 carries a roller 224 abutting the outer end of the cam slide 211. Consequently when the thrust bar is raised by the pattern drum, the cam 210 is moved into position, and when the thrust bar is lowered, the spring 214 withdraws the cam from position.

In the knitting of the garter top or inturned welt, three cams are employed (see Figs. 5 and 11) which are controlled and operated in a manner similar to corresponding cams shown in the aforesaid Patent No. 1,282,958. The first cam 227 acts to divide the needles raised by the pattern jacks as determined by the selector blade 113 from those not raised so that the needles raised will pass above the cam 227 and receive yarn, while those not raised will be deflected down by the cam 227 so as not to receive yarn. This cam 227 is mounted to slide radially in a slideway 228 mounted in a bracket 229 secured to the cam ring 89. A lever 230 is fulcrumed at 231 on the bracket and is operated by a thrust bar 232 controlled by the pattern drum 14 to move the cam 227 into position when required against the action of a spring, not shown.

The second cam 233 is brought into action for a short period to limit one of the operations to a single course and is moved in only sufficiently far to act upon the long butt needles and causes all the long butt needles, as they pass this cam, to be raised thereby into yarn receiving position. This cam 233 is mounted in the slideway 234 in which is also mounted the third cam 235 which is a transfer cam for depressing alternate needles selected by the pattern jacks. The two cams 233 and 235 both slide radially in the slideway 234 and are operated by a single lever 236 fulcrumed on a projection from the bracket 229 at 237. This lever is operated by the thrust bar 238 controlled by the pattern drum 14 and has an adjustable set screw 239 in its end abutting a projection on the slide of the cam 235. In one position of the thrust bar the cam 235 moves inward and carries the cam 233 into position to engage the long butt needles, but leaves the cam 235 out of engagement with any of the other needles. In another position of the thrust bar the cam 235 is carried further inward so as to act upon the butts of all lengths, the cam 233, at this time, having no function although moved further inward.

When it is desired to form the commencement of the gap at the back of the web with a few courses of floating yarn so as to prevent the web above the gap from ravelling back, it is necessary to prevent the long butt needles from taking yarn and necessary to cause them to cast off the yarn

during these courses of round and round knitting. For this purpose the cams 240 and 241 (see Figs. 5, 11 and 19) are provided, the latter cam raising all the needles sufficiently to push their latches up through the loops and the former cam then drawing down all the needles sufficiently to bring them into the path of the cam 227, which causes the long butt needles to be drawn down to cast off their stitches; while at this time, the medium and short butt needles are not affected by this cam 227, but pass on to the stitching point to receive yarn. These cams 240 and 241 (see Fig. 19) are mounted on a support 242 secured on an arm 243 fulcrumed at 244 on the bed 90. The arm 243 is operated by the lever 245 also fulcrumed at 244. For this purpose the arm 243 is provided with an extension 246 on which is mounted an adjustable eccentric 247 abutting the edge of the lever 245. A spring 248 connects the extension 246 and the lever 245 so that the arm 243 moves with the lever 245, but the lever 245 is permitted a further inward and outward movement when the cams 240 and 241 are in their inner position. An arm 249 is pivotally secured at 250 to the opposite end of the lever 245 and is operated by a thrust bar 251 from the pattern drum 14 and against the action of a spring 252 which connects the bar 251 to the bracket 253 secured to the bed plate 90 and through which the thrust bar 251 moves.

In order to prevent the section of long butt needles from taking yarn during the formation of the gap in to and fro knitting, a set of cams similar to the cams 227, 240 and 241 are provided at the opposite side of the stitching point. These are the cams 259, 260 and 261. The cam 259 (see Fig. 18) is a fixed cam secured to the cam ring 89 and the cams 260 and 261 (see Fig. 17) are mounted upon the single support 262 carried by an arm 263 pivoted on the bed plate 90 at 264. This arm is also provided with an extension 265 connected by a spring 266 with an overlying lever 267, hereinafter described, and fulcrumed at 264. An adjustable eccentric 268 on the extension 265 abuts the edge of the lever 267 so that when the lever 267 is swung inward, the cams 260 and 261 are moved into position, and when the lever 267 is swung into its outermost position these cams are moved out of position. Thus, while the lever 267 positions the cams 260, 261 it may have a further inward and outward movement when these cams are at their inner position, as in the case of the corresponding lever 245.

The picker mechanism is of the usual type employed in narrowing and therefore needs no extended description. The picker 254 at the right (see Figs. 5 and 20) is mounted on a support 255 carried by the cam ring 89 and this support is the one provided with the projection in which is formed the slideway 212 for the cam 210. The picker 256 at the left is carried by a similar support 257. During to and fro knitting across the front of the web, as in the knitting of the ankle and foot sections, where no narrowing and widening operation is performed, it is necessary that the pickers be out of action in order to prevent them from acting upon the edge needles at the gap. For this purpose mechanism is provided for raising one of the pickers out of the path of the needle butts. This is sufficient because one of the pickers will already be out of position when to and fro knitting begins. It is assumed that the picker 254 will thus be out of action as shown in Fig. 5, and consequently mechanism is provided for raising the other picker. For this purpose there is provided a lever 258 fulcrumed on the bracket 93, one end of which is beneath the picker 256 and the other end of which is pivotally connected to a thrust bar controlled from the drum 14.

An important feature of this invention resides in the formation of an elastic selvage throughout each edge of the gap at the back of the web. This gives the required strength and finish to the edges of the gap and, by reason of its elastic quality, renders it unnecessary to break the yarn when the edges of the web are seamed together and the web is stretched into shape. In the preferred form of the invention illustrated, this elastic selvage is formed by the action of cams on the needle butts which are moved into and out of position as required, thus presenting a strong and durable mechanism for controlling the needles engaged in the formation of the selvage during the to and fro knitting. A preferred form of the selvage structure is illustrated in detail in Fig. 24. The needles engaged in the formation of the selvage have already been referred to and, in the form illustrated, comprise the short butt edge needles 84 of the segments 81 and 82 and the adjacent long butt needles 85 which do not knit and therefore leave the yarn running free or floating from the wales knit by the edge needle 84 to the wales knit by the medium butt needles of the segments 81 and 82, thus providing for the required elasticity.

The mechanism illustrated for forming this elastic selvage comprises a post 269 (see Fig. 5) on the cam ring 89 which post has mounted on it a sleeve 270 having at its upper end an extension or arm 271 carrying a follower roll 272. Secured to and depending from the extension 271 is a stud 273 which may at the proper time engage a screw in a post 274 mounted on the arm 243 which carries the cams 240 and 241 already described. A cam 275 (see Fig. 9) secured to the sinker bed acts on the roll 272 and at the proper time, through the parts described, forces the arm 243, carrying the cams 240 and 241, outward. A somewhat similar mechanism controls the cams 260 and 261. A post 276 on the upper bed 90 has mounted on it a sleeve 277 having at its upper end an extension or arm 278 carrying a follower roll 279 and at the lower end an extension or arm 280. A screw in a post 281 mounted on the arm 263 is adapted to be engaged by the extension 280. A cam 282 (see Fig. 9) secured to the sinker bed acts on the roll 279 and at the proper time through the parts described moves outward the arm 263 and therewith the cams 260 and 261.

Upon beginning to and fro knitting, the cams 260 and 261 are brought into action, carrying with them the roll 279 and its associated parts. The cylinder at this time is rotating in a clockwise direction, and the needle 84 at the right (see Fig. 23) is the first one to reach the cams 260 and 261 and as they are at this time slightly retracted by the cam 282 on the sinker bed, acting on the roll 279, the cams 260 and 261 do not act on the short butt of this needle so it holds its stitch above the point of the latch while all the rest of the needles in the segments 82, 83 and 81 are raised by the cams 260 and 261 carrying their latches above the stitches. While the needles 82 near the edge of the gap are also acted on in a similar manner by the cams 260 and 261 having long butts, they are immediately depressed by the cam 259 so as not to receive yarn. The long butt needles of the segment 80 are controlled in the same manner as the needles 85. The stitch cam

147 now being in acts on the needles which have received yarn drawing them down and casting off the stitches previously held. The leading needle 84, it will be remembered, was left holding a stitch above the latch so that when it receives yarn and is drawn down by the stitch cam, it does not cast off but retains both stitches. As the movement of the cylinder continues, the usual elevating cam 283 (see Fig. 11) raises all the needles into the path of the cams 240 and 241 by which they are further raised to carry their latches above the stitches. The leading needle 84 thus has its latch carried above both stitches which it has retained. As the last needle 84 approaches the cams 240 and 241, the cam 275 on the sinker bed, acting through the roll 272 and the mechanism described, forces back the cams 240 and 241 out of reach of its short butt and its stitch remains above the point of the latch. The cams 275 and 282 are of such a shape that they act alternately to keep first the cams 240 and 241, and then the cams 260 and 261, retracted sufficiently to miss the short butt needles 84, but these cams are immediately restored to act on the other short butt needles. The cam 275 is positioned to act on the roll 272 and the cam 282 is positioned to act on the roll 279, without one interfering with the other.

Upon the rotation of the cylinder in the opposite direction, or counterclockwise, the stitch cam 146 moves in and the needle 84 at the left (see Fig. 23) which was left retaining a stitch above the latch receives yarn together with the other needles in the segments 81, 82 and 83, with the exception of the long butt needles 85 and 80 which are now controlled by the cam 227, as they were by the cam 259 when the cylinder was rotating in the opposite direction. After receiving yarn, the needles are acted on by the stitch cam 146 in the usual manner and cast off the stitches previously held over the new stitches. But the leading needle 84 holding its stitch above the latch after it receives yarn and is acted on by the stitch cam retains both stitches. As the movement of the cylinder continues, the usual elevating cam 284 raises all the needles, including the leading needle 84, into the path of the cams 260 and 261 where they are further raised to carry their latches above the stitches. As the last needle 84 approaches the yarn receiving point, it takes yarn but at this time its latch is still above both stitches retained by it, being positioned by the cams 240 and 241, so that, when it is acted on by the stitch cam 146 it is drawn down, casting off these two stitches over the new stitch. When this needle 84 approaches the cams 260 and 261, they are retracted by the cam 282 on the sinker bed through the mechanism described, thus allowing the needle 84 to pass without being raised, so that the last stitch is held above the point of the latch. Upon the shift of the cylinder to rotate in the opposite or clockwise direction, the last-mentioned needle 84 again becomes the leading needle, still holding its stitch above the point of the latch, and, as it passes the yarn-receiving point, receives yarn and is acted on by the stitch cam 147, retaining its stitch together with the new stitch, as previously described. Continuing the rotation, the other edge needle 84, which now has two stitches below the latch, as it passes the yarn receiving point, receives yarn and, being acted on by the stitch cam 147, is drawn down, casting off these two stitches over the new stitch. Thus these operations are continued throughout the formation of the web, producing the desired selvage edges.

From the foregoing description it will be seen that at each rotation across the gap, the first edge needle retains its stitch and the second one takes the yarn and casts off and that the long butt needles adjacent the edge needles, herein shown at 85 as two in number, do not take yarn. Consequently the edge needles only knit off at every other course and each time knit off two stitches. Therefore, as shown in Fig. 24, the wales knit by the edge needles each extend over two courses and are formed of two strands of yarn, and between these wales and the body of the web, or the space left by the needles 85, the yarn floats free. There is thus presented a strong and firm selvage with the yarn left unknit by the needles 85 providing therewith the required elasticity.

The dropper mechanism is of the usual type employed in widening but involves novel features required by the present invention. The dropper 285 is mounted and swivelled in the post 92 at the front of the machine (see Figs. 3, 5, 6 and 11) and acts and is operated in the usual manner. But in knitting a web in accordance with this invention, it will be remembered that the angular movement of the needle cylinder in the to and fro work is much greater than usual. This extended to and fro movement of the cylinder would cause the dropper to act twice during each oscillation in the narrowing and widening of the toe pocket, thus dropping four needles instead of two at each oscillation. Provision is, therefore, made to prevent the dropper from acting twice during each oscillation. The dropper during the ordinary narrowing operation is swung downward to its idle position as by an arm 286 controlled by the vertical controlling rod 287. In this invention additional means are provided for moving the dropper to this lower idle position when necessary, as in the knittingting of the heel and toe pockets. A lever 288 is fulcrumed at 289 on the post 92 and one end extends beneath a projection 290 from the dropper shaft 291. The other end of the lever 288 is connected by a rod 292 (see Figs. 3 and 10) to one end of a bell crank 293 fulcrumed on the bracket 294 which is supported on posts 295 from the table 6. A rod 296 extends rearward from the other end of the bell crank 293 and is connected to horizontal bar 297 (see Fig. 2) which is controlled from the drum 35 and operated by the drum 33. The bar 297 is provided with a slot 298 having an offset portion 299 and is pivotally secured at 300 to a thrust bar 301 controlled from a suitable cam on the drum 35. The lower end of the thrust bar 301 is guided and held in position by the slotted plate 302 carried on the shaft 303 secured in the side frames and the thrust bar is held down by the spring 305 connected at one end to a post 305 mounted on plate 302 and at the other end to the bar 297. A lever 306 fulcrumed on a shaft 307 has an arm 308 engaging a suitable cam on the drum 33 and is held in contact with the cam by a spring 309 extending from its upper end to a rod 310 secured in the frame. A stud 311 in the upper arm of the lever 306 extends into the slot 298 in the bar 297. The drum 35, rotated as before described from the shaft 21 by the sprocket chain 37, carries a suitable cam to control the thrust bar 301 and when rotated to present a low portion of the cam, the thrust bar will drop, carrying with it the bar 297 so that the offset 299 of the slot will engage the stud 311 in the lever 306.

The drum 33 driven through the train of gears already described then rocks the lever 306 and thus through the bar 297, the rod 296, bell crank 293 and rod 292 moves the lever 288 to control the dropper. The mechanism such as that described for controlling and operating the dropper involving the bell crank lever 293, the rod 296, the horizontal bar 297 with its L-shaped slot, the thrust bar 301 controlled by suitable cams on the drum 35 for positioning the bar 297, and the lever 306, 308 operated by suitable cams on the drum 33 for reciprocating the bar 297 as determined by the position of the thrust bar 301 is repeated, as indicated in the schematic view of Fig. 2, for operating various other elements of the machine and, where further refinements of control are desired, a plurality of thrust bars such as 301, levers 306, bars 297, and rods 296 may extend to a single bell crank lever such as 293.

In the knitting of the heel and toe pocket sections, those needles which are not employed in the knitting operation are throw out of action by elevating these needles so that their butts pass above the paths of the various cams. In the formation of the heel pocket section, the section of short butt needles 83 are thus elevated, retaining the yarn in their elevated position. In the formation of the toe pocket section, all of the needles except the short butt needles 83 are thus elevated. The medium butt needles 81 and 82 with the short butt edge needles 84 retain the yarn while in elevated position, but the long butt needles 80 and 85 which do not take yarn during to and fro knitting stand in the elevated position without yarn.

The mechanism for thus elevating the required needles upon the commencement of the knitting of the heel and toe pocket sections and for restoring them upon the conclusion of the knitting of these pockets comprises a switch cam 312 and two depressing cams 313 and 314 (see Figs. 5 and 11).

The switch cam 312 is of the usual type mounted to slide radially and to rock in the support 315 on the cam ring 89. The rocking motion is given by the vertical controlling rod 287 engaging an arm 316 projecting from the shank of the cam while the inward and outward movement of the switch cam is given by a lever 317 fulcrumed at 318 on the bracket 222. This lever is provided with an adjusting screw 319 abutting the end of the shank of the switch cam and acts in opposition to a spring 320 connecting the switch cam to its support 315. The rearward end of the lever is provided with a set screw 321 abutting the post 322 to limit the inward movement thereof. The forward end of the lever is provided with an extension 323 connected by a rod 324 (see Figs. 1 and 10) to a lever 325 fulcrumed on the shaft 123 and controlled by cams on the pattern drum 14. Thus under the control of the pattern drum 14 the switch cam 312, which normally stands retracted and in horizontal position, is depressed and moved inward for the period required to elevate the needles required to go out of action at the beginning of the knitting of the heel pocket and toe pocket section and likewise is elevated and moved inward during the period required to restore these needles thus elevated at the conclusion of the knitting of the heel pocket and toe pocket sections, respectively.

The depressing cams 313 and 314 are both for the purpose of enabling the section of short butt needles 83 to be elevated by the switch cam 312 at the commencement of the knitting of the heel pocket section. At this time these cams are moved inward sufficiently to act upon and depress the medium and long butt needles below the level of the point of the switch cam when in its depressed position. Consequently when the switch cam is depressed and moved in to stand beneath the path of the short butt needles, it will elevate the short butt needles 83 without acting upon the remaining needles. These depressing cams 313 and 314 remain in action only for one complete to and fro movement of the needle cylinder but the latter cam must not be withdrawn until the switch cam has been raised out of the path of the needles that have not been elevated.

The depressing cam 313 is carried by a slide 326 mounted to move radially in the switch cam support 315. A set screw 327 carried by the post 328 on the lever 245 stands in line with the end of the slide 326. This lever 245, it will be remembered, is operated from the pattern drum 14 by the thrust bar 251 to move the cams 240 and 241 inward and may thereafter have a further inward movement after the cams 240 and 241 are in position. The corresponding depressing cam 314 (see Fig. 16) is carried by the lever 267 and this lever, it will be remembered, is operated in a similar manner to the lever 245 to position the cams 260 and 261. For this purpose the lever 267 is connected by a rod 329 (see Figs. 1 and 10) to the lever 330 fulcrumed on the shaft 123 and operated by cams on the pattern drum 14.

In this invention the elastic selvage formed at the edges of the gap is continued during the knitting of the heel pocket section in the manner already described, but, as the needle cylinder has been shifted 180°, it is necessary to provide additional mechanism to operate the levers 245 and 267 controlling, respectively, the cams 240, 241, 313 and 260, 261, 314 alternately. During the knitting of the heel pocket section, the controls of these levers from the pattern drum 14 which are used in knitting the ankle section and foot section become inactive and these levers are operated by the drum 33 under the control of the drum 35.

The mechanism for thus controlling and operating the lever 267 is the same as that employed for other mechanisms and is shown in detail in Fig. 29. Fulcrumed on a shaft 331 secured in the frame is a lever 332 connected by a rod 333 (see Figs. 1 and 10) to the lever 267. Pivotally connected to the lever 332 is a bar 334, the rear end of which is held up by a thrust bar 335, guided at its lower end through a slotted plate 336 secured to the shaft 303. A lever 337 is hooked around the shaft 307 being held thereon by a spring 338 which connects its lower end to the rear end of the bar 334 and which also acts to hold the thrust bar 335 down. The lever 337 at its upper end is held in position and guided by the slotted plate 339 secured to a shaft 340 and at its lower end is guided by the slotted plate 341 secured to the shaft 307. A stud 342 in the lever 337 extends beneath the bar 334 and is adapted to engage the shoulder 343 on the bar 334. A follower carrier 344 is pivotally mounted at 3441 on the lever 337 and held in proper adjustment by the screw 345. A two part follower 346 (see Fig. 30) is adjustably pivoted to the carrier at 3461 and by means of the adjusting screws 347 may be so set as to vary the time it contacts with its actuating cam 348 on the drum 33. An angular slotted plate 349 secured to the shaft 179

serves to guide the forward end of the carrier 344.

The drum 35 rotated from the shaft 21 by the sprocket chain 37 carries a suitable cam 351 to control the thrust bar 335 and when the thrust bar drops on a low part of the cam the bar 334 which is kept in contact with the thrust bar by the spring 338 also drops and the stud 342 on the lever 337 snaps into engagement with the shoulder 343 as the lever rocks. When the parts are thus engaged, the cam 348 on the constantly rotating drum 33 acting on the follower 346 and through the parts described, actuates the lever 267.

As the drum 33 is constantly rotating, it is desirable to keep the followers 346 away from their cams until the mechanism they control is to be used, and for this purpose a rod 352 supported in arms 353 on the shaft 354 holds them out of engagement. A bar 355 (see Fig. 1) having a roll to be actuated by a suitable cam on the drum 35 is connected at its upper end to an arm 356 secured to the shaft 354 and as the bar drops at the proper time, through the connections described, rocks the rod 352 away from the followers allowing them to come in contact with their cams.

The mechanism thus described for controlling and operating the lever 267 involving a lever such as 332, a connection thereto, and the mechanism extending therefrom operated by suitable cams on the drums 35 and 33 is repeated for operating various other elements of the machine and, where further refinements of control are desired, a plurality of thrust bars such as 335, follower mechanisms, and bars 334 may extend to a single lever such as 332.

This mechanism is of wide application in the control of various elements of a knitting machine. It will be seen that it may be repeated as many times as required and will occupy a minimum amount of space in the machine. The follower is readily removable for replacement, repair, or substitution. The follower itself is capable of a wide degree of adjustment to take up wear or to vary the timing of the operation and may cooperate with any desired length or configuration of cam. The adjustments provided are readily and easily made and enable an extreme degree of accuracy of control to be effected. Any desired number of the mechanisms operated and controlled from the cam such as 348 and 351 may be connected by independent bars 334 to a single rock arm 332, thus further increasing the flexibility of the mechanism.

The mechanism for thus controlling and operating the lever 245 is similar to that already described for controlling and operating the dropper (see Fig. 2). For this purpose the arm 245 is shown as provided with an extension 396 (see Fig. 10) connected at its end by a rod 397 to a lever 398 fulcrumed on the bracket 294 and operated by a rod 296 extending to a bar 297 and mechanism of the type already described for operating the dropper by suitable cams on the drum 33 under control of suitable cams on the drum 35.

The cams 275 and 282 on the sinker bed operate in the manner already described in the formation of the selvage throughout the knitting of the heel pocket sections.

When the knitting of the toe pocket is to begin, all the needles to be taken out of action, that is, the needles in segments 80, 81, and 82, including the needles 84 and 85, are controlled by the pattern jacks that raise them into position to be elevated out of action by the switch cam. The switch cam, at this time, is so positioned by the cams on the drum 14 that it will act on the needles selected by the pattern jacks, but will not act on the short butt needles in segment 83 because it is not low enough at this time to engage them. When these needles are to be restored into action, the switch cam, as usual, is elevated and moved in sufficiently to engage and depress these needles. Normally the depressing cams stand retracted.

In knitting the stocking web in accordance with this invention, the to and fro knitting takes place across the front of the web in knitting the ankle section; across the back of the web in knitting the heel pocket sections; and across the front of the web in knitting the foot and toe sections. In order to produce this result, means are provided for automatically shifting the relative position of the needle and cam cylinders 180° both at the beginning and at the conclusion of the knitting of the heel pocket section.

In the preferred construction this is accomplished by a clutch connection between the main shaft 10 and the hub 11 carrying the gears 12 and 13 which rotate the needle cylinder and the transfer implement dial and by automatically operating this clutch to cause a shift of the hub with respect to the shaft through 180° at the beginning and at the end of the knitting of the heel pocket section. The control of this clutch is conveniently secured from a cam located on the outer left hand end of the pattern drum 14. The details of a preferred form of the clutch construction are shown in Figs. 31 to 35 inclusive, and the cam and operating connections extending to the clutch in Figs. 1 and 3. A clutch plate 357 is secured to the unit comprising the hub 11 and the gears 12 and 13. This clutch plate 357 is arranged to have a slight give or yield rotarily in both directions with respect to the hub so as to take up the shock caused when the clutch operates. For this purpose, the plate is provided with an arm 358 secured thereto at 359. This arm extends radially outward and then concentric in opposite directions with the periphery of the gear 13. Its free ends are connected by powerful springs 360 secured to the gear at the points 361. A slot or aperture 362 in the arm 358 fits over a stud 363 rigid in the gear and of smaller size than the aperture so that a slight rotary movement of the clutch plate in either direction may take place against the tension of the springs 360. The other clutch member which cooperates with the plate 357 is firmly secured to the shaft 10. It is shown as comprising a block 364 keyed to the shaft at 365 and also fastened thereto by the set screw 366. The clutch connection between the block 364 and the plate 357 is effected by means of two locking pins 367 and 368 mounted in the block and a hole 369 cooperating with the pins in the plate. The pins slide in bores in the block parallel with the shaft and at the same radial distance therefrom as the hole in the plate and are slightly tapered at their ends. The pin 367 is operated by a lever 370 fitted in a slot 371 extending transversely through the block and the shaft and fulcrumed on a pin 372 held in place by a set screw 373. This lever is connected to the pin 367 by a spring pressed pin 374 sliding in the lever and having a ball and socket connection with the pin. A spring 375 acts between the block and the lever normally to project the pin toward the clutch plate 357. The outer end of the lever 370 is slotted at 376 and its extreme outer end presents the extension

377. A similar lever 378 mounted in a similar transverse slot 379 in the block 364 and in the shaft 10 and fulcrumed on the pin 380 is controlled by the spring 381 to operate the pin 368. This lever extends outwardly with its end 382 at the same radial distance from the center of the shaft 10 as the recess 376 in the lever 370. A controlling cam 383 for operating the levers is mounted on a rod 384. This cam presents an arcuate body extending concentric with the shaft and has its face bevelled off at 385. The rod 384 extends transversely across the front of the machine guided in a suitable bracket and is adjustably secured by the nuts 386 in a block 387 adjustably and rigidly secured in turn by a set screw 388 to a vertical shaft 389 mounted at its upper end in a bracket 390 extending laterally from the bed plate of the machine and at its lower end in a bracket 391 extending from the side frame 5. An arm 392 is rigidly and adjustably secured to the shaft 389 by the set screw 393 and is provided at its end with pins 394 cooperating with the cam surfaces on the pattern drum 14.

Up to the time the machine is to begin the knitting of the heel pocket section, the clutch stands with one of the pins 367 or 368 in engagement with the hole 369 or, for example, as illustrated in the drawings with the pin 367 controlled by the lever 370 clutched into the hole 369 of the clutch plate 357 and with the controlling cam 383 aligned with the recess 376 in this lever. When the time arrives to shift the angular position of the hub 11 with its gears 12 and 13 on the shaft 10 so as to cause the to and fro knitting to take place at the opposite side of the web from that employed in the knitting of the ankle section, the pattern drum 14 acts to rock the shaft 389 and thus to shift the controlling cam 383 away from the center of the shaft 10 into the position shown in dotted lines in Fig. 31, where it stands in line with the extension 377 of the lever 370. Immediately with the rotation of the shaft 10, the lever 370 is rocked upon its pivot by the controlling cam withdrawing the pin 367 from clutching engagement with the plate 357, thus stopping the drive of the hub 11 with its gears 12 and 13. As soon as the clutch block 364, which is keyed to the shaft, has rotated 180°, the clutch pin 368 is depressed by the lever 378 into the hole 369 in the clutch plate 357 and the drive of the hub 11 and therefrom of the cylinder and dial is resumed with the to and fro knitting operation for the heel pocket section, taking place on the opposite side of the web from that employed in knitting the ankle section. The controlling cam 383 now remains in its outward position during the knitting of the heel pocket section, but as the pin 367 is now seated on the face of the clutch plate 357 holding the lever 370 with its outer end pressed toward the clutch plate, the controlling cam no longer acts on this lever and as the end 382 of the lever 378 does not extend out as far as the extension 377 of the lever 370, the controlling cam has no effect on it also. When the knitting of the heel pocket section is completed, the pattern drum again acts and the controlling cam 383 is shifted to its inner position or in radial alignment with the recess 376 in the lever 370 and in radial alignment with the end 382 of the lever 378, as shown in Figs. 31 and 35. As soon, then, as this end 382 passes the controlling cam, the pin 368 is withdrawn from the clutch plate, the hub 11 ceases to rotate and the block 364, after making a half rotation, brings the pin 367 opposite the hole 369 and the block is again clutched to the plate 357 in the position it occupied during the knitting of the ankle section of the web.

The springs 360 are made or adjusted to the same tension and thus tend to hold the stud 363 central of the aperture 362. Consequently, when a reversal of rotary movement in either direction takes place, the springs 360 act to absorb the shock. The drive then preferably continues through the medium of one of the springs depending upon the relation between the tension of the springs and the driving torque. This construction is particularly desirable in absorbing the shock of the sudden shift in one direction or the other which takes place when the clutch mechanism for shifting the hub 180° operates.

Upon beginning the knitting of the heel pocket, the clutch having acted to shift the cylinder as described, the lever 258 (see Fig. 5) which has held the picker 256 out of action is operated to restore the picker to action allowing it to function in the usual manner during the formation of the heel pocket. It will be remembered that the depressing cams acting on all medium and long butt needles allow the short butt needles to pass and be raised out of action by the switch cam, and it will be seen that the leading needle 84 being a short butt needle will be raised out of action, and as it is necessary to use this needle in forming the desired selvage, it must be restored. The other needle 84, which also is used in forming the selvage, although it is a short butt needle, is not raised out of action, because the switch cam is elevated to a horizontal position before it passes. The leading needle 84 is restored to action by the dropper which is now controlled by the mechanism already described, the dropper then being held inactive till the usual widening of the heel pocket starts, when both the pickers and dropper act in the narrowing and widening operation in the usual manner to form the heel pocket.

The yarns employed in forming the web are shown as presented by yarn guiding fingers which are moved into and out of position to present and remove the yarns as required in the different stages of the knitting of the web. The number of these yarn guiding fingers will be determined according to the character of the work being performed. In illustrating a preferred form of the invention, six fingers are shown (see Figs. 9 and 21). The yarn finger 399 carries a yarn suitable for knitting the leg, ankle and instep of the foot. The yarn finger 400 carries the yarn for knitting the garter top. The yarn finger 401 carries the yarn employed in knitting half the heel pocket, half the sole and the toe pocket, or the portions where a heavier and more durable web is desirable. The finger 402 carries the yarn employed in knitting the other half of the heel pocket and the other half of the sole, the yarn being of the same type as in the finger 401. The yarn fingers 403 and 404 carry yarns suitable for reinforcing the w|b, as where the high spliced heel is desired.

The fingers 399, 400, 401 and 402 are pivotally mounted at 405 in an upstanding projection 406 of the latch ring 94 while the fingers 403 and 404 are pivotally mounted at 407 in a part of the latch ring. All of them are controlled at times by thrust bars 408 actuated from the drum 14 and the fingers 399, 401, 402, 403 and 404 are at other times controlled by mechanism from the drum 33 similar to that described and shown in detail in Fig. 29, including the thrust bars 335, the bars

334 and the levers 332 to which the fingers are connected by rods 409. The general operation and function of the yarn fingers outside of the novel features hereinafter pointed out will be readily understood. The operation of the yarn fingers in knitting the garter top, the leg and the high spliced ankle section needs no further description.

The preferred means employed for forming the elastic selvage during the knitting of the heel pocket and for forming the joint between the sole and the instep in the foot section require detailed consideration. At the conclusion of the knitting of the high spliced ankle section, the finger 399 carrying the main yarn and the fingers 403 and 404 carrying the splicing yarns are in yarn presenting position. Upon beginning the heel pocket these fingers are acted on by their associated thrust bars 408 and elevated, taking their yarns out of action. Finger 401 is now permitted to drop into yarn presenting position by its thrust bar and as the cylinder at this time is shifted by the clutch the needles in segment 81 take the yarn, the cylinder moving in a counterclockwise direction. The yarns which previously have been taken out of action by the fingers 399, 403 and 404 are cut and clamped by the usual mechanism on the dial cap 410 and the severed ends are wiped down to prevent their being knit into the fabric by the brush 411.

This brush is mounted on the bracket arched over the latch ring and is controlled by mechanism (see Figs. 2 and 10) similar to that described for controlling the dropper, which, it will be remembered, included a bell crank 293 connected at one end to a rod 296. To operate the brush a rod 296 is connected to a lever 413 secured to a shaft 414 mounted in brackets carried on the bracket 294. A lever 415 secured to the shaft 414 is pivotally connected to a bar 416 which, at its opposite end, is pivotally connected to a lever 417 that is secured to the shaft 418 (see Fig. 1) to which the brush 411 is secured. The brush, therefore, when brought into action by the controlling mechanism, is depressed upon each oscillation of the needle cylinder in the same direction to engage the severed end or ends of yarn and depress these ends between the needles and the edge of the dial so that they are always wiped in the same direction and kept from being knit into the web.

The cylinder now rotating in clockwise direction, the finger 401 delivers another course of yarn to the needles in segment 81 and this course extends across the gap and is delivered to the needles in the segment 82. The cylinder now rotating in counterclockwise direction, finger 401 delivers yarn to the needles in the segment 82 and is then raised out of action at the gap by the mechanism controlled from the drum 33, so that delivery of yarn by finger 401 terminates on the needle 84 of segment 82. As the movement of the cylinder continues, the finger 402 is brought into yarn presenting position in the gap by its associated thrust bar 408 and delivers yarn to the segment 81. As the to and fro knitting to form the heel pocket continues, the fingers 401 and 402 are controlled by the mechanism from the drum 33 alternately to bring those fingers into and out of yarn presenting position, the finger 401 presenting yarn to the segment 82 and the finger 402 presenting yarn to the segment 81.

At the end of the heel pocket, the cylinder is rotating in a counterclockwise direction and, while the finger 402 is delivering yarn to the segment 81, the finger 401 is raised out of action at the gap by the drum 33, the edge needle 84 of segment 82 being the last needle to receive yarn from finger 401. The associated thrust bar 408 is then raised by the drum 14 to hold the finger 401 out of action. The cylinder at this time is shifted by the clutch and is rotating in a clockwise direction, the finger 402 presenting yarn only to the segment 81. As the cylinder starts a counterclockwise movement, the finger 401 is brought into a yarn presenting position by the action of its associated thrust bar 408 and finger 402 is raised out of action by the drum 33. The finger 401 now presents yarn to segment 81, the edge needle 84 being the first one to take yarn from finger 401 on this reciprocation, thereby extending a course of yarn across the gap. The edge needle 84 of the segment 81 still carrying the yarn from finger 402 passes a deflector 419 which engages the yarn held by the edge needle 84 and guides it under the dial. The terminal needle in the segment 81, that is, the needle opposite the needle 84, is the last needle to receive yarn from finger 401 and at this time the finger 399 is brought into yarn presenting position by its associated thrust bar 408 and presents yarn to segment 83. The deflector 419 now is raised out of action. The cylinder still rotating in counterclockwise direction brings the segment 82 into position to receive yarn from the finger 402, thereby extending a course of yarn from the needle 84 of the segment 81 across the gap and to the terminal needle in segment 82.

The purpose of the deflector is to prevent yarn extending from a needle, such as a needle at the edge of the gap, to a raised yarn guide finger from being wrapped around the mechanism above the dial whenever the needle cylinder is shifted 180° with respect to the cam cylinder. This deflector is therefore normally inactive but is thrown into action when required to depress such a yarn beneath the dial and then, when its function is accomplished, is thrown out of action. The deflector may therefore be operated whenever required and is conveniently operated by the following mechanism. The deflector is shown (see Fig. 1) carried on one end of a bell crank lever 420, fulcrumed on the bracket 93, the other end of the bell crank being connected to a bar 421. A thrust bar 422 controlled from a suitable cam on the drum 35 has extending from it a stud 423 engaging a shoulder 424 in the bar 421 and holding the bar back against the action of a suitable spring similar to the one shown at 338. A spring 424 connecting the thrust bar 422 with the plate 336 serves to keep the bar in engagement with the cam on the drum 35. When the thrust bar 422 is lowered, it withdraws the stud 423 from engagement with the shoulder 424 and the bar 421 is carried forward by its spring, rocking the bell crank and thus bringing the deflector 419 down into operative position. In order to restore the deflector to the inoperative position, a shoulder 425 is provided on the bar 421 adapted to be engaged by a stud extending from a follower carrier controlled from the drum 33, similar to the mechanism previously described and illustrated in Fig. 29.

Upon the completion of the heel pocket section, the segment of needles 83 which have been out of action retaining the body yarn fed by the finger 399 are restored to action and the foot section is knit with the instep formed by the yarn fed by the fingers 401 and 402, the former feeding the yarn to the segment 81 and the latter to

the segment 82. The yarn fingers at this time are controlled by the mechanism described and operated from the drum 33. One type of yarn, such as silk, may be used in the finger 399 while another, such as cotton, may be used in the fingers 401 and 402 and the needles are controlled in conjunction with the yarn fingers to produce at each side a strong joint of pleasing appearance between the instep and sole portions thus formed respectively by the silk and cotton yarns. These joints are shown as formed by the following mechanism.

One or more needles at the edges of the segments 81 and 82 adjacent the segment 83 are controlled by the pattern jacks and are raised thereby to a higher plane than the rest of the needles forming the foot. When the stitch cam 146 is in action, and the cylinder is rotating toward it, the edge needles forming the joint between the instep and sole are raised by the pattern jacks controlled by the cam 137 and when the cylinder is rotating in the opposite direction and the stitch cam 147 is in action, these needles are raised by the pattern jacks controlled by the cam 138. This control of the edge needles continues throughout the knitting of the foot.

Figs. 12 to 15, inclusive, illustrate diagrammatically different positions of the yarn fingers 399, 401 and 402 and of the needles at and adjacent the two joints between the instep and the sole in one direction of oscillation of the cylinder indicated by the arrows. At each joint, both of the yarns in alternation float over several of the needles and in the construction illustrated these needles are four in number indicated at x and are the four needles at the edges of the segments 81 and 82 on which the sole portions are formed. In Fig. 12 the needles at the end of the segment 81 adjacent the needles x are passing down the stitch cam taking the cotton yarn above their latches from the yarn finger 401 which is in yarn presenting position; the four needles x at the edge of the segment 81 are raised by the pattern jacks to higher than normal position and the silk yarn is leading from the first of these needles to the yarn guide 399 which is in yarn presenting position, while the yarn guide 402 is raised to inactive position holding the cotton yarn which extends to the edge needle of the segment 82. As the needle cylinder rotates, as shown in Fig. 13, and the needles x of the segment 81 pass down the stitch cam, they also take cotton yarn from the yarn guide 401 in the usual manner, but the silk yarn from the yarn guide 399 being led below their latches is not taken thereby and so floats thereacross, while the needles of the segment 83 being operated in the usual manner take the silk yarn as usual. The yarn guide 401 rises as the last of the needles x of the segment 81 passes and the yarn guide moves into inactive position holding the yarn. Thus the silk yarn floats across the web for four stitches, not being knit by the needles x of the segment 81. As the rotation of the cylinder continues, and as shown in Fig. 14, the needles at the end of the segment 83 adjacent the segment 82 continue to take the silk yarn; the needles x of the segment 82 are raised by the pattern jacks; the yarn guide 402 is brought down to yarn-presenting position, and the yarn guide 399 starts up to inactive position. Thus, as shown further in Fig. 15, the silk yarn is taken by the needles x of the segment 82 and knit as usual, while the cotton yarn from the yarn guide 402 is led beneath the latches of the needles x of the segment 82 and so is not taken thereby but is first taken by the needles of the segment 82 following the needles x. Thus at this joint the cotton yarn floats over the four needles x. On the reverse movement of the cylinder, a similar but reverse operation takes place, the cotton yarn floating over the needles x of the segment 81 and the silk yarn floating over the needles x of the segment 82, and so the operation proceeds.

Thus it will be seen that each yarn-presenting finger going into yarn presenting position will have its yarn floated laterally across the needles at the inner edge of the sole sections and in going out of action will have its yarn knit into the web in the usual manner, producing a joint in which, in a single course of knitting in one direction the silk is floated and the cotton knit and in the next course in the opposite direction, the silk is knit and the cotton is floated.

It is necessary that the yarn fingers going into and out of action be accurately controlled so they will be in proper relation to the needles to which they deliver yarn. The fingers 399, 401 and 402 are made in two parts. For example (see Fig. 9), the finger 401 has the part 426 pivoted at 405 and connected by a spring 427 to the shaft 92 and the part 428 pivoted at 429 to the part 426 and connected by a spring 430 to a suitable part of the machine. Thus when one of these fingers is in yarn delivering position and under the control of the mechanism operated from the drum 33 and is to go out of action, the part 428 being pulled by the rod 409 is first rocked on the pivot 429, swinging its yarn delivering end over the top of the needles that have not been raised by jacks until the shoulder 431 engages the part 426, and then both parts are rocked about the pivot 405. When the finger is to go into action, both the parts 426 and 428 rock together on the pivot 405 until an extension on the part 426 engages a screw 432 in a plate mounted on the projection 406, by which the part 426 is held against further movement and the part 428 continues to move, swinging its yarn delivery end down over the top of the needles into yarn-presenting position. When a finger is controlled from a thrust bar 408, the parts 426 and 428 are engaged by the shoulder 433 (as shown in Fig. 9) by the action of the spring 430, and, upon going into action, the thrust bar allows the finger to drop onto the throat plate, the yarn delivery end being properly positioned by the part 428 swinging on the pivot 429 while its upper end is held by the rod 409.

The position of the joint between the sole section and the instep section of the foot at each side may be shifted laterally of the web as desired by controlling through the pattern jacks the needles employed in the knitting of these joints. Preferably, as previously pointed out, these joints are shifted over further into the instep section near the end of the knitting of the foot section so as to produce the so-called guarded toe. Preferably also the knitting of these joints ceases shortly before the foot section is completed and the entire foot section, instep and sole, is finished with a few courses of the yarn forming the sole, the yarn in knitting these courses being fed from the finger 401.

The mechanism for supporting and operating the transfer elements, the sinkers or web holders, and the other elements at the head of the needle cylinder, except as particularly described herein, may be, and are illustrated as of the same general construction as shown in the before-men-

tioned patents. The web holders or sinkers, over which the stitches are drawn, are constructed and operated substantially as in Patent No. 1,695,734. These sinkers 434 (see Fig. 9) slide in radial grooves in the sinker bed 435 rigidly mounted upon the extreme upper end of the outer face of the needle cylinder 64 and their inner ends are guided by a stitch ring 436 secured to the inner upper end of the needle cylinder. The sinker cam ring 437 rests upon the sinker bed and contains the usual cam groove 438 for operating the sinkers 434 through their butts. This cam ring is provided with lugs 439 (see Figs. 2 and 6) containing adjustable set screws 440 abutting the opposite sides of the post 92 and thus maintaining the rotary position of the sinker cam ring fixed with respect to the main cam ring 89.

The transfer implements (see Fig. 9) are constructed and operated in general as in the aforesaid Patent No. 1,282,958. The interior dial 65, already referred to, is supported by a central vertical shaft or a spindle journalled in the hub 441 of a bracket 442 arched over and mounted upon the latch ring 94 so that the dial axis aligns with the needle cylinder axis. A gear 443 at the top of this spindle meshes with a gear 444 on the transverse shaft 74 already described. Nuts 445 on the end of the dial spindle, above the gear 443, enable the dial to be adjusted vertically. The dial 65 is provided with the usual grooves 446, preferably equal to one-half of the cylinder needles. The transfer implements mounted in the grooves in the dial bed are shown as comprising, as in the aforesaid patent, two flat bodies 449 and 450 having actuating butts 451. Each body terminates in a point and has directly behind the point a notch. In the rear of the notch, the bodies are bent away from each other. The implements are preferably made of thin, resilient sheet metal, and may or may not be fastened together. The actuation of these transfer implements is controlled by suitable cams carried by the dial cap 455, having the hub 456 mounted in a depending sleeve portion 457 of the bracket hub 441, so that the dial cap is held relatively stationary with respect to the rotating dial.

The latch ring, as in the aforesaid Patent No. 1,695,734, is fitted with a gap closing ring 458 (see Fig. 9) fitting a recess in the latch ring 94 and rotarily mounted therein. This gap closing ring is constructed and operated as in the aforesaid patent and according, as it is rotated in one direction or the other, one or the other of its pointed ends 459 acts to close the upper part of the gap formed in the yarn feeding throat 460 in the latch ring. The mechanism for thus operating the gap closing ring (see Fig. 1) comprises a bell crank lever 461 fulcrumed at 462 on the post 93. The vertical arm of this lever is connected by a link 463 to the gap closing ring 458 and the horizontally projecting arm 464 is operated by a usual thrust bar 465 from the pattern drum 14. But when forming the heel pocket, as previously described, it is necessary to provide additional means for operating the gap closing ring so as to close the gap in the throat when the needles are raised and pass the gap so their latches will remain open. For this purpose, the gap closing ring is removed from control of the pattern drum 14, and the ring is temporarily controlled by the drum 33. The lever 461 is provided with a projecting stud 466 and this stud rides in a right angle slot 467 in the end of a lever 468 fulcrumed at 469 on a follower lever 470. This follower lever is fulcrumed on the shaft 350 and at its lower end cooperates with a suitable cam on the drum 33. A thrust bar 471 operated by suitable cams on the pattern drum 14 acts at the proper time to lower the lever 468 so that the stud 466 rests in the vertical portion of the slot 467, thus placing the gap closing ring under the control of the drum 33 to close and open the gap as the heel pocket is formed.

It is necessary that the appearance of the web be maintained throughout and shall not change as the change takes place from round and round knitting at the upper part of the web to the to and fro knitting which is carried on throughout the remainder of the web. In order to get the desired effect, it has been found necessary to vary the tension on the stitches and hence to provide mechanism for raising and lowering the tubular column 73. For this purpose, the drum 33 is provided with suitable cams 472 and 473 (see Fig. 4), which act on followers 474 and 475 carried on one arm of a lever 476. This lever is fulcrumed on a shaft 477 carried in the frame 5 and the support extending from the stand 1. The forwardly extending end 478 of the lever 476 extends beneath an adjustable stop shown as a set screw 479, threaded into a projection 480 on the tubular column 73. While to and fro knitting is being performed toward the left, the cam 473 acts through the mechanism thus described to raise or lower the tubular column 73, thus to vary the tension of the stitches, and when the to and fro knitting is toward the right, the cam 473 is out of action and the cam 472 acts through the same mechanism to control the length of the stitch. Both of the followers 474 and 475 are adjustably mounted on the arm 481 (see Figs. 1 and 4) of the lever 476 so that they may be independently adjusted as required.

The tubular column 73 is connected in the usual manner to the sinker cam ring 437 so as to cause the parts supported by the needle cylinder to rise and fall therewith. For this purpose (see Figs. 1 and 3), the vertical curved arm 700 is bolted at its lower end at 701 to the column 73 and at its upper end is provided with a vertical, adjustable screw 702 abutting the top of the sinker cam ring 437.

The yarn fingers 403 and 404 (see Figs. 9 and 21) carry the splicing yarn for splicing the lower ankle section at each side of the gap to form the high spliced heel. In the form illustrated, these fingers are pivoted at 407 in part of the latch ring and are normally elevated and are dropped into yarn-presenting position by their associated thrust bars 408, controlled in the usual manner from the pattern drum 14. But, when these yarn guides are thus in operative position, they pass under the control of suitable cams on the drum 33 by means of which, through mechanism such as previously described and illustrated in Fig. 29, they throw the yarns in and out as required by the pattern of the spliced area. Springs 482 connecting the ends of these fingers to the plate extending from a part of the latch ring tend to pull the ends of the fingers into engagement with adjustable screws 483 when they are in yarn feeding position.

The yarn guides 401 and 402 employed for carrying the yarns for knitting heavier sections of the web, such as the heel pocket, toe pocket, and sole sections, are off center at the throat plate and consequently in to and fro knitting the needles first brought to yarn-receiving posi-

tion are likely to receive the yarn beneath their latches, which would result in the yarn being cast off and no stitches being formed when the needles were brought down by the stitch cam. To prevent this happening, the invention provides means (see Figs. 9 and 22) for forcing the yarn extending from one or the other of the fingers over to one or the other side of the throat plate or into a position where, when the needles reach the yarn, the stitch cams will have acted to bring them down sufficiently so that the yarn will be received above the latch and taken by the needle in the usual manner. For this purpose, yarn guiding pins 484 and 485 are employed and moved transversely of the throat as required to shift the yarn into the proper position. The pin 484 is carried by a plate 486 pivoted at 487 on a bar 488 secured to the rearwardly projecting hinged portion of the latch ring 94. This plate is guided and supported in its movement about the pivot 487 by a screw 489 secured in the latch ring and passing through an arcuate slot in the plate. The pin 485 is carried in a similar manner on a plate 490 pivoted at 487 and guided by the screw 489. These pins project up through an opening 491 in a plate 492 adjustably secured by set screws 493 to the latch ring and forming the bottom of the throat. The plate 486 (see Fig. 10) carrying the pin 484 is connected by a rod 494 to a block 495 swivelled on one end of a lever 496 pivoted on the bracket 294. This lever is actuated from the drum 33 by mechanism such as already described for controlling the dropper (see Fig. 2). The plate 490 carrying the pin 485 is connected by a rod 497 to one end of a similar bell crank pivoted on the bracket 294, the other end of which is actuated from the drum 33 through similar mechanism. Consequently, at the required time, the pins 484 and 485 under the control of the drum 35 and operated by the drum 33 and through the connections described, are moved from one side of the throat to the other properly to position the yarns.

Suitable means are provided for severing and holding the yarns when withdrawn from the needles and for that purpose a construction is indicated such as shown in the patent to Scott, No. 1,282,598, above referred to, and including (see Fig. 9) a guide and a clamp 498 spring-actuated about a pivot 499 mounted from the hub 456 of the dial cap 455. But as the construction and operation of such a severing and holding means are well known and familiar and disclosed in the said patent, no further description thereof is here necessary.

During the periods when forming the high spliced heel and the sole of the foot, it is necessary further to control the tension of the stitch by shifting the vertical position of the tubular column 73. For this purpose, the lever 476 has an arm 500 (see Figs. 2 and 4) opposite the arm 481 provided with followers 501 and 502 controlled from cams 503 and 504 on the sliding drum 34. During the normal operation, when forming the high spliced heel and the sole of the foot is not taking place, the followers 501 and 502 are out of engagement with the cams 503 and 504; but when these operations are to be performed, the drum 34 is shifted into position to cause the cam 504 to cooperate with the follower 502 to control the tension while forming the high spliced heel and is further shifted to cause the cams 503 to cooperate with the follower 501 to control the tension while forming the sole of the foot. For this purpose, the drum 31 is provided with the step cam 505 (see Fig. 4) which acts on a follower 506 secured to a sliding rod 507 mounted in the frame. A spring 508 connecting the rod to the frame keeps the follower 506 in engagement with the step cam 505. The rod has secured to it an arm 509 engaging a groove formed in the hub 510 of the sliding drum. The drum 31 is rotated at the proper time and cams the follower 506 to the left, viewing Fig. 4, and thus moves the sliding drum 34 with its operating cam 504 step by step into engagement with the follower 502, and through the lever 476 controls the tension when forming the high spliced heel, while further rotation of the drum 31 moves the sliding drum 34 with its operating cam 503 into engagement with the follower 501 to control the tension when forming the sole of the foot. The follower 502 is out of engagement with its cams before the follower 501 is engaged by the cams 503. The shape of the cams which thus give the step by step movement may be varied in accordance with the shape of the high spliced heel or sole area. The lever 476 is held against the operating cams by a spring 511 extending from the lever to the frame.

The pattern drum 14, as already pointed out, is driven by either of two separate mechanisms. At one time it is driven from the shaft 21 by the interposed train of gears 25, 26 and 27 (see Figs. 1 and 2). At other times it is driven from the shaft 16, which, it will be remembered, is driven from the main shaft by the interposed gears 17, 19 and 19 (see Fig. 2). For this purpose a plurality of pawl carrying levers 512, herein shown as five in number, are fulcrumed on the shaft 103. For convenience in making adjustments, the pawl carriers are made in two parts, the part 512 carrying the pawls 513 and the part 514 carrying the follower rolls 515. A suitable screw 516 in the part 512 provides means for adjustment. The follower rolls 515 engage cams 517 (see Fig. 4) secured to the shaft 16. The pawls 513 pivotally mounted in the carriers are provided with rearward extensions 518. A link 519 provided with a collar 520 passes up through a block 521 which is carried on a bar 524 secured on the arm 522 fulcrummed on the shaft 523. A spring 526 connecting the rearward extension 518 to the pawl carrier 512 keeps the collar 520 in engagement with the block 521. The arm 522 carrying the bar 524 acting through the block 521, the collar 520, and the link 519 hold the rearward extension of the pawl down, thereby elevating the forward end of the pawl. The pawls when in action, cooperate with the toothed wheels 525 on the pattern drum 14 according to the shape of the cams 517 and are yieldingly held in engagement with the toothed wheels by the springs 526. The pawl carriers are held yieldingly in engagement with the cams 517 by suitable springs 527 connected to the rod 528. An arm 529 secured to the shaft 523 is pivotally connected to a link 530, the lower end of which is pivotally connected to an arm 531 secured to the shaft 532. This shaft (see Figs. 2 and 4) is journalled in the frame and has an arm 533 secured at the opposite end and connected by a link 534 to an arm 535 connected with the pawl controller 536. This pawl controller operates as fully described in the aforesaid Patent No. 1,695,734, under the control of the pattern chain 30, to control the engagement of the pawl 23 with the rack wheel 22. Consequently, the movement imparted to the pawl controller by the pattern chain is transmitted through the link 534 and the connections

described to control the engagements of the pawls 513 with the ratchet wheels 525 on the pattern drum 14. The teeth on the ratchet wheels 525 are so arranged that only one pawl is driving at the same time and the arrangement is such that these pawls 513 actuated by the cams 517 drive the pattern drum at one time, while the usual pawl 23 acting on the rack wheel 22 drives the pattern drum 14 through the medium of the shaft 21 and the gears 25, 26 and 27 at another time, all as required by the work to be performed.

As already pointed out, the drum 31 with its shaft 32 is driven from the main shaft 10 under the control of both the pattern chain 30 and the drum 33. A suitable mechanism for thus operating the drum 31 is shown in Figs. 25 and 26. The shaft 32 on which the drum 31 is mounted is provided with the ratchet wheel 537 and this ratchet wheel is operated, and with it the drum 31, intermittently by a pawl 538 on a pawl carrier 539 pivoted at its forward end to a lever 540 fulcrumed on the shaft 46 and carrying at its upper end a roll 541 engaging an eccentric 542 carried on the end of the main shaft 10, see Figs. 33 and 35. Thus, as the main shaft is operated, the shaft 32 is intermittently rotated provided the pawl 538 is in engagement with the ratchet wheel 537. Two means are provided, the action of both of which must concur in order to permit engagement of the pawl with the ratchet wheel and either of which may prevent such engagement. As one means, a cam 543 is provided on the drum 33 or secured to the shaft 16 to rotate therewith. This cam acts upon one arm 544 of a bell crank lever journalled on the shaft 32 and having its other arm 555 extending beneath the pawl carrier 539. When the low part of the cam 543 is in engagement with the arm 544, the pawl 538 may if not otherwise controlled, drop into engagement with the ratchet wheel 537. As the other means, a second pawl controlling lever 556 (see Fig. 3) is journalled on the shaft 46. One arm 557 of this lever has adjustably mounted therein a pin 558 overlying the pattern chain 30 on the sprocket wheel 29; while another arm 559 has adjustably connected thereto a rod 560 extending back and connected to one arm 561 of a bell crank lever fulcrumed on a vertical stud 562 carried from the frame. The other arm 563 of this lever is normally drawn by a spring 564 against the face of the ratchet wheel 537 and beneath the pawl 538, camming it upward and holding it out of engagement with the ratchet wheel. When a lug on the pattern chain 30 passes beneath the pin 558, the arm 563 of the lever is withdrawn from beneath the pawl 538, allowing it to drop into engagement with the ratchet wheel 537 providing the cam 543 permits.

The spliced area in the lower ankle portion may be of any desired type to form a spliced or high spliced heel, and preferably will be formed as disclosed in the patent to La Montagne, No. 1,893,588, granted January 10, 1933, and of that type wherein the spliced area at each side of the gap coincides at one edge with the gap and at the other edge in the web of the angle is of any desired configuration. Preferably also, the lateral edges of the spliced areas lying within the body of the web are formed as disclosed in the said application with the splicing yarn floating laterally from alternate to intermediate courses.

It will be understood that the machine disclosed is in many respects illustrative of the broader principles of the invention. The machine will, of course, be equipped with the usual adjunctive devices such as yarn take-ups and other mechanisms required in knitting. Many of the parts, the general construction and operation of which are familiar to those skilled in the art, have not been described in detail and in some cases have been omitted for clearness of illustration. The various pattern mechanisms including the cams and similar elements will be designed and changed according to the requirements and, in so far as they are herein illustrated, are shown for the purpose of disclosing the principles of operation rather than the actual constructional design.

Having thus described the invention, what is claimed as new, and desired to be secured by Letters Patent, is:

1. A knitting machine comprising a needle cylinder, a circular series of needles mounted to reciprocate therein, a cam cylinder for controlling the needles, means for relatively rotating and for relatively oscillating the needle and cam cylinders for predetermined periods to knit in succession a section of round and round work to form the leg and calf sections of a stocking web, a section of to and fro work to form the ankle section, a section of to and fro work to form the heel section, a section of to and fro work to form the foot section, a section of to and fro work to form the toe section, means for automatically shifting the relative rotary positions of the needle and cam cylinders 180° at the beginning and at the end of the knitting of the heel section to cause the heel section to be knit on the opposite side of the web from the ankle, foot and toe sections, means for maintaining a segment of the needles at the back of the web out of action and without retaining yarn during the entire knitting of the to and fro work, and means for feeding a separate yarn to each half of the heel section during the knitting thereof.

2. A knitting machine comprising a circular series of needles including four groups arranged in circular sequence with the first and third groups diametrically disposed and with the second and fourth groups of similar extent and symmetrically disposed with respect to the said diameter, means for, first, operating all the needles to produce a web section of round and round work, second, maintaining the needles of the third group out of action and operating needles of the remaining groups to produce a web section of to and fro work, third, maintaining the needles of the third group out of action, rendering needles of the first group inactive holding the stitches and operating, narrowing and widening, the needles of the second and fourth groups to produce separate web sections of to and fro work, fourth, maintaining the needles of the third group out of action, restoring the needles of the first group into action and operating the needles of the first, second, and fourth groups to produce a web section of to and fro work, and, fifth, maintaining the needles of the second, third, and fourth groups out of action and operating, narrowing and widening, the needles of the first group to produce a web section of to and fro work, and means for shifting the rotary position of said series of needles with respect to said operating means 180° both when the needles of the first group are rendered inactive and when they are restored into action.

3. A knitting machine comprising a needle cylinder, a circular series of needles mounted to reciprocate therein, a cam cylinder for controlling

the needles, means for relatively oscillating the needle and cam cylinders for predetermined periods to knit in succession a section of to and fro work to form the ankle section of a stocking web, a section of to and fro work to form the heel section, a section of to and fro work to form the foot section and a section of to and fro work to form the toe section, means for automatically shifting the relative rotary positions of the needle and cam cylinders 180° at the beginning and at the end of the knitting of the heel section, means for maintaining a segment of needles out of action and without retaining yarn during the knitting of the said sections to form a gap throughout the length thereof, and means for preventing each edge needle employed in the to and fro knitting of the said ankle, heel, foot and toe sections from taking yarn on the reciprocation in one direction and for causing each of these needles to knit only on the reciprocation in the opposite direction whereby a selvage is formed throughout each edge of the gap.

4. A knitting machine comprising the construction defined in claim 3, together with means for preventing one or more of the needles adjacent each of said edge needles from taking yarn thus to render the selvages elastic.

5. A knitting machine comprising a needle cylinder and a circular series of needles mounted to reciprocate therein, a cam cylinder for controlling the needle cylinder, means for maintaining a group of the needles out of action holding stitches of the previously knit web, means for preventing a second diametrically opposite group of the needles from taking yarn, separate yarn feeding means for each of the two intermediate groups, and means for producing relative oscillation of the needle and cam cylinders and for operating the needles of the two intermediate groups narrowing and widening on the needles of each adjacent the first group with the edge needle of each adjacent the second group prevented from taking yarn at alternate courses and knitting off only at alternate courses and with one or more needles adjacent each of said edge needles prevented from taking yarn at each course thus to form separated pocket sections each having an elastic selvage.

6. A knitting machine comprising a needle cylinder and a circular series of needles mounted to reciprocate therein, a cam cylinder for controlling the needles, means for maintaining a group of the needles out of action holding stitches of the previously knit web, means for producing relative oscillation of the needle and cam cylinders over the segment of needles opposite said group, two yarn guides for feeding yarn respectively to the groups of needles at each side of said first group, and means for operating the needles of said segment to prevent a group of needles diametrically opposite the first group from taking yarn, to cause each edge needle of the side groups to take yarn and knit off only on alternate courses, to prevent one or more needles of each side group adjacent its edge needle from taking yarn, and to cause the remaining needles of each side group to knit at each course narrowing and widening on the needles adjacent the first group thus to form attached to the web separated pocket sections with elastic selvages.

7. A knitting machine comprising a circular series of needles including a group of short butt needles, two groups of medium butt needles, one at each side of the short butt needles, and a group of long butt needles diametrically opposite the group of short butt needles, means for operating the needles to produce successive web sections including a section of to and fro knitting formed on the short and medium butt needles, a section of to and fro knitting formed on the medium butt needles, a section of to and fro knitting formed on the short and medium butt needles and a section of to and fro knitting formed on the short butt needles, and means for preventing the long butt needles from taking yarn during the knitting of all of the aforesaid sections, a short butt needle at the end of each group of medium butt needles adjacent the group of long butt needles, one or more long butt needles adjacent said short butt needle in each group of medium butt needles, three separate yarn feeds, one for each of the groups of short and medium butt needles, and means for controlling the short butt needles and long butt needles at the end of each group of medium butt needles to form elastic selvages at the edges of the section of to and fro knitting formed on the groups of medium butt needles adjacent the group of long butt needles.

8. A knitting machine comprising a needle cylinder, a series of needles forming a circular segment mounted to reciprocate in the needle cylinder, a cam cylinder for controlling the needles, means for relatively oscillating the needle and cam cylinders, and means for operating the needles to knit to and fro work on said segment of needles including means to prevent each edge needle of said segment from knitting on the oscillation away from its edge and to cause the said needle to knit only on the oscillation toward its edge and including means to prevent one or more needles of said segment adjacent each edge needle from taking yarn at each oscillation whereby an elastic selvage is formed throughout each edge of the web.

9. A knitting machine comprising a needle cylinder, a series of needles forming a circular segment mounted to reciprocate in the needle cylinder, a cam cylinder for controlling the needles, means for relatively oscillating the needle and cam cylinders, and means for operating the needles to knit to and fro work on said segment including means for preventing each edge needle of said segment from knitting on the reciprocations away from its edge and to cause the said needle to knit only on the reciprocations toward its edge and for preventing one or more needles of said segment adjacent each edge needle from taking yarn thus to form an elastic selvage at each edge of the web.

10. A knitting machine comprising a needle cylinder, a series of needles forming a circular segment mounted to reciprocate in the needle cylinder, a cam cylinder for controlling the needles, means for relatively oscillating the needle and cam cylinders, and means for operating the needles to knit to and fro work on said segment including cams carried by the cam cylinder and moved in and out at each oscillation acting to prevent each edge needle of said segment from knitting on the reciprocations away from its edge and to cause the said needle to knit only on the reciprocations toward its edge and for preventing one or more needles of said segment adjacent each edge needle from taking yarn thus to form an elastic selvage at each edge of the web.

11. A knitting machine comprising a needle cylinder, a series of needles forming a circular segment mounted to reciprocate in the needle

cylinder, a cam cylinder for controlling the needles, means for relatively oscillating the needle and cam cylinders, two sets of cams carried by the cam cylinder and means for moving the two sets in and out alternately as said oscillation takes place to prevent each edge needle of said segment from knitting on the oscillation away from its edge and to cause the said needle to knit only on the oscillation toward its edge thus to produce selvages on the web knit by said segment of needles.

12. A knitting machine comprising a needle cylinder, a series of needles forming a circular segment mounted to reciprocate in the needle cylinder, a cam cylinder for controlling the needles, two sets of cams carried by the cam cylinder, means for moving the two sets in and out alternately as said oscillation takes place to prevent each edge needle of said segment from knitting on the oscillation away from its edge and to cause the said needle to knit only on the oscillation toward its edge, and means acting to prevent one or more needles of said segment adjacent each edge needle from taking yarn at each oscillation thus to produce elastic selvages on the web knit by said segments of needles.

13. A knitting machine comprising a needle cylinder, a circular series of needles mounted to reciprocate therein, a cam cylinder for controlling the needles, means for relatively oscillating the needle and cam cylinders to knit to and fro work, two sets of needle raising and lowering cams carried by the cam cylinder, two independent pattern mechanisms, one of which acts at one time and the other of which acts at another time, to move both sets of cams inward to operate upon selected needles, and means acting at each oscillation, when both sets of cams are thus moved inward, to give in alternation a further inward and an outward movement thereto to operate upon other selected needles.

14. A knitting machine comprising a needle cylinder, a circular series of needles mounted to reciprocate therein, a cam cylinder for controlling the needles, means for relatively oscillating the needle and cam cylinders to knit to and fro work, two sets of needle raising and lowering cams carried by the cam cylinder, two independent pattern mechanisms, one of which acts at one time and the other of which acts at another time, to move both sets of cams inward to operate upon selected needles, a pair of cams secured to the needle cylinder and acting at each oscillation thereof when the said sets of cams are thus moved inward to give in alternation a further inward and an outward movement thereto to operate upon other selected needles.

15. A knitting machine comprising a circular series of needles including a group for knitting a section of to and fro work and two groups, one at each side of the first group, for knitting independent sections of to and fro work, means for operating the said needles to knit at one period to and fro work on the first group narrowing and widening on the needles thereof adjacent the other two groups and to knit at another period to and fro work separately on each of the other two groups narrowing and widening on the needles thereof adjacent the first group and to knit at a third period to and fro work on the three groups as a whole, and means for shifting the center of the arc of oscillation 180° before and after knitting separately on the said two groups.

16. A knitting machine comprising a needle cylinder, two adjacent segments of needles mounted to reciprocate therein, a cam cylinder for controlling the needles, stitch cams carried by the cam cylinder, means for relatively oscillating the needle and cam cylinders to knit to and fro work, a yarn guiding finger for each segment of the needles for feeding yarn thereto, and means for raising a plurality of the needles at the juncture of the segments above the level of the others each time they reach the stitch cams on either oscillation and for operating the yarn guiding fingers to cause the yarn from one finger not to be taken by said plurality of needles upon oscillation in one direction and the yarn from the other finger not to be taken upon oscillation in the opposite direction, whereby a joint is formed in the web at the juncture of the segments with the two yarns in alternation floating and knit in at each course throughout the zone of the said plurality of needles.

17. A knitting machine comprising a needle cylinder, two adjacent segments of needles mounted to reciprocate therein, a cam cylinder for controlling the needles, stitch cams carried by the cam cylinder, means for relatively oscillating the needle and cam cylinders to knit to and fro work, a yarn guiding finger for each segment of the needles for feeding yarn thereto, and means for raising a plurality of the needles at the edge of one segment ajacent the other segment above the level of the other needles each time they reach the stitch cams on either oscillation and for operating the yarn guiding fingers to cause the yarn from one finger not to be taken by said plurality of needles upon oscillation in one direction and the yarn from the other finger not to be taken upon oscillation in the opposite direction, whereby a joint is formed in the web at the juncture of the segments with the two yarns in alternation floating and knit in at each course throughout the zone of the said plurality of needles.

18. A knitting machine comprising a needle cylinder, two adjacent segments of needles mounted to reciprocate therein, a cam cylinder for controlling the needles, a yarn guiding throat associated with the cam cylinder, stitch cams carried by the cam cylinder, means for oscillating the needle cylinder to knit to and fro work, two yarn guiding fingers located in the throat one for each segment of the needles for feeding yarn thereto, and means for raising a plurality of the needles at the juncture of the segments above the level of the other needles each time they reach the stitch cams on either oscillation and for operating the yarn guiding fingers to cause the yarn from one finger not to be taken by said plurality of needles upon oscillation in one direction and the yarn from the other finger not to be taken upon oscillation in the opposite direction, whereby a joint is formed in the web at the juncture of the segments with the two yarns in alternation floating and knit in at each course throughout the zone of the said plurality of needles.

19. A knitting machine comprising a needle cylinder, three successively adjacent segments of needles mounted to reciprocate therein, a cam cylinder for controlling the needles, stitch cams carried by the cam cylinder, means for relatively oscillating the needle and cam cylinders to knit to and fro work, three yarn guiding fingers one for each segment of the needles for feeding yarn thereto, and means for conjointly controlling a plurality of the needles at each juncture of the segments and the yarn guiding fingers each time

the said plurality of needles reaches the stitch cams on either oscillation to cause each of the two yarns at each juncture in alternation to float over and to be knit in by said plurality of needles.

20. A knitting machine comprising a needle cylinder, three successively adjacent segments of needles mounted to reciprocate therein, a cam cylinder for controlling the needles, stitch cams carried by the cam cylinder, means for relatively oscillating the needle and cam cylinders to knit to and fro work, three yarn guiding fingers one for each segment of the needles for feeding yarn thereto, and means for conjointly controlling a plurality of the needles at the edge of each outer segment adjacent the intermediate segment and the yarn guiding fingers each time the said plurality of needles reaches the stitch cams on either oscillation to cause each of the two yarns at each of said edges in alternation to float over and to be knit in by said plurality of needles.

21. A knitting machine comprising a needle cylinder, three successively adjacent segments of needles mounted to reciprocate therein, a cam cylinder for controlling the needles, stitch cams carried by the cam cylinder, means for oscillating the needle cylinder to knit to and fro work, a yarn guiding throat associated with the cam cylinder, three yarn guiding fingers one for each segment of needles for feeding yarn thereto located at the throat, and means for conjointly controlling a plurality of the needles at the edge of each outer segment adjacent the intermediate segment and the yarn guiding fingers each time the said plurality of needles reaches the stitch cams on either oscillation to cause each of the two yarns at each of said edges in alternation to float over and to be knit in by said plurality of needles.

22. A knitting machine comprising a needle cylinder, two adjacent segments of needles mounted to reciprocate therein, a cam cylinder for controlling the needles, means for oscillating the needle cylinder to knit to and fro work, two yarn guiding fingers each for feeding a yarn to one of said segments of needles, and means for operating said yarn guiding fingers and for dividing a group of the needles at the adjacent edges of said segments to cause the said yarns alternately to be knit by and to float over said groups of needles at each course thus to form a strong and well-appearing joint between the segments of the web.

23. A knitting machine comprising a needle cylinder, two adjacent segments of pivoted latch needles mounted to reciprocate therein, a cam cylinder for controlling the needles, stitch cams carried by the cam cylinder, means for relatively oscillating the needle and cam cylinders to knit to and fro work, a yarn guiding finger for each segment of the needles for feeding yarn thereto, and means for raising a plurality of the needles at the juncture of the segments each time they reach the stitch cams on either oscillation and for operating the yarn guiding fingers to cause the yarn from one finger to be fed beneath the latches of said plurality of needles upon the oscillation in one direction and to cause the yarn from the other finger to be fed beneath the said latches upon the oscillation in the opposite direction whereby a joint is formed in the web at the juncture of the segments with the two yarns in alternation floating and knit in at each course throughout the zone of the said plurality of needles.

24. A knitting machine comprising a needle cylinder, two adjacent segments of pivoted latch needles mounted to reciprocate therein, a cam cylinder for controlling the needles, means for oscillating the needle cylinder to knit to and fro work, two yarn guiding fingers each for feeding a yarn to one of said segments of needles, and means for operating said yarn guiding fingers and for dividing and raising a group of the needles at the adjacent edges of said segments at each approach of the said group to the knitting point to cause in alternation at each course one of said yarns to be fed beneath the latches and the other to be taken by the needles of said group thus to form a joint in the web with the two yarns in alternation floating and knit in at each course throughout the zone of the said group of needles.

25. A knitting machine comprising a needle cylinder, a circular segment of needles mounted to reciprocate therein, a cam cylinder for controlling the needles, means for oscillating the needle cylinder to knit to and fro work, a yarn guiding throat associated with the cam cylinder, two yarn guiding fingers each mounted off center at opposite sides of the throat, means for moving each finger as required into feeding position, and transversely movable means for forcing the yarn carried by each of said fingers when in feeding position laterally toward that side of the throat where the knitting takes place and into position where it will be received by the needles.

26. A knitting machine comprising a needle cylinder, a circular segment of needles mounted to reciprocate therein, a cam cylinder for controlling the needles, means for oscillating the needle cylinder to knit to and fro work, a yarn guiding throat associated with the cam cylinder, two yarn guiding fingers each mounted off center at opposite sides of the throat, means for moving each finger as required into feeding position, and pattern controlled means for forcing the yarn carried by each of said fingers when in feeding position laterally toward that side of the throat where the knitting takes place and into position where it will be received by the needles.

27. A knitting machine comprising a needle cylinder, a circular segment of needles mounted to reciprocate therein, a cam cylinder for controlling the needles, means for oscillating the needle cylinder to knit to and fro work, a yarn guiding throat associated with the cam cylinder, two yarn guiding fingers each mounted off center at opposite sides of the throat, means for moving each finger as required into feeding position, and independent pattern controlled means for forcing the yarn carried by each of said fingers when in feeding position laterally toward that side of the throat where the knitting takes place and into position where it will be received by the needles.

28. A knitting machine comprising a needle cylinder, a circular segment of needles mounted to reciprocate therein, a cam cylinder for controlling the needles, means for oscillating the needle cylinder to knit to and fro work, a yarn guiding throat associated with the cam cylinder, two yarn guiding fingers each mounted off center at opposite sides of the throat, means for moving each finger as required into feeding position, two yarn guiding pins cooperating respectively with the fingers, and means for moving each pin as required transversely toward that side of the throat where the knitting takes place thus to force the yarn presented by its cooperating finger into position to be received by the needles.

29. A knitting machine comprising a needle

cylinder and a circular series of needles mounted to reciprocate therein, a cam cylinder for controlling the needles, means for producing relative oscillation of said needle and cam cylinders to knit to and fro work, stitch cams carried by the cam cylinder, means located at each side of the stitch cams acting to raise and lower a predetermined group of needles as they approach the stitch cams in either direction, two deflecting cams, one at each side of the stitch cams and between them and the raising and lowering means, acting to deflect said group of needles beneath the stitch cams whereby the said group of needles is prevented from knitting at each oscillation thus forming a gap throughout the to and fro knitted web.

30. A knitting machine comprising a needle cylinder and a circular series of needles mounted to reciprocate therein, a cam cylinder for controlling the needles, means for relatively rotating and oscillating the needle and cam cylinders to cause the needles to knit round and round or to and fro work as required, means for automatically shifting the relative rotary position of the needle and cam cylinders 180° at predetermined times, and an oppositely acting spring means, interposed in said means for relatively rotating and oscillating the needle and cam cylinders, acting to dampen the shock upon each change in direction of oscillation and upon the said shift in either direction.

31. A knitting machine comprising a needle cylinder and a circular series of needles mounted to reciprocate therein, a cam cylinder for controlling the needles, a shaft, means for rotating and oscillating the shaft, a gear journalled on the shaft, a clutch member secured to the gear to yield slightly with respect thereto in either rotary direction, clutch means secured to the shaft coacting with the clutch member, means for transmitting the movement of the gear to effect relative rotation and oscillation of the needle and cam cylinders to cause the needles to knit round and round or to and fro work as required, and means for automatically operating the clutch means to shift the rotary position of the gear with respect to the shaft 180° prior to the beginning of and at the conclusion of a predetermined section of to and fro knitting.

32. A knitting machine comprising a needle cylinder and a circular series of needles mounted to reciprocate therein, a cam cylinder for controlling the needles, a shaft, means for rotating and oscillating the shaft, a gear journalled on the shaft, a clutch member, oppositely acting spring means securing the clutch member to the gear to permit the clutch member to yield slightly with respect to the gear in either rotary direction, clutch means secured to the shaft coacting with the clutch member, means for transmitting the movement of the gear to effect relative rotation and oscillation of the needle cylinder and cam cylinder to cause the needles to knit round and round or to and fro work as required, and means for automatically operating the clutch means to shift the rotary position of the gear with respect to the shaft 180° prior to the beginning of and at the conclusion of a predetermined section of to and fro knitting.

33. In a knitting machine an element controlling and operating mechanism comprising a rotating cam, a reciprocable actuator, a connection from the actuator to said element, a follower lever, a two-part follower mounted on said lever, means for independently adjusting each follower part on said lever to adjust its relation to the cam, and pattern-operated means to effect as required the connection and disconnection of the follower lever and actuator.

34. In a knitting machine an element controlling and operating mechanism comprising a rotating cam, a reciprocable actuator, a connection from the actuator to said element, a follower lever, a follower carrier mounted on said lever, means for adjusting the follower carrier with respect to said lever, a two-part follower mounted on said carrier, means for independently adjusting each follower part on said carrier, and pattern-operated means to effect as required the connection and disconnection of the follower lever and actuator.

35. A knitting machine comprising a needle cylinder and a circular series of needles mounted to reciprocate therein, a dial and a series of elements therein to cooperate with the needles, a cam cylinder and a dial cam for controlling the said needles and elements respectively, means for rotating and oscillating the needle cylinder and dial, means for automatically shifting the rotary position of the needle cylinder and dial 180° at predetermined times, a plurality of yarn guiding fingers movable into and out of position for feeding yarns as required to the needles, and means acting automatically to depress a yarn extending from a yarn guiding finger when moved out of position to beneath the dial when said shift of rotary position takes place thus to prevent the yarn from being wrapped around the machine above the dial.

36. A knitting machine comprising a needle cylinder and a circular series of needles mounted to reciprocate therein, a dial and a series of elements therein to cooperate with the needles, a cam cylinder and a dial cam for controlling the said needles and elements respectively, means for rotating and oscillating the needle cylinder and dial, means for automatically shifting the rotary position of the needle cylinder and dial 180° at predetermined times, a plurality of yarn guiding fingers movable into and out of position for feeding yarns as required to the needles, a normally inactive yarn deflector, pattern-controlled means acting when the said shift of rotary position takes place to depress a yarn extending to a yarn guiding finger out of position beneath the dial so that the said yarn will not be wrapped around the mechanism of the machine when the shift takes place.

37. A knitting machine comprising a needle cylinder, a circular series of needles mounted for reciprocation therein, a cam cylinder for controlling the needles, means for oscillating the needle cylinder to knit to and fro work, a plurality of yarn guiding fingers, pattern-controlled mechanism for selectively moving the yarn guiding fingers into and out of yarn presenting position, means for clamping and severing the yarns carried by said fingers when moved out of yarn presenting position, a brush, and pattern controlled means for operating said brush to wipe the severed yarn ends into a position where they will be prevented from being knit into the web.

38. A knitting machine comprising a needle cylinder, a circular series of needles mounted for reciprocation therein, a cam cylinder for controlling the needles, means for oscillating the needle cylinder to knit to and fro work, a plurality of yarn guiding fingers, means for selectively moving the yarn guiding fingers into and

out of yarn presenting position, means acting to clamp and sever the yarn or yarns carried by the finger or fingers moved out of yarn presenting position, and means engaging the severed yarn end or ends upon and only upon successive oscillations in the same direction when the said end or ends are severed during to and fro knitting to wipe the said end or ends into a position to prevent knitting thereof into the web.

39. The method of knitting a continuous web on a circular series of needles which comprises knitting to and fro upon a segment of said needles a web section, throwing out of action while retaining the stitches a central section of said segment of needles, shifting the center of reciprocation 180° and knitting to and fro narrowing and widening upon needles at the opposite side of the series a web pocket section contiguous to the first section, preventing the needle at each end of the said segment from taking the yarn upon each reciprocation away from said needle toward the center of the segment thereby to form selvaged edges on the web section knit on the said segment.

40. A knitting machine comprising a needle cylinder having three successively adjacent segments of needles mounted to reciprocate therein, the intermediate segment for knitting the instep and the side segments each for knitting half the sole of a stocking, a cam cylinder for controlling the needles, means for relatively oscillating the needle and cam cylinders through an angle greater than that comprising the three segments, three yarn guiding fingers one for cooperating with each segment to feed yarn thereto, means for operating the yarn guiding fingers and the needles as the said oscillation takes place to cause each respective yarn to be fed to its corresponding segment and to be cut out and in at the juncture with the adjacent segment, and means acting to produce a different length of stitch in the knitting of the instep from that in the knitting of the sole portion.

41. A knitting machine comprising a needle cylinder having three successively adjacent segments of needles mounted to reciprocate therein, the intermediate segment for knitting the instep and the side segments each for knitting half the sole of a stocking, a cam cylinder for controlling the needles, means for relatively oscillating the needle and cam cylinders through an angle greater than that comprising the three segments, three yarn guiding fingers one for cooperating with each segment to feed yarn thereto, means for operating the yarn guiding fingers and the needles as the said oscillation takes place to cause each respective yarn to be fed to its corresponding segment and to be cut out and in at the juncture with the adjacent segment, and means acting at each oscillation past the juncture of the segments to vary the length of stitch and thus produce different lengths of stitches in the knitting of the instep and sole portions.

42. A knitting machine comprising a needle cylinder having three successively adjacent segments of needles mounted to reciprocate therein, the intermediate segment for knitting the instep and the side segments each for knitting half the sole of a stocking, a cam cylinder for controlling the needles, means for oscillating the needle cylinder through an angle greater than that comprising the three segments, three yarn guiding fingers one for cooperating with each segment to feed yarn thereto, means for operating the yarn guiding fingers and the needles as the said oscillation takes place to cause each respective yarn to be fed to its corresponding segment and to be cut out and in at the juncture with the adjacent segment, and means for shifting the position of the needle cylinder at each oscillation past the juncture of the segments to vary the length of stitch and thus produce different lengths of stitch in the knitting of the instep and sole portions.

PATRICK P. LA MONTAGNE.
GEORGE H. FROEMMING.