Dec. 20, 1966 G. F. SQUILLARIO ETAL 3,292,392

CIRCULAR KNITTING MACHINE FOR KNITTING SEAMLESS PANTY GIRDLES AND THE LIKE

Filed June 5, 1963 17 Sheets-Sheet 1

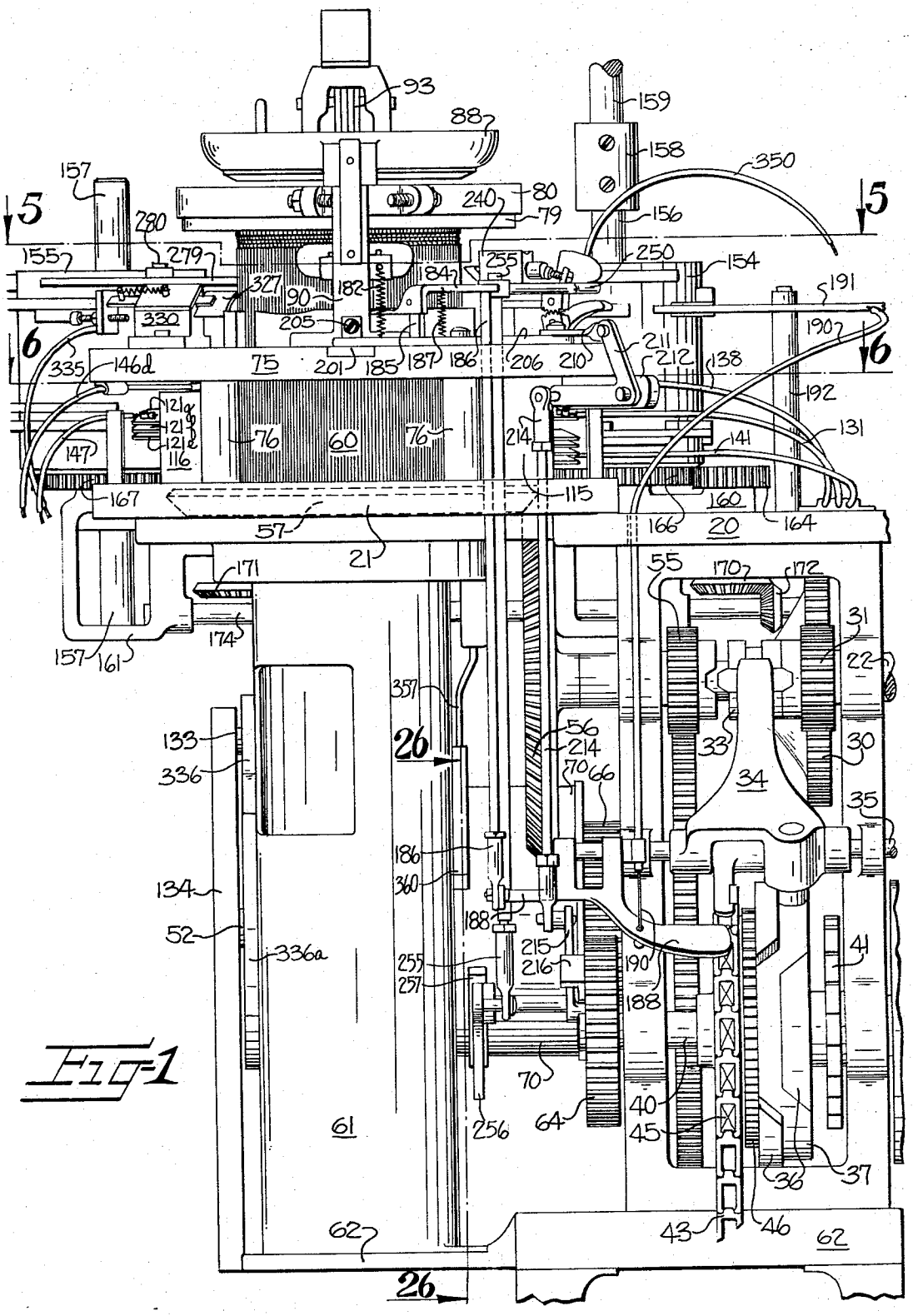


Fig-1

Dec. 20, 1966 G. F. SQUILLARIO ETAL 3,292,392
CIRCULAR KNITTING MACHINE FOR KNITTING SEAMLESS PANTY GIRDLES AND THE LIKE
Filed June 5, 1963 17 Sheets-Sheet 2

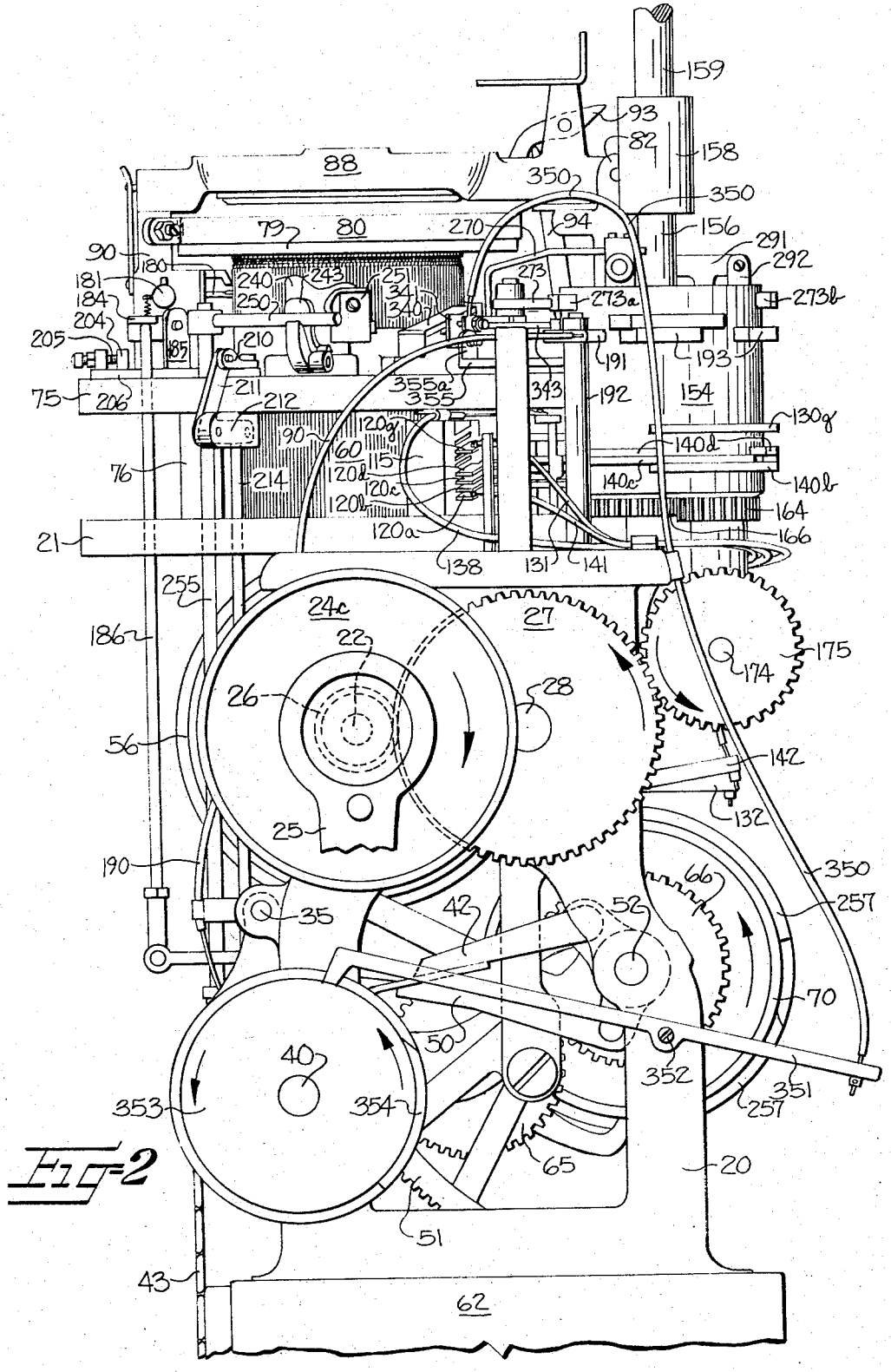


Fig-2

Dec. 20, 1966 G. F. SQUILLARIO ETAL 3,292,392

CIRCULAR KNITTING MACHINE FOR KNITTING SEAMLESS PANTY GIRDLES AND THE LIKE

Filed June 5, 1963 17 Sheets-Sheet 3

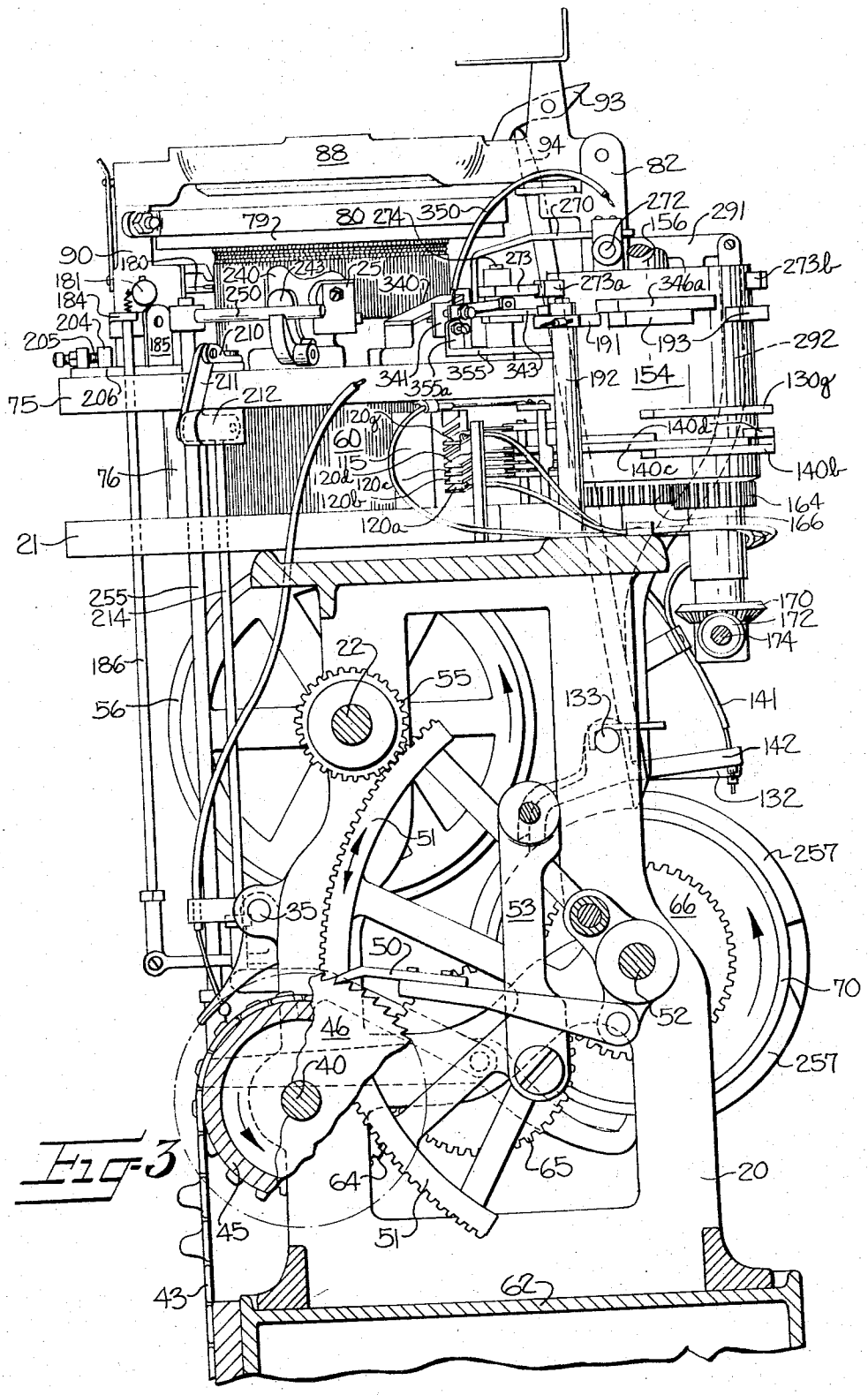


Fig-3

Dec. 20, 1966 G. F. SQUILLARIO ETAL 3,292,392

CIRCULAR KNITTING MACHINE FOR KNITTING SEAMLESS PANTY GIRDLES AND THE LIKE

Filed June 5, 1963 17 Sheets-Sheet 4

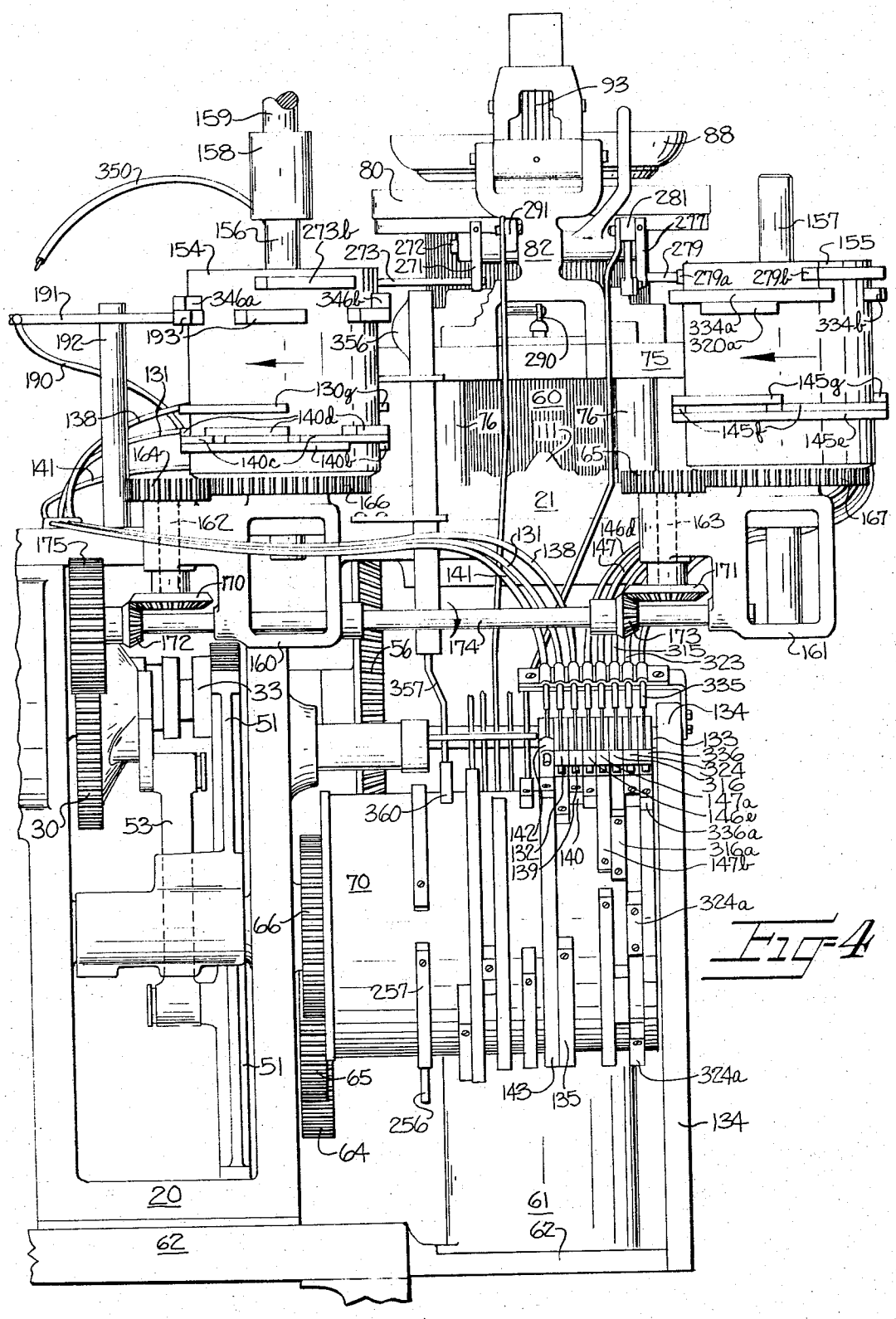


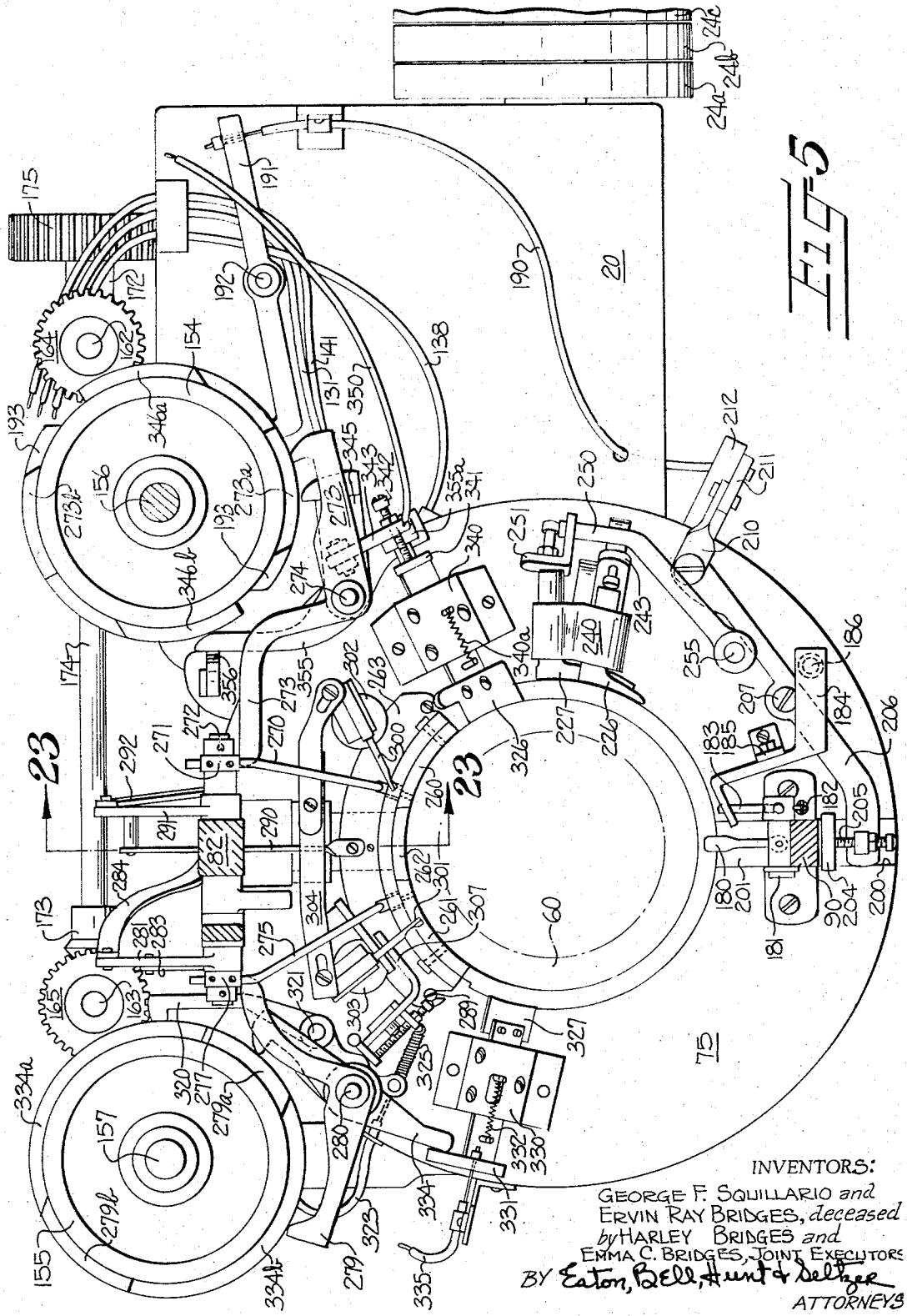
Fig-4

Dec. 20, 1966 G. F. SQUILLARIO ETAL 3,292,392

CIRCULAR KNITTING MACHINE FOR KNITTING SEAMLESS PANTY GIRDLES AND THE LIKE

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FIG. 5



INVENTORS:
GEORGE F. SQUILLARIO and
ERVIN RAY BRIDGES, deceased
by HARLEY BRIDGES and
EMMA C. BRIDGES, JOINT EXECUTORS
BY Eaton, Bell, Hunt & Deltzer
ATTORNEYS

Dec. 20, 1966 G. F. SQUILLARIO ETAL 3,292,392

CIRCULAR KNITTING MACHINE FOR KNITTING SEAMLESS PANTY GIRDLES AND THE LIKE

Filed June 5, 1963 17 Sheets-Sheet 6

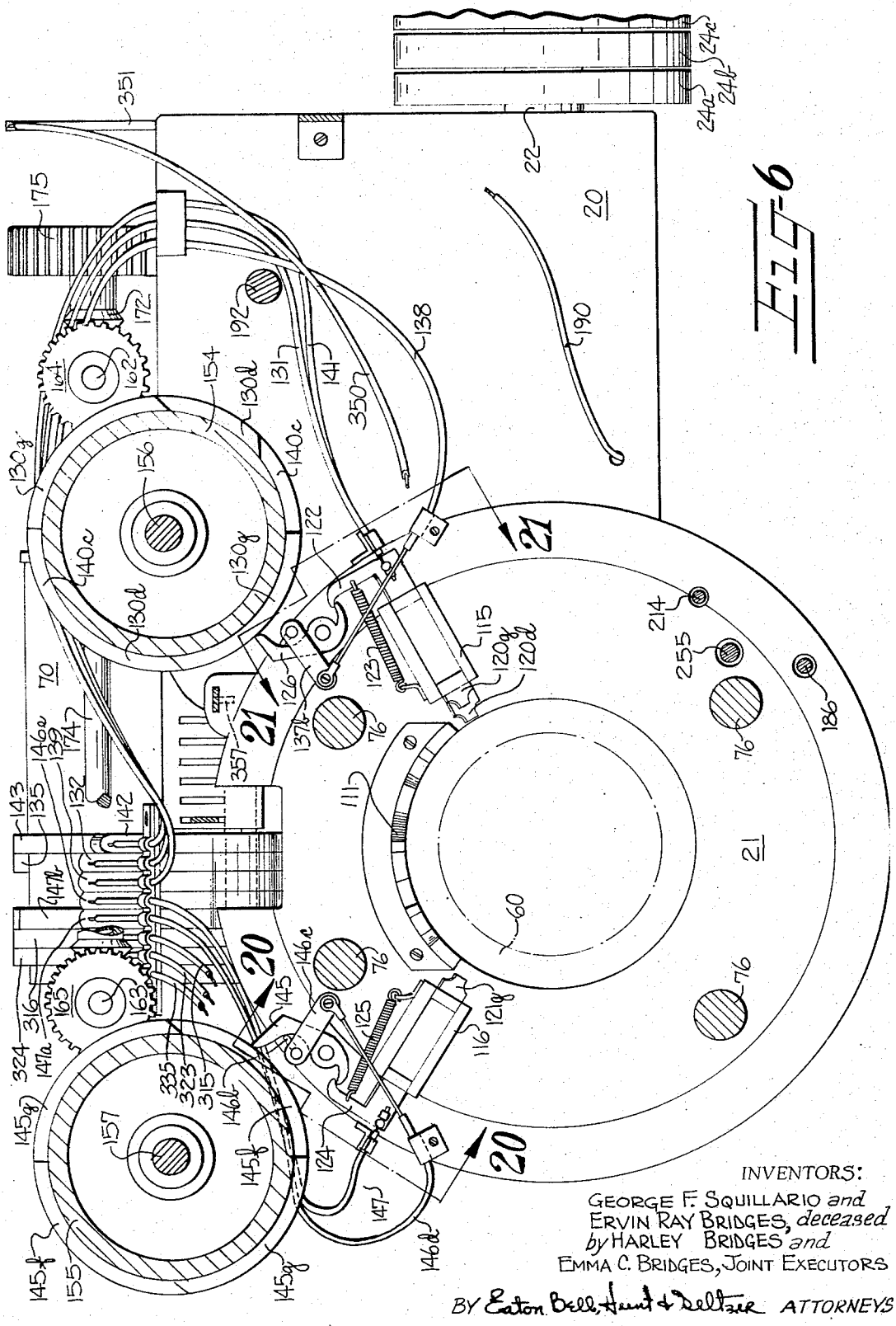


FIG-6

INVENTORS:
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by HARLEY BRIDGES and
EMMA C. BRIDGES, JOINT EXECUTORS

BY Eaton Bell, Hunt & Deltzer ATTORNEYS

Dec. 20, 1966 G. F. SQUILLARIO ET AL 3,292,392

CIRCULAR KNITTING MACHINE FOR KNITTING SEAMLESS PANTY GIRDLES AND THE LIKE

Filed June 5, 1963 17 Sheets-Sheet 7

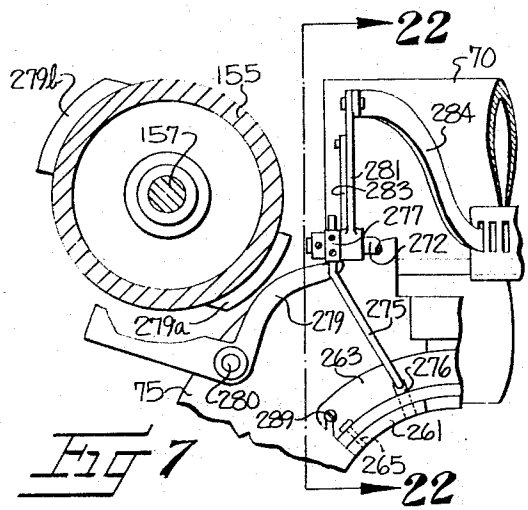


Fig 7

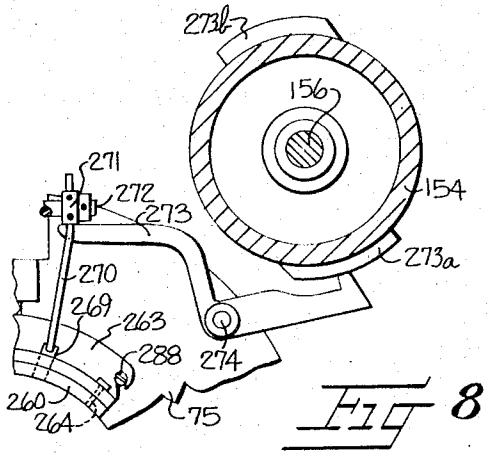


Fig 8

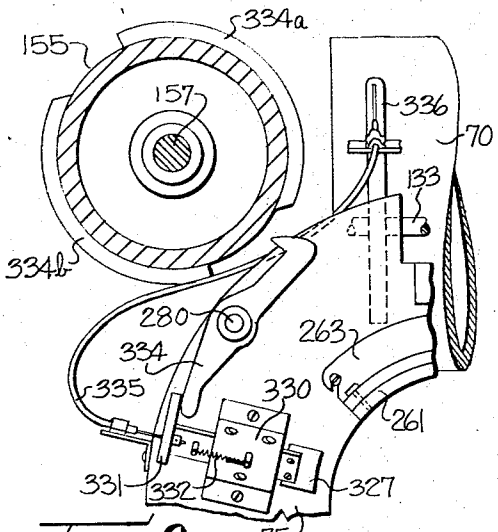


Fig-9

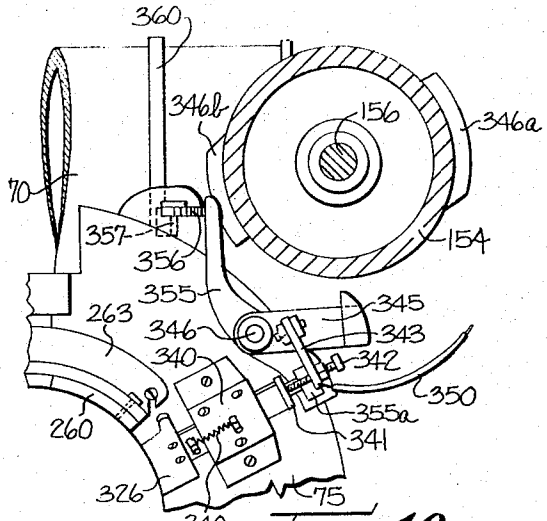


Fig-10

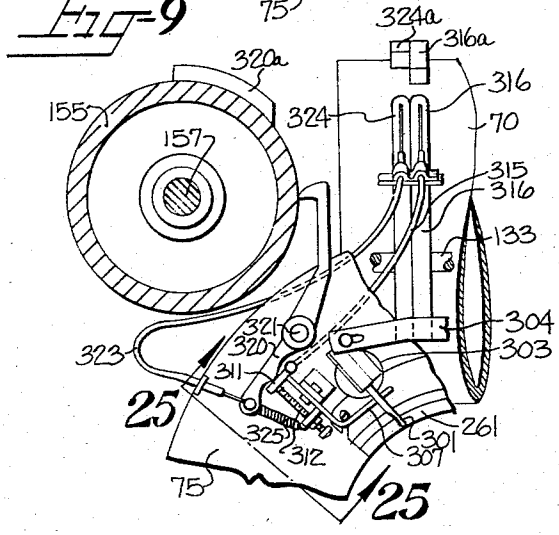


Fig-11

INVENTORS:
GEORGE F. SQUILLARIO and
ERVIN RAY BRIDGES, deceased
by HARLEY BRIDGES and
EMMA C. BRIDGES, JOINT EXECUTORS
BY Eaton, Bell, Hunt & Seltzer
ATTORNEYS

Dec. 20, 1966 G. F. SQUILLARIO ETAL 3,292,392

CIRCULAR KNITTING MACHINE FOR KNITTING SEAMLESS PANTY GIRDLES AND THE LIKE

Filed June 5, 1963 17 Sheets-Sheet 8

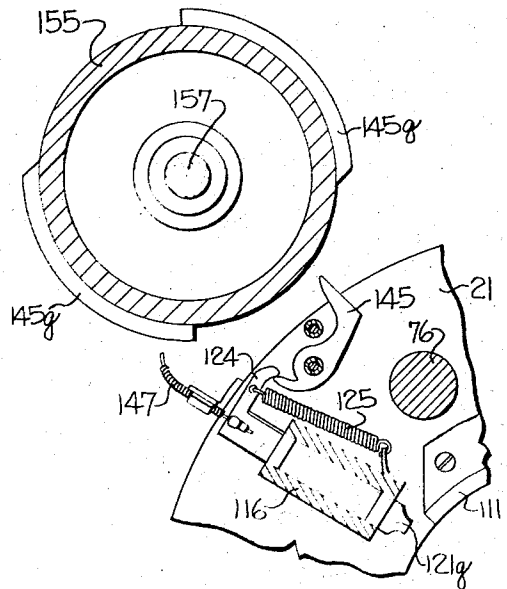


Fig-12

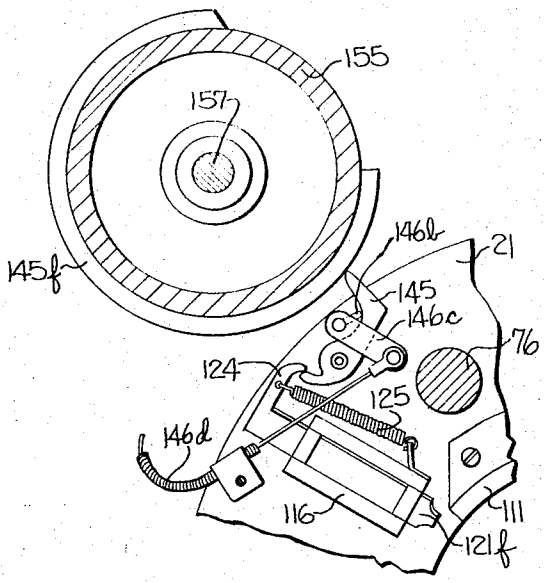


Fig-13

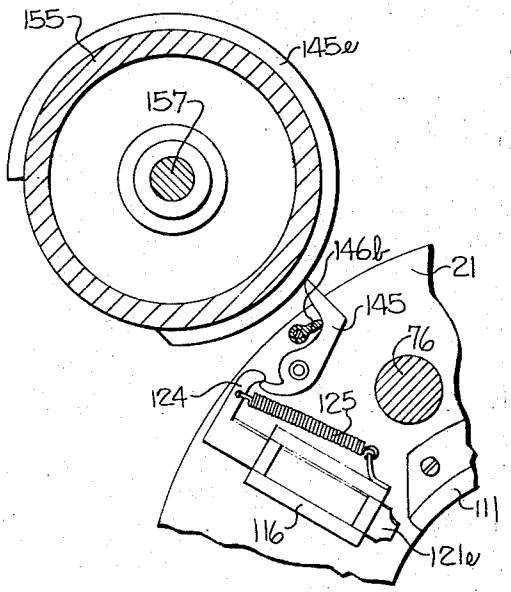


Fig-14

INVENTORS:
GEORGE F. SQUILLARIO and
ERVIN RAY BRIDGES, deceased
by HARLEY BRIDGES and
EMMA C. BRIDGES, JOINT EXECUTORS

By Eaton, Bell, Hunt & Deltzer ATTORNEYS

Dec. 20, 1966 G. F. SQUILLARIO ETAL 3,292,392

CIRCULAR KNITTING MACHINE FOR KNITTING SEAMLESS PANTY GIRDLES AND THE LIKE

Filed June 5, 1963 17 Sheets-Sheet 9

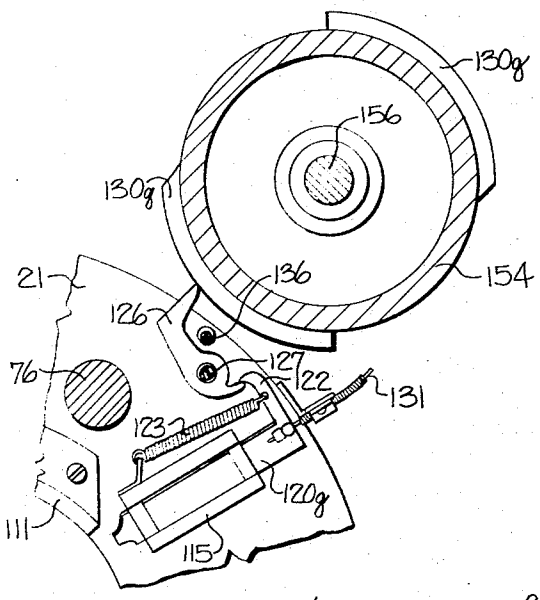


Fig-15

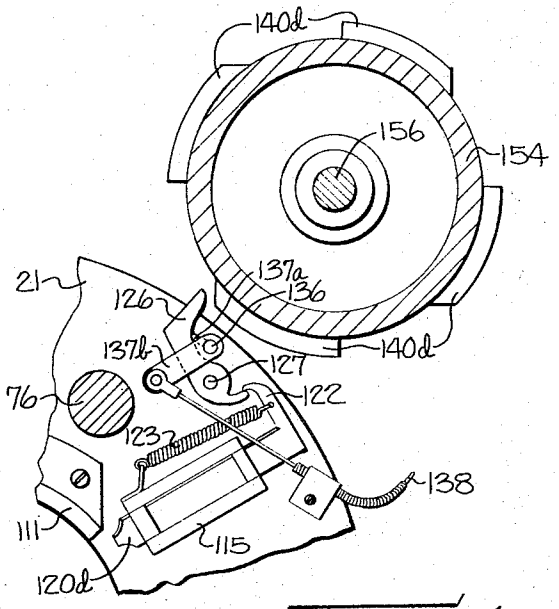


Fig-16

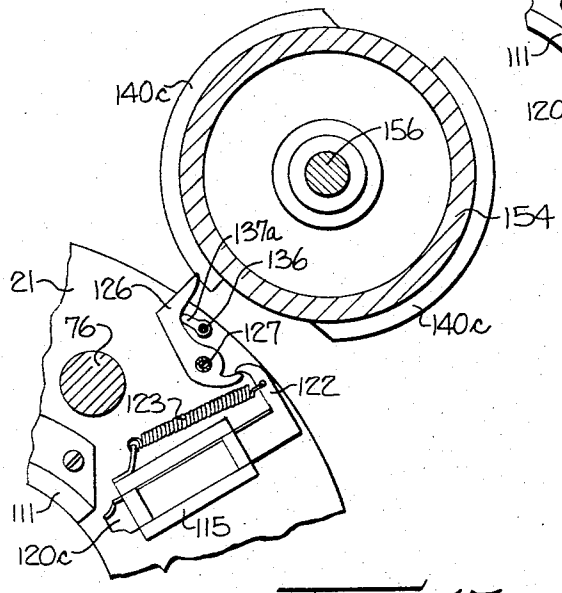


Fig-17

INVENTORS:
GEORGE F. SQUILLARIO and
ERVIN RAY BRIDGES, deceased
by HARLEY BRIDGES and
EMMA C. BRIDGES, JOINT EXECUTORS

BY Eaton, Bell, Hunt & Belt ATTORNEYS

Dec. 20, 1966 G. F. SQUILLARIO ETAL 3,292,392
CIRCULAR KNITTING MACHINE FOR KNITTING SEAMLESS PANTY GIRDLES AND THE LIKE
Filed June 5, 1963 17 Sheets-Sheet 10

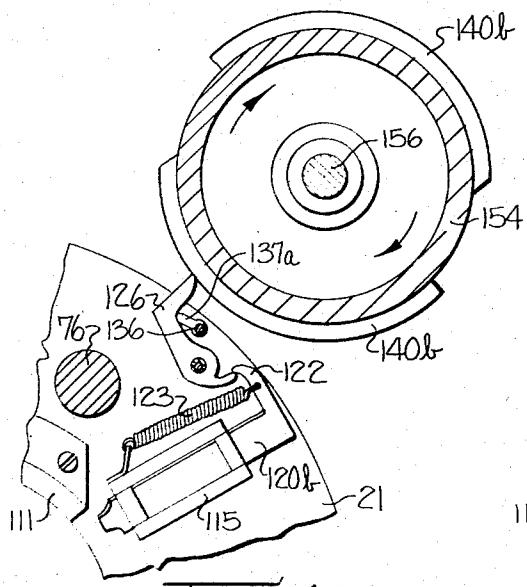


FIG-18

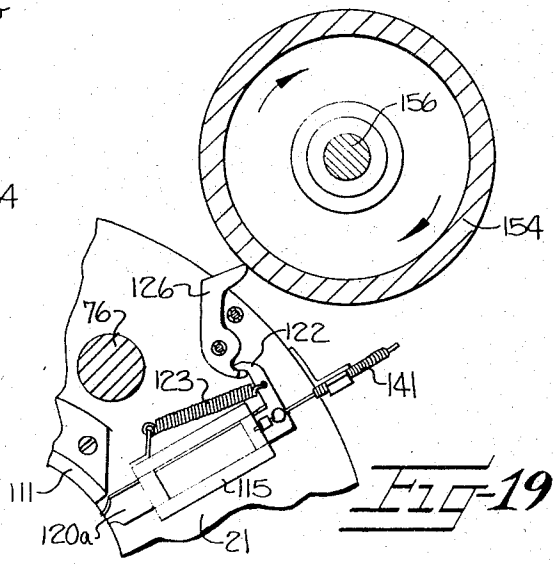


FIG-19

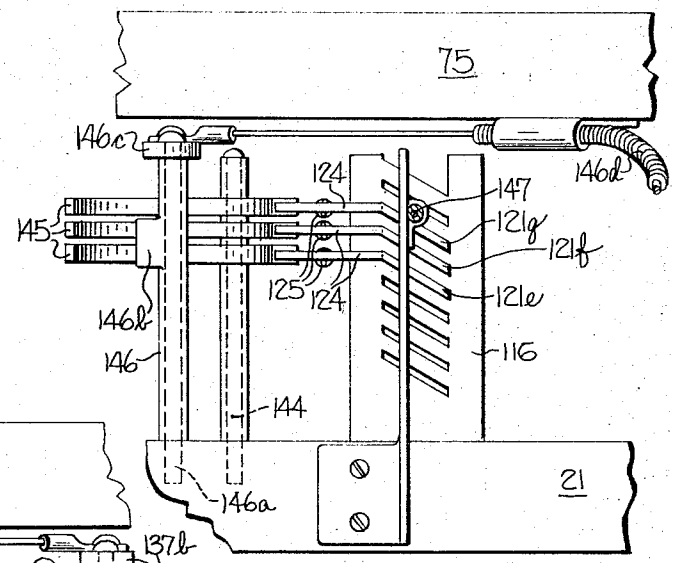


FIG-20

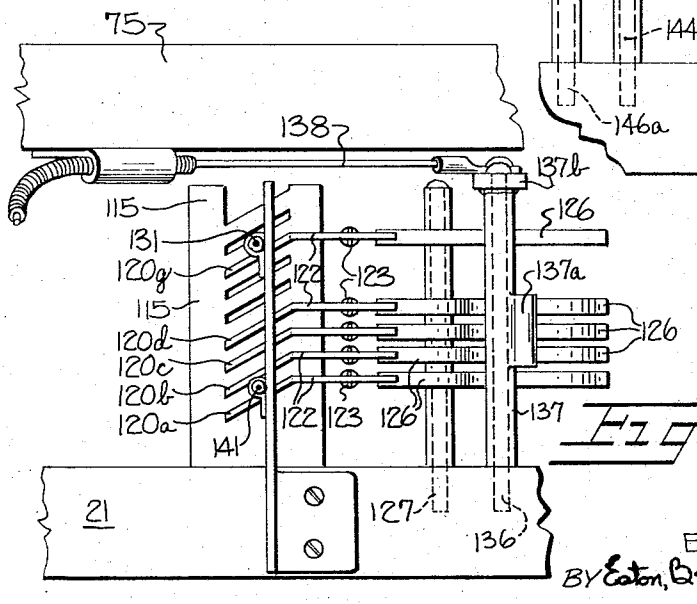
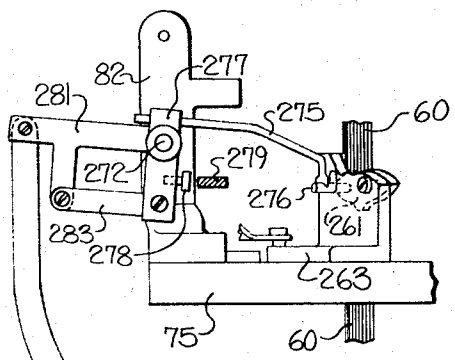


FIG-21

INVENTORS:
GEORGE F. SQUILLARIO and
ERVIN RAY BRIDGES, deceased
by HARLEY BRIDGES and
EMMA C. BRIDGES, JOINT EXECUTORS
BY Eaton, Bell, Hunt & Dellger ATTORNEYS



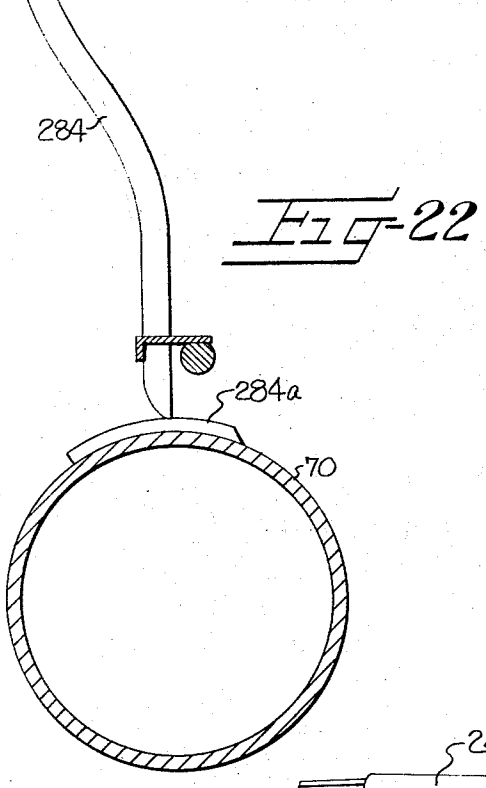
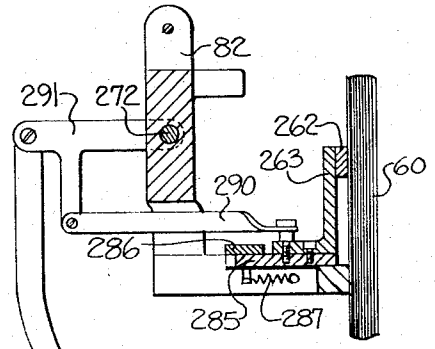


Fig-22



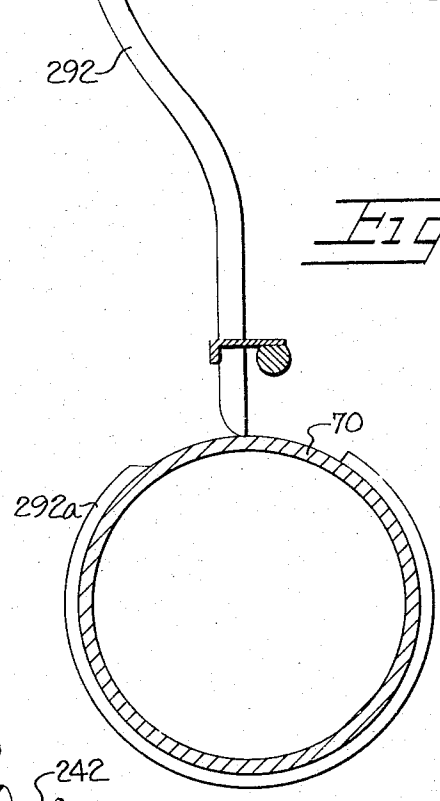


Fig-23

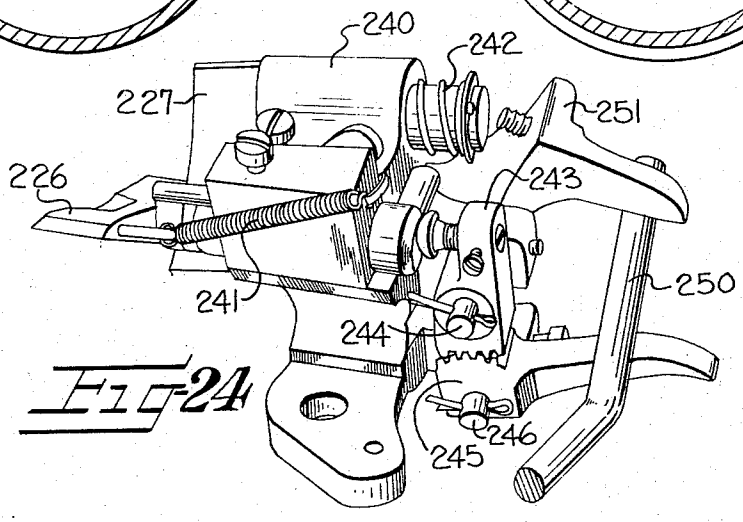


Fig-24

Dec. 20, 1966 G. F. SQUILLARIO ETAL 3,292,392

CIRCULAR KNITTING MACHINE FOR KNITTING SEAMLESS PANTY GIRDLES AND THE LIKE

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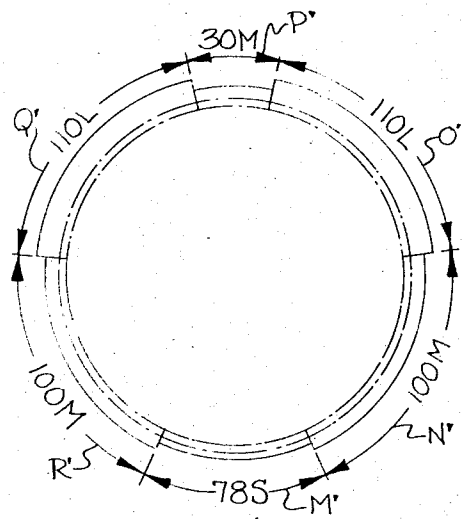


Fig-27

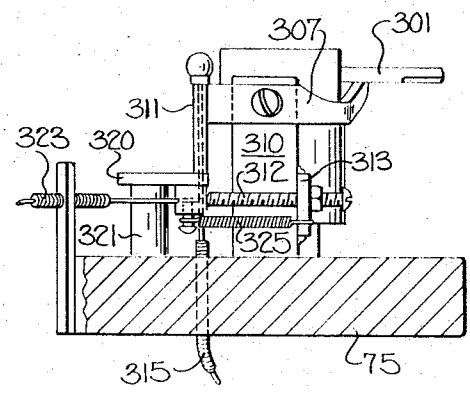


Fig-25

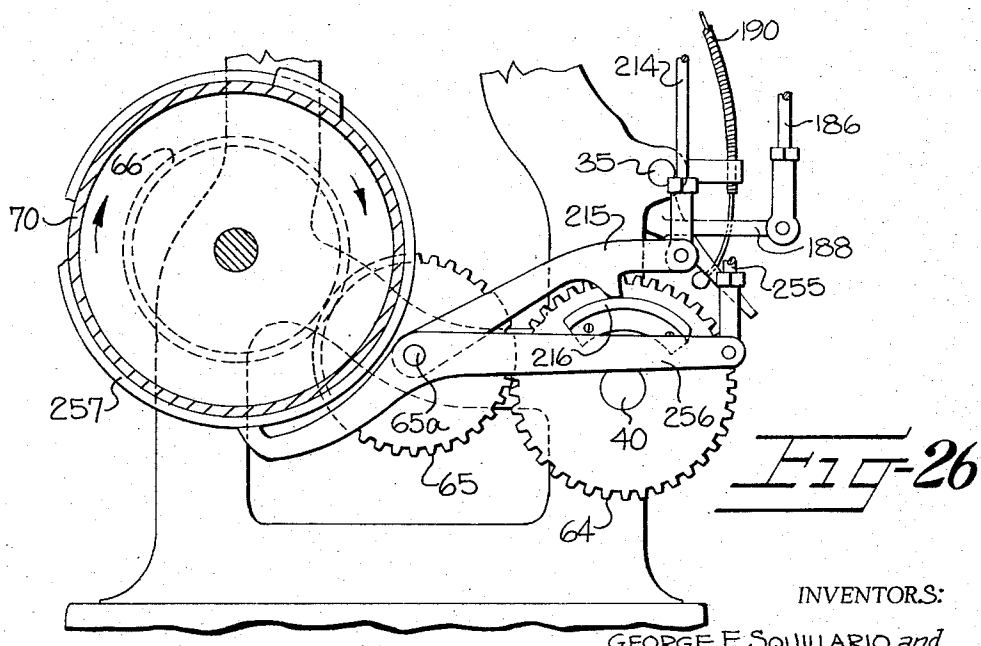


Fig-26

INVENTORS:
GEORGE F. SQUILLARIO and
ERVIN RAY BRIDGES, deceased
by HARLEY BRIDGES and
EMMA C. BRIDGES, JOINT EXECUTORS

BY Eaton, Bell, Hunt & Seltzer ATTORNEYS

Dec. 20, 1966 G. F. SQUILLARIO ETAL 3,292,392

CIRCULAR KNITTING MACHINE FOR KNITTING SEAMLESS PANTY GIRDLES AND THE LIKE

Filed June 5, 1963 17 Sheets-Sheet 13

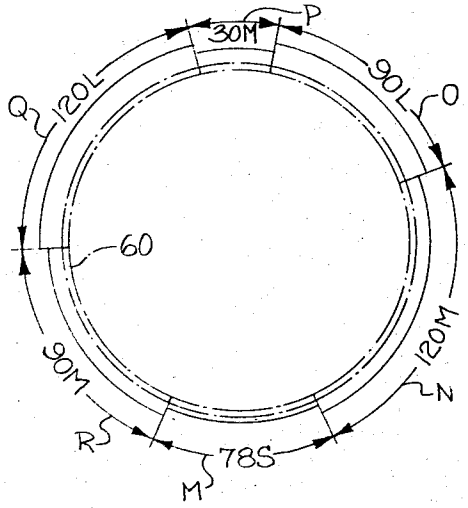


Fig-28

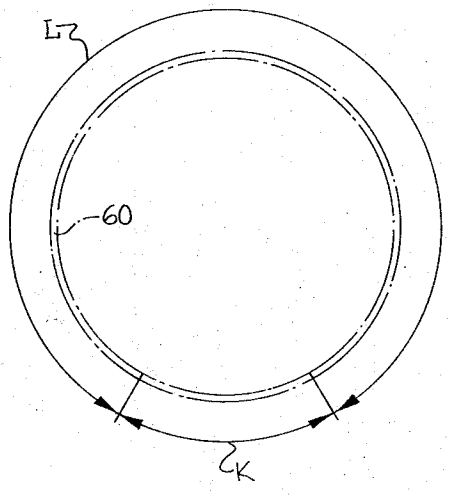


Fig-29

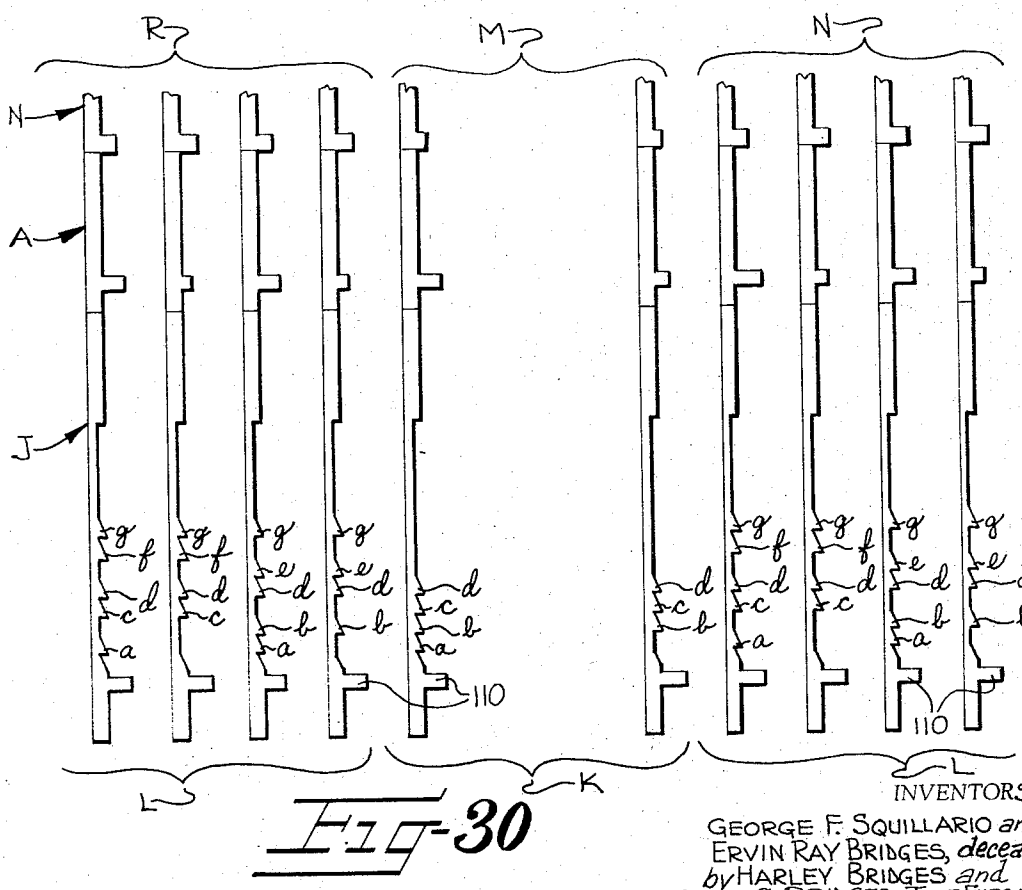


Fig-30

INVENTORS:
GEORGE F. SQUILLARIO and
ERVIN RAY BRIDGES, deceased
by HARLEY BRIDGES and
EMMA C. BRIDGES, JOINT EXECUTORS

By Eaton, Bell, Hunt & Selter ATTORNEYS

Dec. 20, 1966 G. F. SQUILLARIO ETAL 3,292,392

CIRCULAR KNITTING MACHINE FOR KNITTING SEAMLESS PANTY GIRDLES AND THE LIKE

Filed June 5, 1963 17 Sheets-Sheet 14

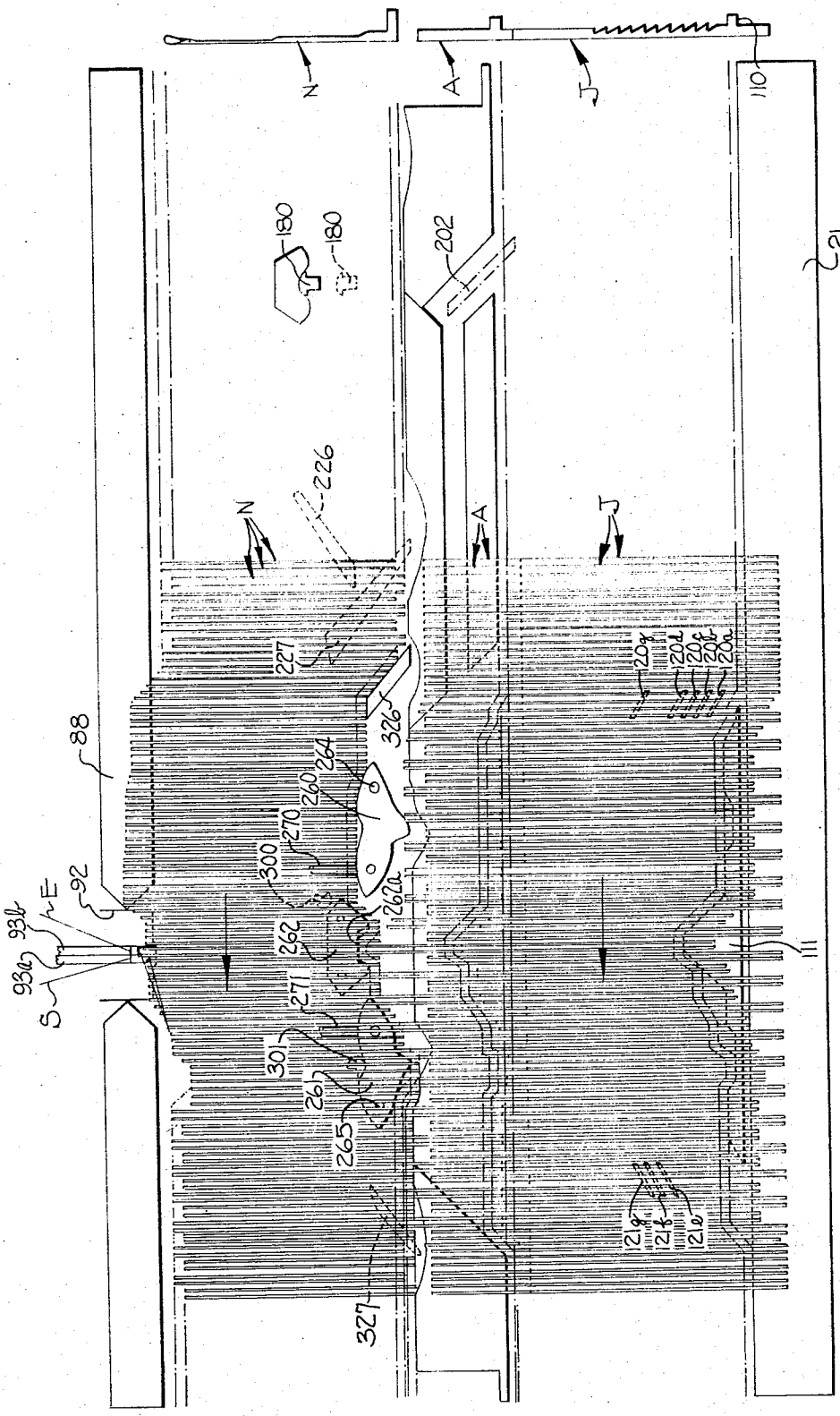


FIG-31

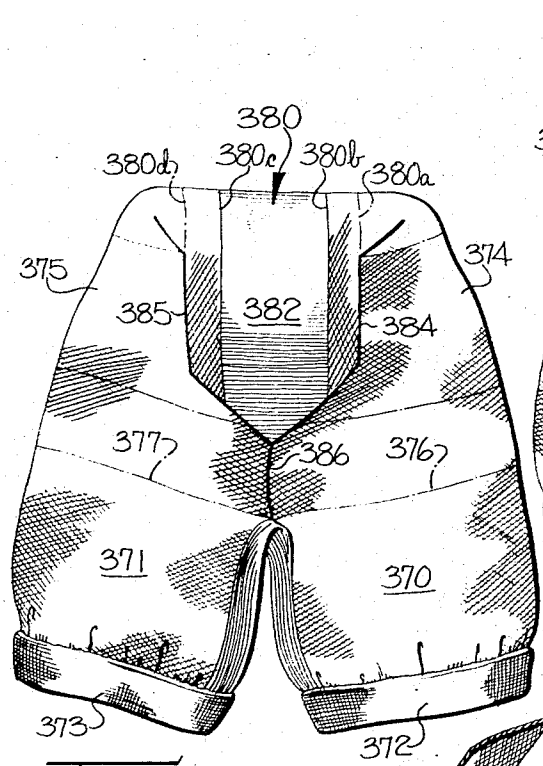


FIG-32

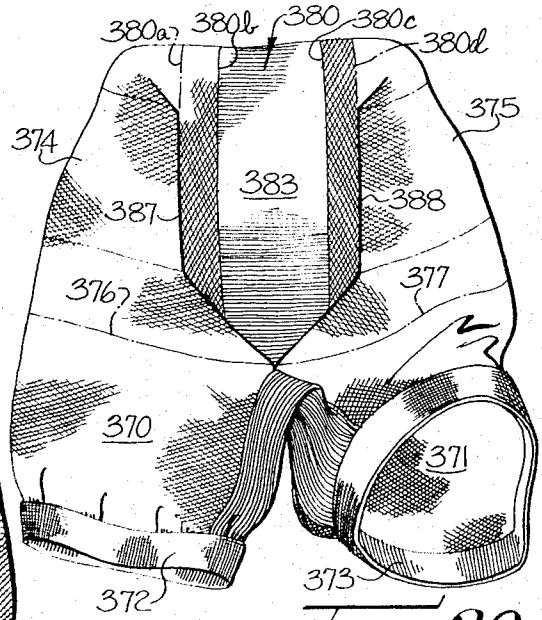


FIG-33

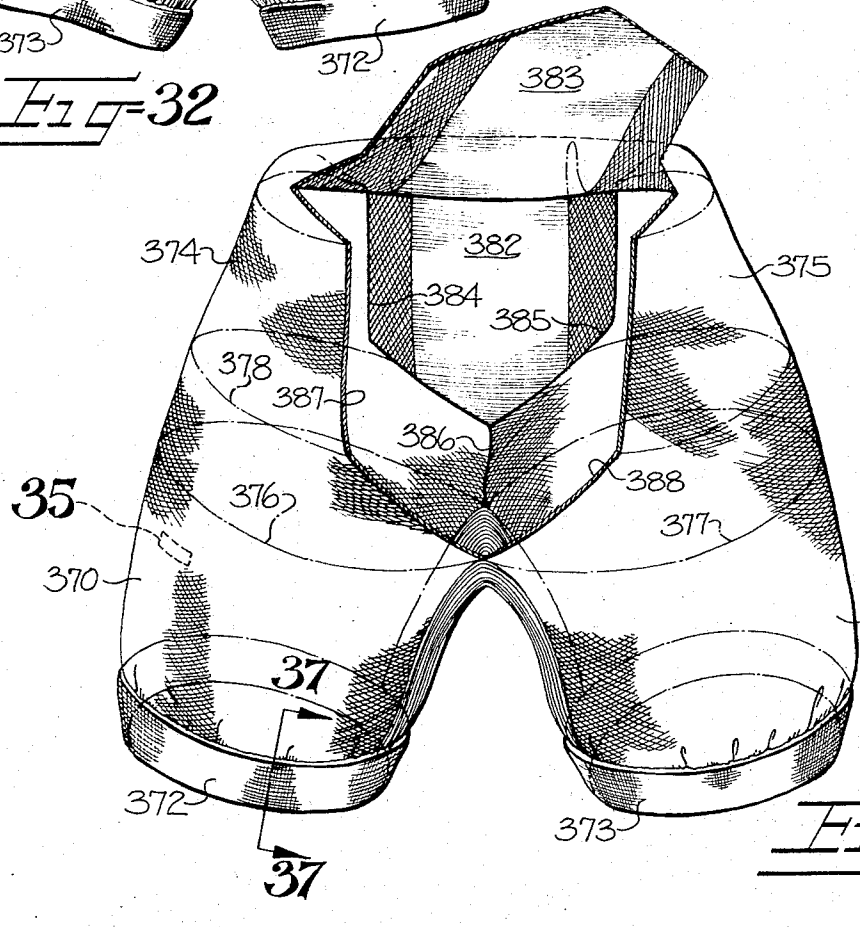


FIG-34

Dec. 20, 1966 G. F. SQUILLARIO ETAL 3,292,392
CIRCULAR KNITTING MACHINE FOR KNITTING SEAMLESS PANTY GIRDLES AND THE LIKE
Filed June 5, 1963 17 Sheets-Sheet 16

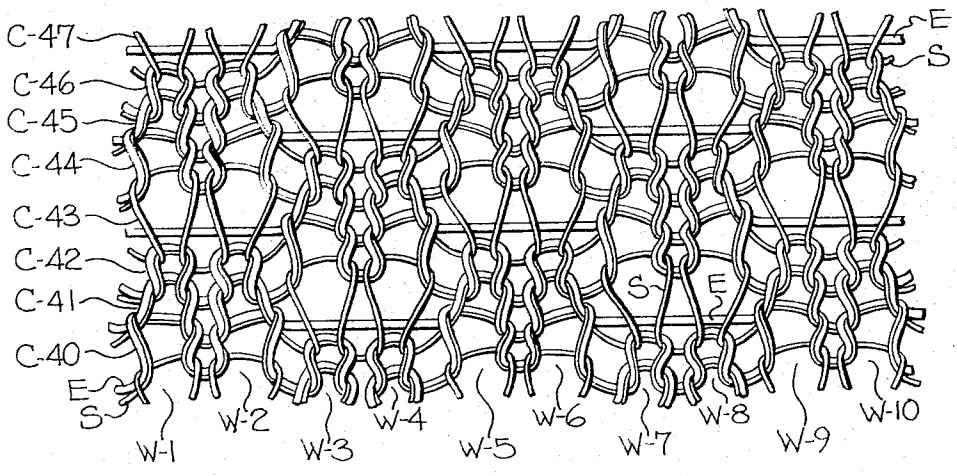


Fig-35

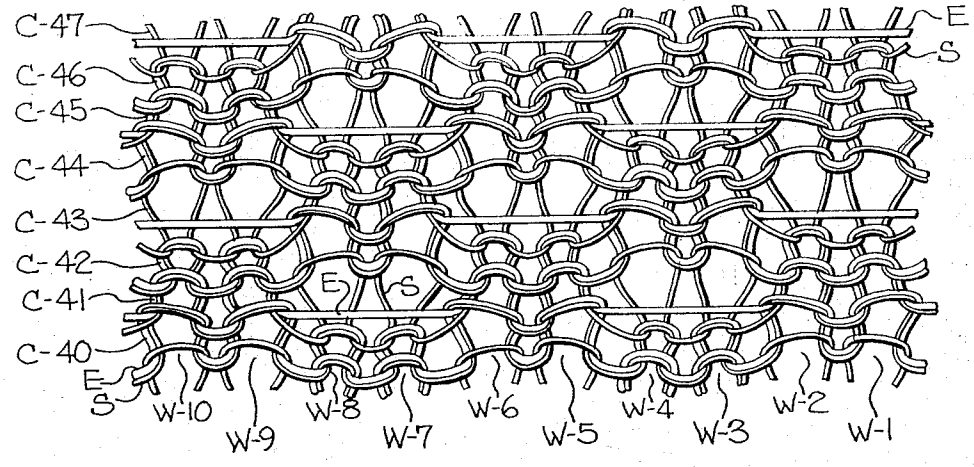


Fig-36

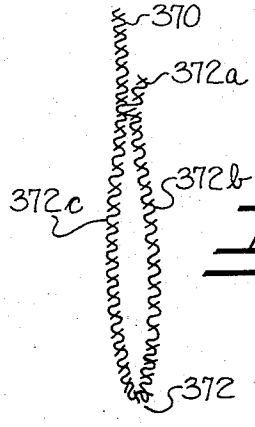


Fig-37

INVENTORS:
GEORGE F. SQUILLARIO and
ERVIN RAY BRIDGES, deceased
by HARLEY BRIDGES and
EMMA C. BRIDGES, JOINT EXECUTORS
BY Eaton, Bell, Hunt & Seltzer ATTORNEYS

Dec. 20, 1966 G. F. SQUILLARIO ETAL 3,292,392

CIRCULAR KNITTING MACHINE FOR KNITTING SEAMLESS PANTY GIRDLES AND THE LIKE

Filed June 5, 1963 17 Sheets-Sheet 17

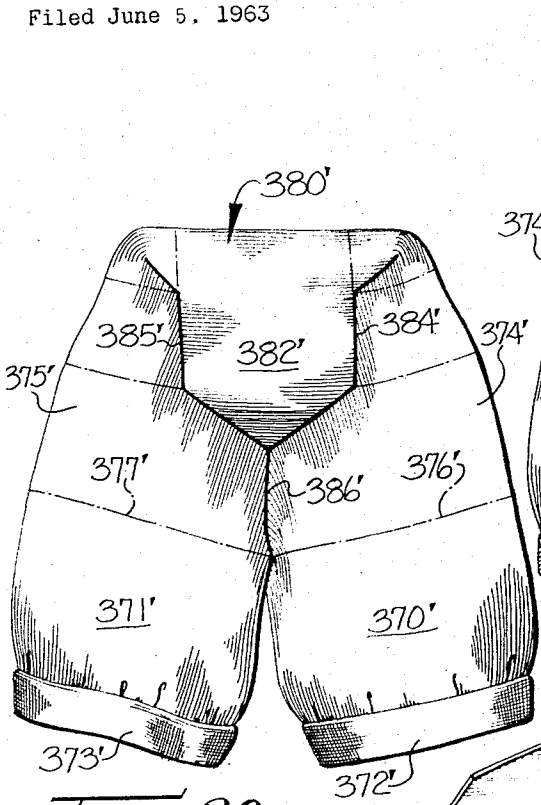


FIG-38

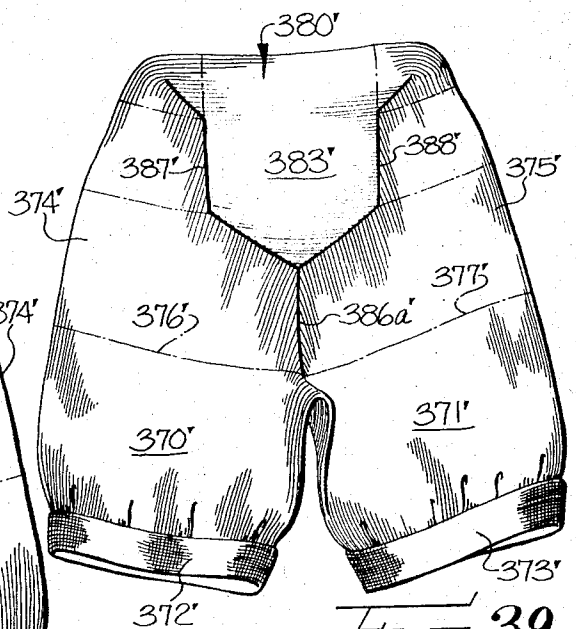


FIG-39

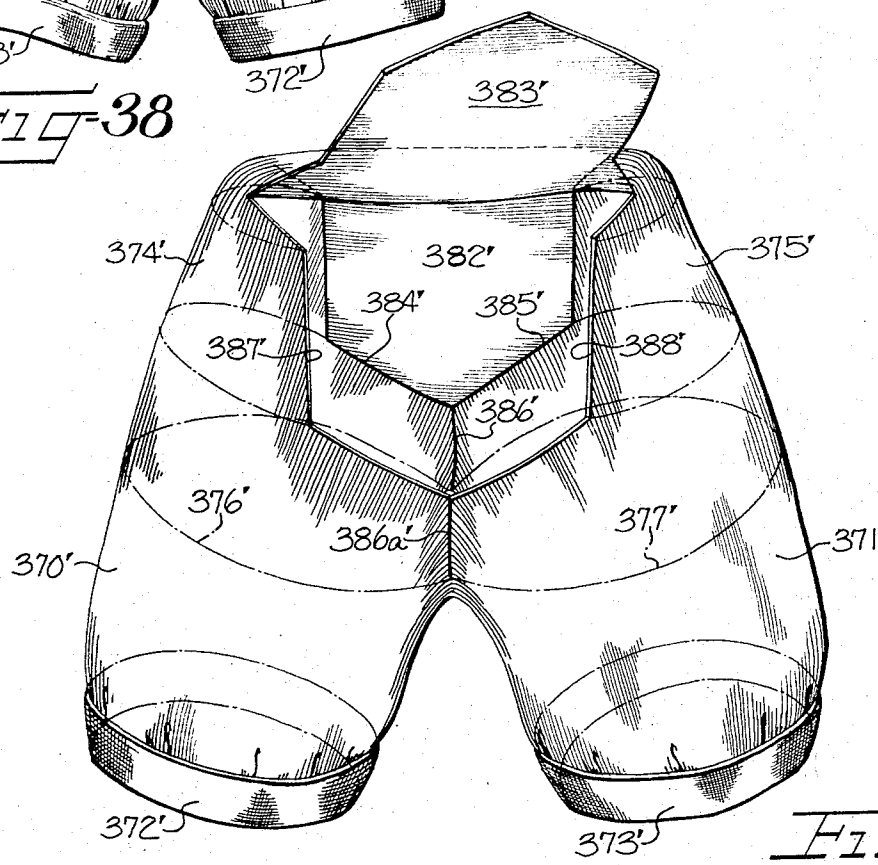


FIG-40

United States Patent Office 3,292,392 Patented Dec. 20, 1966

3,292,392

CIRCULAR KNITTING MACHINE FOR KNITTING SEAMLESS PANTY GIRDLES AND THE LIKE

George F. Squillario, Valdese, N.C., and Ervin Ray Bridges, deceased, late of Connellys Springs, N.C., by Harley Bridges, executor, Palmetto, Ga., and Emma C. Bridges, executrix, Connellys Springs, N.C., assignors, by mesne assignments, to Pilot Research Corporation, Valdese, N.C., a corporation of North Carolina

Filed June 5, 1963, Ser. No. 285,841
15 Claims. (Cl. 66—48)

The present invention relates to an improved circular knitting machine for knitting seamless panty girdles and the like. The present improved machine is particularly adapted for knitting panty girdles of the general type shown in U.S. Patent No. 2,962,884, and of the type shown in U.S. patent applications, Serial No. 55,302, filed September 12, 1960 and Serial No. 60,456, filed October 4, 1960. Generally, each of these seamless panty girdles includes a pair of seamless legs which are knit with rotary motion of the needle cylinder and integrally formed widened and narrowed gussets which are knit with reciprocating motion of the needle cylinder and which are fashioned during knitting to provide the desired shape and proper fit to the garment.

In addition to being capable of forming the general type of seamless panty girdles disclosed in the above-noted patent and applications, the improved machine of the present invention is also capable of forming improved variations and other types of seamless panty girdles.

With the foregoing in mind, it is an object of the present invention to provide a knitting machine of the type described which is provided with means to vary the type of stitch structure formed in selected portions of the garment and thereby vary the constrictive qualities of the fabric in these portions of the garment.

It is another object to provide a knitting machine of the type described which is provided with means for varying the fashioning of the gussets at the front and rear of the garment and thereby provide a better fit.

It is yet another object to provide a knitting machine of the type described which includes means for finishing the terminal ends of the legs of the garment by a turned welt.

In order to carry out the above-noted objects, as well as other objects, the present knitting machine is provided with means for alternately raising and lowering the stitch cams during reciprocatory knitting to prevent drawing the inactive low needles to stitch forming level during reciprocation of the needle cylinder and thereby reduce the drawing of the stitch loops carried thereby.

The machine is also provided with means for raising and maintaining selected inactive needles at a relatively high elevation to pass above the stitch cams while maintaining other selected needles in a lowermost inactive position to pass beneath the stitch cams during reciprocatory knitting.

A rotating pattern drum is provided at each side of the knitting station and each pattern drum is provided with cams which actuate suitable linkage in timed relation to movement of the needle cylinder for controlling the alternate raising and lowering of the stitch cams, for selectively rendering the narrowing picks inoperative during certain reciprocations of the needle cylinder for moving the widening pick to inoperative position for a portion of each reciprocation of the needle cylinder, and for alternately moving a pair of auxiliary needle raising cams positioned in advance of each of the stitch cams to operative position during corresponding opposite knitting strokes of the needle cylinder.

The machine is also provided with a radially movable

stitch cam block and control means for at times positioning the stitch cams in an innermost position to engage the butts of all of the needles and for at other times positioning the stitch cams in an outermost position to engage the longer butt needles only while allowing the short butt needles to pass thereby without being actuated.

In order to selectively form plain and float stitches and to provide fabric portions of different types of knit stitches, the machine is also provided with selector jacks and corresponding selector fingers which are operated from the rotating pattern drums to selectively raise the needles to knit two yarns together and to knit one yarn and float the other yarn. A set of selector fingers is positioned in advance of and at each side of the knitting station and a jack raising cam is positioned directly beneath the knitting station to raise selected jacks and their corresponding needles so that the feeding of the yarns to the needles is controlled in both directions during reciprocatory knitting of the fashioned gussets as well as during the rotary knitting of the leg portions.

Some of the objects of the invention having been stated, other objects will appear as the description proceeds, when taken in connection with the accompanying drawings, in which—

FIGURE 1 is a front elevation of the central portion of the knitting machine with the driving pulleys broken away;

FIGURE 2 is a side elevation of the right-hand side of FIGURE 1;

FIGURE 3 is a vertical sectional view taken substantially along the line **3—3** in FIGURE 1;

FIGURE 4 is a rear elevation of the knitting machine with the driving pulleys and manually operable handle broken away;

FIGURE 5 is an enlarged horizontal sectional view taken substantially along the line **5—5** in FIGURE 1;

FIGURE 6 is an enlarged horizontal sectional view taken substantially along the line **6—6** in FIGURE 1;

FIGURE 7 is a somewhat schematic illustration of a portion of the mechanism shown in the upper left-hand portion of FIGURE 5, illustrating the control lever and cams for operating the left-hand stitch cam;

FIGURE 8 is another somewhat schematic view of a portion of the upper right-hand portion of FIGURE 5, illustrating the control lever and cams for operating the right-hand stitch cam;

FIGURE 9 is a view similar to FIGURE 7 but showing the control lever and cams for operating the left-hand auxiliary needle raise cam;

FIGURE 10 is a view similar to FIGURE 8 but illustrating the control lever and cams for operating the right-hand auxiliary needle raise cam;

FIGURE 11 is a view similar to FIGURES 7 and 9 but illustrating the control lever and mechanism for at times deactivating the left-hand narrowing pick;

FIGURES 12, 13 and 14 are somewhat schematic successive horizontal sectional views, from top to bottom, of the selector fingers carried by the left-hand selector block shown in the upper left-hand portion of FIGURE 6 and illustrating the manner in which each of these selector fingers is controlled;

FIGURES 15, 16, 17, 18 and 19 are successive horizontal sectional views, from top to bottom, of the selector fingers carried by the right-hand selector block shown in the upper right-hand portion of FIGURE 6 and illustrating the manner in which each of these selector fingers is controlled;

FIGURE 20 is an enlarged fragmentary elevation looking inwardly at the left-hand selector block and being taken substantially along the line **20—20** in FIGURE 6;

FIGURE 21 is an enlarged fragmentary elevation look-

ing inwardly at the outside of the right-hand selector block and being taken substantially along the line **21—21** in FIGURE 6;

FIGURE 22 is a vertical sectional view taken substantially along the line **22—22** in FIGURE 7;

FIGURE 23 is a vertical sectional view taken substantially along the line **23—23** in FIGURE 5;

FIGURE 24 is an isometric view of the switch cam block shown in the central portion of FIGURE 5 and illustrating the controls for operating the needle switch cams;

FIGURE 25 is an enlarged fragmentary vertical sectional view taken substantially along the line **25—25** in FIGURE 11;

FIGURE 26 is a fragmentary vertical sectional view taken substantially along the line **26—26** in FIGURE 1;

FIGURE 27 is a diagrammatic illustration of the needle cylinder in plan view and showing one arrangement of the needles, according to their various lengths of butts for forming one type of girdle;

FIGURE 28 is a diagrammatic illustration of the needle cylinder and showing a second arrangement of the needles according to their butt lengths, for forming another type of girdle;

FIGURE 29 is a schematic view of the needle cylinder and illustrating the arrangement of the pattern jacks positioned beneath the needles;

FIGURE 30 is a view of some of the auxiliary and selector jacks, illustrating the arrangement of the operating butts thereon;

FIGURE 31 is a developed elevation of the cams surrounding the needle cylinder, including the needle cams and the selector fingers which operate on the pattern jacks with the needles and jacks moving from right to left as when the needle cylinder is rotated in a counterclockwise direction;

FIGURE 32 is a front elevation of one type of panty girdle blank which may be knit on the machine of the present invention;

FIGURE 33 is a rear view of the same garment;

FIGURE 34 is a perspective view of the garment blank with the front panel cut along the gore or suture lines and raised to illustrate the inside of the garment blank;

FIGURE 35 is a greatly enlarged fragmentary view of that portion of the lace or mesh knit fabric within the dotted rectangle indicated at **35** in FIGURE 34;

FIGURE 36 is a view looking at the reverse side of that portion of the fabric shown in FIGURE 35;

FIGURE 37 is a somewhat schematic vertical sectional view taken substantially along the line **37—37** in FIGURE 34 and illustrating the manner in which the turned cuffs or hems are formed at the lower free ends of the legs of the garment; and

FIGURES 38, 39 and 40 are similar to FIGURES 32, 33 and 34 but illustrate a modified form of garment blank which may be knit on the machine of the present invention.

Although the present knitting machine is particularly adapted for knitting seamless panty girdles and the like, many of the parts are very similar to corresponding parts of a circular hoisery knitting machine of the type manufactured by Scott and Williams, particularly the drive mechanism for imparting rotary and reciprocatory motion to the needle cylinder. A brief description of this drive mechanism will be given and other details can be obtained from U.S. Patent No. 1,152,850, dated September 7, 1915, which shows a circular hosiery knitting machine having generally the same type of drive mechanism as is employed in the present knitting machine.

The knitting machine includes a frame **20** which supports the drive mechanism, to be presently described, and a lower bed plate **21** which is suitably secured to the upper edge of the frame **20**. A main drive shaft **22** (FIGURES 1 and 2) is supported for rotation in the frame **20** and one end of the main drive shaft **22** is provided with respective conventional high speed, slow speed and idler pulleys **24***a*, **24***b* and **24***c* (FIGURES 5 and 6) and a manual crank handle **25** (FIGURE 2) which may be rotated to impart manual rotation to the machine, when desired. The pulleys **24***a*, **24***b* and **24***c* are adapted to be selectively engaged by an endless drive belt, not shown, which may be shifted from one to the other of the pulleys in a conventional manner.

A pinion **26** (FIGURE 2) is supported on the main drive shaft **22** and is driven by the drive pulleys to impart rotation to a gear **27**. The gear **27** is fixed on one end of stub shaft **28** (FIGURE 2) which is rotatably supported in the frame **20** and has a bull gear **30** fixed on its inner end (FIGURES 1 and 4). The bull gear **30** is in driving engagement with a rotary drive pinion **31** (FIGURE 1) which is supported on the main drive shaft **22** and which imparts rotary motion to the main drive shaft when a clutch element **33** is shifted into driving engagement therewith, as shown in FIGURE 1.

The clutch element **33** is keyed to the main shaft **22** and is moved longitudinally by the clutch fork **34**, the lower end of which is supported for longitudinal sliding movement on a shaft **35**. The position of the clutch fork **34** is determined by cams **36** which are supported on a clutch shipper drum **37** which is in turn rotatably supported on a main pattern shaft **40** (FIGURE 1). The main pattern shaft **40** is supported for rotation in the lower forward portion of the knitting machine frame **20**. Rotational step-by-step movement is imparted to the clutch shipper drum **37** by a rack wheel **41** (FIGURE 1) which is racked in a conventional manner by the forward end of a racking pawl **42** (FIGURE 2) which is controlled by conventional pattern lugs on the right-hand side of a pattern chain **43**.

The pattern chain **43** is supported on a sprocket wheel **45** which is mounted for rotation on the main pattern shaft **40**. A chain racking wheel **46** (FIGURE 1) is suitably connected to the sprocket wheel **45** and is adapted to be moved in a step-by-step manner by the forward end of a conventional racking pawl, **50** (FIGURE 3). The rear ends of the racking pawls **42** and **50** are suitably connected to off-set portions of a quadrant gear **51**. The quadrant gear **51** is supported for oscillation on a pattern drum support shaft **52** which is in turn supported in the frame **20** of the knitting machine. The lower end of a drive link **53** is connected to the quadrant gear **51** and its upper end is suitably connected to the bull gear **30** in off-center relationship (FIGURE 4) so that rotation of the bull gear **30** causes the quadrant gear **51** to oscillate on the shaft **52**.

As shown in FIGURE 3, the quadrant gear **51** drivingly engages a reciprocatory drive pinion **55** which is supported on the main drive shaft **22** and is adapted to at times be engaged by the clutch element **33** to impart reciprocatory motion to the main shaft **22**. The inner end of the main shaft **22** (FIGURE 1) is provided with a bevel gear **56** which drivingly engages a bevel gear **57** supported for rotation in the lower bed plate **21** in a conventional manner. The bevel gear **57** is conventionally connected to the needle cylinder **60** which extends upwardly from the lower bed plate **21**. A needle cylinder support tube **61** extends downwardly from the bed plate **21** and its lower end is conventionally supported in a support base **62** on which the frame **20** is supported and to which the upper ends of the legs of the knitting machine are secured.

A main pattern drum drive gear **64** (FIGURES 1 and 26) is fixed to the inner end of the main pattern shaft **40** and drivingly engages an intermediate drive gear **65** (FIGURE 26) which is suitably supported for rotation on a stub shaft **65***a* fixed at one end on the machine frame **20**. The gear **65** drivingly engages a gear **66** which is fixed on one end of a main pattern drum **70**. The main pattern drum **70** is supported for rotation on

the shaft **52** and controls various operations of the knitting machine, in a manner to be presently described.

The portion of the driving mechanism heretofore described is substantially the same as the driving mechanism of all Scott and Williams hosiery knitting machines and is adapted to impart rotary motion to the needle cylinder **60** when the clutch element **33** is shifted to the position shown in FIGURE 1. Reciprocatory motion may be imparted to the needle cylinder by shifting the clutch element **33** from the position shown in FIGURE 1 so that it moves out of engagement with the rotary pinion **31** and into engagement with the reciprocatory pinion **55**. This shifting of the clutch element **33** is controlled by rotation of the shipper drum **37**, which is conventionally controlled by the pattern chain **43**.

The needle cylinder **60** extends upwardly from the lower bed plate **21** and through an upper bed plate **75** which is supported in spaced relation above the lower bed plate **21** by a plurality of support posts **76** (FIGURE 6), the lower ends of which are fixed in the lower bed plate **21** and the upper ends of which are fixed in the upper bed plate **75**. The lower bed plate **21** supports suitable jack selector mechanisms and the upper bed plate **75** supports various needle actuating cams, to be presently described.

The upper end of the needle cylinder **60** is provided with a sinker bed **79** (FIGURE 1) which supports conventional sinkers for radial movement between the needles in the needle cylinder in a conventional manner. A sinker cap **80** is supported on the sinker bed **79** in a conventional manner and contains suitable cams which move the sinkers radially in the sinker bed **79**.

The rear portion of the upper bed plate **75** supports the lower end of a latch ring support post **82** (FIGURE 4), the upper end of which pivotally supports the rear portion of a latch ring **88**. The forward end of the latch ring **88** is normally held in latch position as shown in FIGURES 1, 2 and 3, against the upper end of a widening pick or bunter post **90**, the lower end of which is suitably secured to the upper bed plate **75**. The widening pick and the manner in which it is supported in the post **90** will be presently described.

The latch ring **88** is provided with a yarn feeding throat opening **92** (FIGURE 31) into which yarn feeding fingers **93** are moved between active and inactive positions by suitable thrust rods **94** (FIGURE 3), the lower ends of which normally engage the periphery of the pattern drum **70** and the upper ends of which engage the yarn feed fingers **93**, forwardly of their pivot points. Any desired number of yarn feeding fingers **93** may be positioned in the throat opening **92** of the latch ring **88** and in the present instance two fingers, indicated at **93*a*** and **93*b*** in FIGURE 31, are shown.

As best shown in the right-hand portion of FIGURE 31, each slot of the needle cylinder **60** contains a selector jack J, an auxiliary jack A and a latch needle N, each of which are supported for longitudinal or vertical movement in the slots of the needle cylinder **60**. The jacks J are disposed in the general area of the needle cylinder **60** between the lower bed plate **21** and the upper bed plate **75** and have outwardly extending operating butts **110** on their lower ends which at times pass beneath and at other times pass above a selector jack raise cam **111** (FIGURE 31). The jack raise cam **111** (FIGURE 6) is suitably supported on the lower bed plate **21** and adjacent the needle cylinder **60**.

A pair of selector finger support blocks **115, 116** (FIGURE 6) are suitably secured to the upper surface of the lower bed plate **21** and slidably support a plurality of jack selector fingers for radial movement toward and away from the needle cylinder **60**. In the present instance, the selector block **115** slidably supports five selector fingers indicated at **120*a***, **120*b***, **120*c***, **120*d*** and **120*g*** (FIGURES 21 and 31). The selector block **116** slidably supports three selector fingers **121*e***, **121*f*** and **121*g*** (FIGURES 20 and 31), however, it is to be understood that additional selector fingers may be used in either of the blocks **115** or **116**. As best shown in FIGURE 30, the jacks J have a series of selector butts, *a* through *g*, certain of which are broken off in a predetermined arrangement, corresponding with the selector fingers and their operation. The particular arrangement of jacks shown in FIGURE 30 will be later described in connection with the knitting of a particular garment.

As shown in FIGURE 21, the outer end of each of the selector fingers **120** has a control arm **122** extending laterally therefrom and all of the selector fingers **120** are normally urged inwardly toward the needle cylinder **60** by tension springs **123**. The outer ends of the tension springs **123** are connected to the control arms **122** and their inner ends are suitably connected to a spring perch on one side of the support block **115** (FIGURES 15–19).

The selector slide block **116** is fixed on the lower bed plate **21** (FIGURE 6) and the selector fingers **121** are mounted for radial sliding movement therein. The outer end of each of the selector fingers **121** has a control arm **124** (FIGURE 20) extending laterally therefrom and all of the selector fingers **121** are normally urged inwardly toward the needle cylinder **60** by tension springs **125**. The outer ends of the tension springs **125** are connected to the control arms **124** and their inner ends are suitably connected to a spring perch on one side of the support block **116** (FIGURES 12–14).

Referring particularly to FIGURES 12 through 21, it will be noted that the radial inward and outward movement of some of the selector fingers **120** and **121** are controlled from suitable cams on a pair of rotating pattern drums or wheels, to be later described, and at other times the radial movement of the selector fingers is controlled by Bowden wires which are operated from levers on the main pattern drum **70**, in a manner to be now described. As shown in FIGURE 21, five selector levers **126** are pivotally supported in horizontal spaced relationship on a pivot post **127**, the lower end of which is suitably secured in the lower bed plate **21**. These selector levers **126** are spaced horizontally so that their ends engage the transversely extending control arms **122** of the respective selector fingers **120*a***, **120*b***, **120*c***, **120*d*** and **120*g***.

As shown in FIGURE 15, the selector lever **126** which corresponds with the uppermost selector finger **120*g***, is adapted to at times be engaged by cams **130*g*** fixed on the right-hand pattern wheel. These cams **130*g*** are adapted to withdraw the selector finger **120*g*** in timed relation to movement of the needle cylinder and during reciprocatory knitting, for purposes to be later described. However, as shown in FIGURE 15, the selector finger **120*g*** is being held in its outermost inoperative position by a Bowden wire **131**, one end of which is suitably secured to the outermost end of the selector finger **120*g***. The Bowden wire **131** extends around to the rear of the machine (FIGURE 4) and its other end is suitably connected to the rearmost end of a control lever **132**.

The control lever **132** is pivotally supported intermediate its ends on a shaft **133**, one end of which is supported in the upper end of a support member **134**, the lower end of which is suitably secured to the base **62** of the machine. The opposite end of the shaft **133** is enlarged and is suitably supported in the frame **20** of the machine. The forward end of the control lever **132** engages a cam **135** on the main pattern drum **70** to hold the selector finger **120*g*** in operative position except for a short period of time during reciprocatory knitting, for purposes to be later described.

An upstanding post **136** (FIGURE 21) is suitably secured at its lower end in the lower bed plate **21** and oscillatably supports a control sleeve **137** thereon. The control sleeve **137** has an outwardly extending cam portion **137*a*** positioned intermediate its ends and, as is clearly shown in FIGURE 21, the cam portion **137*a***, is of sufficient length to engage a medial portion of each of the three selector levers **126** which operate the cor-

responding selector fingers **120***b*, **120***c* and **120***d*. The upper end of the control sleeve **137** has one end of a control arm **137***b* connected thereto. The opposite end of the control lever **137***b* (FIGURE 16) has one end of a Bowden wire **138** suitably connected thereto. The Bowden wire **138** extends around behind the knitting machine (FIGURE 4) and its opposite end is suitably connected to the rearmost end of a control lever **139**. The control lever **139** is pivotally supported on the shaft **133** and its forward end at times engages a cam **140** carried by the main pattern drum **70** to thereby maintain the three selector levers **126** (FIGURES 16, 17, 18) and their corresponding selector fingers **120***b*, **120***c* and **120***d* in inoperative position. When the Bowden wire **138** is released, by its corresponding control lever **139** moving off of the cam **140** on the main pattern drum **70**, the selector fingers **120***b*, **120***c* and **120***d* are released to be operated by corresponding cams **140***b*, **140***c* and **140***d* which are carried on the right-hand pattern wheel, to be later described, for purposes to be later described.

As shown in FIGURE 19, the selector finger **120***a* is controlled solely by a Bowden wire **141**, one end of which is suitably connected to the outer end of the selector finger **120***a*. The Bowden wire **141** extends around behind the knitting machine (FIGURE 4) and its other end is suitably connected to the rearmost end of a control lever **142**. The control lever **142** is pivotally supported intermediate its ends on the shaft **133** and its forward end is, in the present instance, in engagement with the pattern control drum **70** so that the selector finger **120***a* is released to move inwardly to its innermost operative position as shown in FIGURE 19. At times, a cam **143** (FIGURE 4), which is carried by the pattern drum **70**, moves beneath the forward end of the lever **142** to thereby pull on the Bowden wire **141** and move the selector finger **120***a* to the outermost or inoperative position, for purposes to be latter described. Although there is a selector lever **126** associated with the selector finger **120***a* (FIGURE 19), there are no cams in this race of the pattern drum and therefore operation of the selector finger **120***a* is solely controlled by the Bowden wire **141**.

As shown in FIGURE 20, a pivot post **144** is suitably secured at its lower end in the lower bed plate **21** and pivotally supports in horizontal spaced apart relationship three selector levers **145**. One end of each of the selector levers **145** engages the transverse control arms **124** of the corresponding selector fingers **121***e*, **121***f* and **121***g* (FIGURES 14, 13 and 12). The opposite ends of the selector levers **145** are adapted to engage suitable respective cams **145***e*, **145***f* and **145***g* carried by the left-hand pattern wheel and which at times control inward and outward movement of their respective selector fingers.

A control sleeve **146** (FIGURE 20) is supported for oscillation on the upper end of a support post **146***a*, the lower end of which is suitably secured in the lower bed plate **21**. The medial portion of the cam sleeve **146** is provided with an outwardly extending cam portion **146***b* which is of sufficient length and positioned to engage the two lowermost selector levers **145** (FIGURE 20). The control sleeve **146** may be rotated so that the cam portion **146***b* will engage and hold these two selector levers out of action. One end of a control arm **146***c* (FIGURE 13) is suitably secured to the upper end of the control sleeve **146** and its other end has one end of a Bowden wire **146***d* suitably connected thereto. The Bowden wire **146***d* extends around and behind the knitting machine (FIGURE 4) and its opposite end is suitably connected to the rearmost end of a control lever **146***e*. The control lever **146***e* is pivotally supported on shaft **133** and its forward end is adapted to at times engage a cam **146***f* on the main pattern drum **70**. Thus, when the control lever **146***e* is positioned on the cam **146***f*, the Bowden wire **146***d* will be pulled to the position shown in FIGURE 13 to thereby rotate the control sleeve **146** so that its cam **146***b* engages and holds both of the control levers **145** associated with the selector fingers **121***e* and **121***f* in an inoperative position, for purposes to be later described.

As shown in FIGURE 12, the selector finger **121***g* is at times controlled by the cams **145***g* to move the selector finger outwardly in timed relation to rotation of the needle cylinder. At other times, the selector finger **121***g* is held in the outermost inoperative position by a Bowden wire **147**, one end of which is suitably connected to the outer end of the selector finger **121***g*. The Bowden wire **147** extends around behind the knitting machine (FIGURE 4) where its opposite end is suitably connected to the rearmost end of a control lever **147***a*. The control lever **147***a* is pivotally supported intermediate its ends on the shaft **133** and its forward end is adapted to at times engage a cam **147***b* which is carried on the pattern drum **70**. Thus, when the control lever **147***a* moves off of the cam **147***b*, the Bowden wire **147** is released so that the selector finger **121***g* is then under control of the cams **145***g* (FIGURE 12 and the selector finger **121***g* is alternately moved in and out from one position to the other in timed relation to movement of the needle cylinder, for purposes to be later described.

All of the selector fingers, except the selector finger **120***a*, are at times controlled by the cams shown in FIGURES 12–18 which are carried on continuously rotating respective right-hand and left-hand pattern drums or wheels **154** and **155** (FIGURE 6). Referring particularly to FIGURE 4, it will be noted that the continuously rotating pattern wheels **154** and **155** are supported for rotation in a vertical position and extend from the lower bed plate **21** up beyond the upper bed plate **75**.

The wheels **154** and **155** are supported for rotation on respective spindles **156**, **157** (FIGURE 4), the lower ends of which are suitably supported in respective support brackets **160** and **161**. A connector collar **158** is fixed to the upper end of the spindle **156** and supports the lower end of a yarn rack support post **159**. The support bracket **160** is suitably secured to the frame **20** of the knitting machine and the support bracket **161** is suitably supported on the lower bed plate **21**. The support brackets **160** and **161** rotatably support respective drive shafts **162** and **163**, the upper ends of which have respective drive pinions **164** and **165** fixed hereto. The pinions **164**, **165** drivingly engage respective drive gears **166** and **167** fixed to the lower ends of the respective wheels **154**, **155**.

The lower ends of the drive shafts **162**, **163** have respective bevel gears **170**, **171** fixed thereto, which mate with respective bevel gears **172**, **173** fixed on a drive shaft **174**. As best shown in FIGURE 4, the drive shaft **174** is supported for rotation in the brackets **160**, **161** and extends across the back of the knitting machine. One end of the drive shaft **174** has a drive gear **175** fixed thereto and this drive gear **175** mates with the bull gear **30** and is continuously rotated during operation of the knitting machine.

Thus, as continuous rotation is imparted to the bull gear **30**, rotation will be imparted to the drive gear **175**, shaft **174** and through means of he bevel gears **172**, **173** and **170**, **171**, driving pinions **164**, **165** and driving gears **166**, **167**, the pattern wheels **154**, **155** will be continuously rotated during operation of the knitting machine. The rotation of the pattern wheels **154**, **155** is in timed relationship to rotation of the needle cylinder **60** since the drive for these pattern wheels **154**, **155** is taken directly from one of the drive gears of the needle cylinder drive means. The lower portions of the pattern wheels **154**, **155**, that is those portions which are positioned below the upper bed plate **75**, are provided with suitable cams for operating those selector fingers **120**, **121** heretofore described during certain portions of the knitting of a seamless panty girdle or the like.

As has been stated, the upper bed plate **75** supports the various cams for controlling the needles N and one cam for controlling the position of the auxiliary jacks A. Referring particularly to FIGURE 5, it will be noted

that the widening pick or bunter post **90** supports a widening pick **180** on a pivot shaft **181**. The free inner end of the widening pick **180** is normally urged upwardly into the position shown in FIGURE 31 by a tension spring **182** (FIGURES 1 and 5), the upper end of which is suitably secured to the pivot shaft **181** and the lower end of which is suitably secured to the lower foot portion of the bunter post **90**. One end of the pivot shaft **181** is provided with a downwardly and inwardly bent control rod **183** (FIGURE 5) and the free inner end of an operating lever **184** overlies the free end of the control rod **183**. The operating lever **184** is pivotally supported intermediate its ends on a bracket **185** (FIGURE 5) and its outer free end is resiliently urged down to engage the upper end of a control rod **186** by a tension spring **187** (FIGURE 1).

Referring particularly to FIGURE 1, it will be noted that the control rod **186** extends downwardly through the upper bed plate **75** and the lower bed plate **21** with its lower end being connected to the forward end of a control lever **188** which is in turn pivotally supported on the end of the shaft **35**. The control lever **188** has a branch arm overlying the left-hand side of the pattern chain **43**, which is provided with lugs, not shown. When on of the pattern chain lugs engages the branch arm of the control lever **188**, the control rod **186** will be raised to lower the inner end of the lever **184** and in turn lower the widening pick **180** to inoperative position. In FIGURE 31 the widening pick **180** is shown in the active position in solid lines and in the inactive position in dotted lines, for purposes to be later described.

The position of the widening pick **180** is also at times controlled by the right-hand pattern wheel **154**. To this end the lower end of a Bowden wire **190** (FIGURE 1) is suitably attached to the branch arm of the control lever **188**. The Bowden wire **190** extends upwardly and its upper end is suitably attached to one end of a control lever **191** which is pivotally supported intermediate its ends on the upper end of a pivot post **192**, the lower end of which is fixed in the upper portion of the frame **20** of the knitting machine. The opposite end of the control level **191** (FIGURE 5) is provided with a cam engaging foot which alternately engages the outer periphery of the right-hand pattern wheel **154** and suitable cams **193** (FIGURES 2 and 4) positioned thereon.

When the control lever **188** is not maintained in an uppermost position by lugs on the pattern chain **43**, the cams **193** will cause the lever **188** to be raised for part of each swing of the needle cylinder, by means of the lever **191** and Bowden wire **190**. As has been explained, when the lever **188** is raised, the widening pick **180** is lowered to inactive position. Since the cams **193** are rather short, the widening pick will remain inactive for only a short period of each certain swings of the needle cylinder, for purposes to be later described. Thus, the widening pick **180** may be maintained in inactive position for any desired length of time by lugs on the pattern chain **43** and it may be alternately moved between active and inactive positions by the cams **193** on the right-hand pattern wheel **154**.

A radially extending groove **200** is cut in the upper surface of the bed plate **75** (FIGURE 5) and this groove extends beneath the central portion of the bunter post **90** to provide a guideway for a slide plate **201** which is positioned for radial sliding movement therein. The inner end of the slide plate **201** has an auxiliary jack raising cam **202** (FIGURE 31) suitably secured thereto and which may be moved inwardly far enough to engage certain of the butts of the auxiliary jacks A, for purposes to be later described.

The outer end of the slide plate **201** has an upstanding control block **204** fixed thereto (FIGURE 5) which is engaged by the inner end of an adjustable screw **205**. The slide plate **201** and the control block **204** are resiliently urged outwardly by a spring, not shown to maintain the control block **204** against the inner end of the screw **205**. The screw **205** is mounted in an upstanding block on one end of a control lever **206**. The medial portion of the control lever **206** is pivotally supported as at **207** on the upper bed plate **75** and its opposite end is suitably connected to the inner end of a control link **210**.

The outer end of the control link **210** is suitably connected to the upper leg of a bell crank **211** (FIGURE 1) which is pivotally supported on a support bracket **212** fixed on the upper bed plate **75**. The inner end of the horizontal leg of the bell crank **211** is suitably secured to the upper end of a control rod **214** which extends downwardly through the lower bed plate **21** and is suitably connected to the forward end of a control lever **215**. As shown in FIGURE 26, the rear end of the control lever **215** is pivotally supported on an extension of the stub shaft **65***a* which supports the gear **65** and the medial portion of the lever **215** is shown in engagement with a cam plate **216** which is fixed on the gear **64**. While the lever **215** is in engagement with the cam plate **216**, the auxiliary jack raising cam **202** will remain in an inner position and when the cam plate **216** moves out of engagement with the lever **215**, the jack raising cam **202** will move to an outer position, for purposes to be later described.

In order to move certain needles N between active or lowered position and inoperative or raised position, suitable switch cams are supported for radial movement adjacent the needle cylinder **60** and on the upper bed plate **75**. As shown in FIGURE 31, these switch cams include a needle lowering cam **226** and a needle raising cam **227**.

Referring particularly to FIGURE 24, it will be noted the needle lowering cam **226** and the needle raising cam **227** are supported for radial movement in a cam block **240**, which is in turn fixed on the upper surface of the upper bed plate **75**. A tension spring **241** normally urges the needle lowering cam **226** outwardly to an inoperative position and a compression spring **242** normally urges the needle raising cam **227** to an outermost inoperative position. An operating lever **243** engages the outer end of the radially movable stem of the cam **226** and is pivotally supported intermediate its ends on a stub shaft **244**. The lower end of the lever **243** is provided with gear teeth which mate with gear teeth on the inner end of a lever **245** which is in turn pivotally supported on a stub shaft **246**. The lever **245** is provided with an outwardly extending substantially horizontal tail which extends beneath one end of a control arm **250**.

The control arm **250** also extends beneath the outwardly extending tail of a control lever **251** which is pivotally supported on the cam block **240** and its upper end is adapted to engage the outer end of the radially movable stem of the needle raising cam **227**. The control arm **250** is shown in a lowermost position in FIGURE 24 so that the needle lowering cam **226** is moved inwardly to an operative position to engage the butts of certain of the needles N and lower the same as they pass thereby. When the arm **250** is raised to the intermediate position shown in FIGURES 2 and 5, the needle raising cam **227** and the needle lowering cam **226** will be positioned in an outermost inoperative position.

When the control arm **250** is raised to its uppermost position, the lever **251** will move inwardly and thereby move the needle raising cam **227** inwardly to operative position while allowing the needle lowering cam **226** to remain inactive. Thus, when the control arm **250** is in a lowermost position, the needle lowering cam **226** will be moved inwardly to operative position, when the control arm **250** is raised to an uppermost position, the needle raising cam **227** will be moved inwardly to operative position, and when the control arm **250** is in an intermediate position between the upper and lower positions, the cams **226** and **227** will both be in an inoperative position.

As shown in FIGURE 5, the upper end of the control

arm 250 is suitably secured to the upper end of a control rod 255, which extends downwardly through the upper bed plate 75 and the lower bed plate 21. The lower end of the rod 255 (FIGURE 1) is suitably connected to the forward end of a control lever 256 (FIGURE 26) which extends rearwardly and is pivotally supported intermediate its ends on the extension of the stub shaft 65*a*. The rearmost end of the lever 256 is shown in engagement with a cam 257 which is carried by the pattern drum 70. The cam 257 is of sufficient height to maintain the control arm 250 in an intermediate position and when the lever 256 moves onto the high portion of the cam 257, the control arm 250 will be raised to its upper position. On the other hand when the lever 256 moves off of the cam 257, the control arm 250 will be moved to its lowermost position.

Referring particularly to FIGURE 31, it will be noted that the knitting machine is provided with a single set of stitch cams, including a right-hand or reverse stitch cam 260, a left-hand or forward stitch cam 261, and a top center cam 262. The top center cam 262 is provided with a notch 262*a* on its lower surface to allow the butts of certain needles to be raised thereinto, for purposes to be later described. The stitch cams are supported for vertical movement on a cam support bracket 263 (FIGURE 5) which is in turn supported on the upper bed plate 75 and adjacent the needle cylinder. The stitch cam support bracket 263 is suitably supported for radial movement toward and away from the needle cylinder 60, in a manner to be presently described. In the embodiment illustrated in the drawings, the right-hand stitch cam 260 is pivotally supported at one end on the cam bracket by a pivot screw 264 and the left-hand stitch cam is pivotally supported on the cam bracket by a pivot screw 265 (FIGURES 7, 8 and 31).

In order to prevent elongation of the stitch loops which are held on a group of inactive or idle needles that pass beneath the stitch cams, the pivoted stitch cams 260 and 261 are adapted to be released to swing up as the butts of these inactive needles pass therebeneath. However, the stitch cams 260 and 261 must be held in stitch drawing position as the butts of the active needles are drawn down.

Referring particularly to FIGURE 8, it will be noted that the right-hand stitch cam 260 has the inner end of an operating pin 269 fixedly secured therein and the pin extends through a slot in the bracket 263. The outer free end of the operating pin 269 is engaged by the lower inner end of a control rod 270. The rearmost end of the control rod 270 is suitably connected to the upper portion of a downwardly depending lever 271 which is pivotally supported on a stub shaft 272 that is in turn suitably supported in the latch ring support post 82 (FIGURE 4). The lower end of the lever 271 is engaged by one end of a control lever 273. The medial portion of the control lever 273 is pivotally supported on an upstanding post 274, the lower end of which is fixed in the upper bed plate 75.

The opposite end of the lever 273 is positioned adjacent the right-hand pattern wheel 154 and is adapted to at times be engaged by suitable cams 273*a* and 273*b* secured thereto. Thus, with continuous rotation of the pattern wheel 154, the cams 273*a* and 273*b* successively engage the lever 273 and lower the inner end of the control rod 270 to thus move the stitch cam 260 downwardly to its stitch drawing position. The cams 273*a* and 273*b* are arranged on the pattern wheel 154 and its rotation is timed relative to movement of the needle cylinder so that the stitch cam 260 is lowered to stitch drawing position during a portion of each clockwise swing of the needle cylinder, for purposes to be later described.

As shown in FIGURES 7 and 22, the inner lower end of a control rod 275 is in engagement with the outer end of an operating pin 276, the inner end of which is threadably supported in the left-hand stitch cam 261. The outermost end of the control rod 275 is fixed in the upper end of a downwardly depending lever 277 (FIGURE 22) which is pivotally supported at its upper end of the shaft 272. The medial portion of the lever 277 is provided with an adjustable bunter 278 which is adapted to be engaged by one end of a control lever 279. The control lever 279 is pivotally supported intermediate its ends on an upstanding post 280, the lower end of which is fixed in the upper bed plate 75 (FIGURE 7). The opposite end of the control lever 279 is positioned adjacent the outer periphery of the left-hand pattern wheel 155 and at other times is engaged by suitable cams 279*a* and 279*b* carried thereby. Thus, when the end of the control lever 279 engages one of the cams 279*a* or 279*b*, the control rod 275 will be lowered to thereby move the left-hand stitch cam 261 downward to stitch drawing level.

At times, such as during rotary knitting of the leg portions of a panty girdle, it is desired to maintain the left-hand or forward stitch cam in stitch drawing position and to this end, the inner end of a lever arm 281 (FIGURE 22) is pivotally supported on the shaft 272. The medial portion of the lever arm 281 has a downwardly depending arm to which the rearmost portion of a connecting link 283 is connected. The forward end of the connecting link 283 is suitably secured to the lower end of the control lever 277 and the rear end of the control arm 281 is suitably connected to the upper end of a thrust rod 284. The lower end of the thrust rod 284 is adapted to at times engage the outer periphery of the main pattern drum 70 and at other times to engage a cam 284*a* carried thereby. Thus, when the lower end of the thrust rod 284 is positioned on the cam 284*a*, as shown in FIGURE 22, the arm 281 will be raised at its outer end to thereby rock the control arm 277 and lower the inner end of the control rod 275 to thereby move the left-hand stitch cam 261 downward to operative or stitch drawing position. When the cam 284*a* moves from beneath the thrust rod 284, as during reciprocatory knitting, the left-hand stitch cam 261 is alternately lowered by engagement of the cams 279*a* and 279*b* with the outer end of the control lever 279, for purposes to be later described. Thus, during reciprocatory knitting, the left-hand stitch cam 261 is alternately lowered and released by means of the cams on the left-hand pattern wheel 155 and during rotary knitting, the stitch cam 261 is maintained in a stitch drawing position by a cam on the main pattern drum 70.

Referring particularly to FIGURE 23, it will be noted that the stitch cam support bracket 263 has a rearwardly extending guide plate 285 fixed to its lower surface and which is mounted for radial sliding movement in a groove cut in the upper bed plate 75. A stop plate 286 is suitably secured to the upper surface of the bed plate 75 and spans the groove in which the guide plate 285 is located. The plate 286 also serves as a stop against which the outer lower edge of the stitch cam support bracket 263 engages when it is moved to its outermost position. The stitch cam support block 263 is normally urged inwardly toward the needle cylinder 60 by a tension spring 287, one end of which is suitably secured to a spring perch depending from the guide plate 285 and the other end of which is suitably secured to the upper bed plate 75. As shown in FIGURES 7 and 8, opposite ends of the stitch cam support bracket 263 are maintained in sliding engagement with the upper surface of the bed plate 75 by shoulder screws 288 and 289 which are positioned in slots in the horizontal flange of the bracket 263 to guide the bracket as it is moved toward and away from the needle cylinder 60.

A connecting link 290 (FIGURE 23) is connected at its inner or forward end to the stitch cam support bracket 263 and its outer end is suitably connected to a downwardly depending arm of a control lever 291. The inner end of the control lever 291 is pivotally supported on the shaft 272 and its outer end is suitably connected to the upper end of a thrust rod 292. The lower end of the thrust 292 is adapted to at times engage the outer periphery of the main pattern drum 70 and at other times

it is raised by a cam **292***a* which is carried by the pattern drum **70**. Thus, when the lower end of the thrust rod **292** is in engagement with the outer periphery of the pattern drum **70**, as is shown in FIGURE 23, the stitch cams carried by the support bracket **263** will be pulled inwardly by the tension spring **287** to their innermost or operative position to engage the butts of all of the needles in the needle cylinder. On the other hand, when the cam **292***a* moves beneath the thrust rod **292**, the stitch cam bracket **263** will be moved back away from the needle cylinder far enough that groups of needles having short butts may pass by the stitch cams without engaging the same while the needles having longer butts will be engaged and controlled by the stitch cams, for purposes to be later described.

The stitch cams **260**, **261** are rovided with respective narrowing picks **300** and **301** (FIGURES 5 and 31). The free inner ends of which are adapted to rest on the respective stitch cams and the outer ends of which are pivotally supported in respective pick stands **302** and **303** (FIGURE 5) which are fixed on the upper bed plate **75**. The pick stands are connected together by an adjustable link **304** which assures their alternate operation during the normal narrowing operation, to be later described.

When the needle cylinder is rotating in the rotary or counterclockwise direction, as seen in FIGURE 5, the narrowing picks **300** and **301** remain in the position shown. When the needle cylinder is reciprocated, the narrowing pick **301** will normally engage and raise the first active needle to an inactive position where it will pass above the top center cam **262** during the first clockwise swing of the needle cylinder **60**. Movement of the left-hand narrowing pick **301** will cause the right-hand narrowing pick **300** to swing back above the right-hand stitch cam **260** where it will be in position to engage and raise the first active needle as the needle cylinder swings back in a counterclockwise direction. Thus, in normal operation the narrowing picks raise one needle to inactive level with each swing of the needle cylinder.

The narrowing picks **300**, **301** may be rendered inoperative by merely raising the inner end of the left-hand narrowing pick **301** to a position above the left-hand stitch cam **261**. To this end the inner end of a pick control lever **307** extends beneath the shank of the narrowing pick **301** (FIGURE 5). As is more clearly shown in FIGURE 25, the lever **307** is pivotally supported intermediate its ends on the upper end of a bracket **310** which is fixed at its lower end on the upper bed plate **75**.

The outermost end of the pick control lever **307** has a vertically extending plate **311** suitably secured thereto and its lower end is adapted to engage the free end of an adjustment stop screw **312**. The stop screw **312** is threadably supported in a plate **313** which is suitably connected to the bracket **310**. Thus, the stop screw **312** limits upward movement of the pick control lever **307** as the lower end of the plate **311** engages the same. The upper end of a Bowden wire **315** (FIGURE 25) is suitably connected to the plate **311** at the outer end of the pick control lever **307** and this Bowden wire **315** extends downwardly through the upper bed plate **75**, around behind the machine (FIGURE 4) and its lower end is suitably connected to the rearmost end of a control lever **316**.

The control lever **316** is pivotally supported on the shaft **133** and its forward end at times engages the main pattern drum **70** and at other times is engaged by suitable cams **316***a* carried thereby. Thus, when one of the cams **316***a* moves beneath the control lever **316**, the Bowden wire **315** will be pulled to thereby rock the pick control lever **307** in a counterclockwise direction to the position shown in FIGURE 25 so that the inner free end of the narrowing pick **301** is raised and held in spaced relationship above the left-hand stitch cam **261**.

During the narrowing of certain portions of the panty girdle, to be later described, it is desirable to narrow the fabric at a reduced or slower rate and in the present instance, this is accomplished by moving the lefthand narrowing pick **301** to inoperative position during alternate clockwise swings of the needle cylinder **60**. To this end, one end portion of an operating lever **320** (FIGURES 11 and 25) is adapted to engage the vertically depending plate **311** of the pick control lever **307** and the lever **320** is pivotally supported intermediate its ends as at **321** or on the upper end of a pivot post **321**. The opposite end of the control lever **320** is adapted to at times engage the outer periphery of the left-hand pattern wheel **155** and at other times be engaged by a cam **320***a* which is carried thereby. One end of a Bowden wire **323** is suitably connected to the end of the lever **320** and it extends around behind the machine (FIGURE 4) where its opposite end is connected to the rearmost end of a control lever **324**.

The control lever **324** is pivotally supported on the shaft **133** and its forward end is adapted to at times engage the periphery of the main pattern drum **70** and at other times to engage suitable cams **324***a* carried thereby. Thus, when the lever **324** is in engagement with one of the cams **324***a* the Bowden wire **323** will be pulled to thus move the lever **320** in a clockwise direction from the position shown in FIGURE 11 so that the cam **320***a* will have no effect on the position of the narrowing pick **301**. On the other hand, when the lever **324** is in engagement with the periphery of the pattern drum **70**, a tension spring **325** (FIGURES 11 and 25) urges the free end of the lever **320** toward the periphery of the left-hand pattern wheel **155**. Then, when the cam **320***a* engages the end of the lever **320**, it will move in a clockwise direction to thereby allow the narrowing pick **301** to move down into operative position during alternate clockwise swings of the needle cylinder, for purposes to be later described.

As shown in FIGURES 9, 10 and 31, radially movable end cams or needle raising cams **326** and **327** are positioned in advance of the respective stitch cams **260** and **261**. These end cams **326**, **327** may also be termed respective forward and reverse end cams since they normally operate in an alternate manner to raise the needles N to pass above the stitch cams during corresponding forward and reverse swings of the needle cylinder in reciprocatory knitting. During rotary knitting the right-hand needle raise cam **326** is maintained in an operative position to raise all the needles to pass above the right-hand stitch cam **260**.

Referring particularly to FIGURE 9, it will be noted that the left-hand needle raising cam **327** is fixed on the inner end of a slide plate which is in turn mounted for radial sliding movement in a cam block **330**. The cam block **330** is suitably secured to the upper surface of the upper bed plate **75** and the outer end of the slide plate of the cam **327** has a bunter plate **331** fixed thereto. A tension spring **332** is connected at one end to the slide plate of the cam **327** and at its other end to the cam block **330** so that the cam **327** is resiliently urged inwardly to the operative position.

One end of a control lever **334** engages the bunter plate **331** and its medial portion is pivotally supported on the pivot post. The lower end of the post **280** is suitably secured in the upper bed plate **75** and the opposite end of the lever **334** is adapted to at times engage the periphery of the selector drum **155** and is at other times to engage suitable cams **334***a* and **334***b*. The lever **334** and the cams **334***a* and **334***b* on the drum **155** are adapted to control in and out movement of the needle raising cam **327** during reciprocation of the needle cylinder and in timed relationship to movement of the needle cylinder so that when the needle cylinder is moving in a clockwise direction, the cam **327** will be moved inwardly to raise all except the inactive shot butt needles to pass above the left-hand stitch cam **261**.

During rotary knitting, the left-hand needle raising cam **327** must be maintained in an outermost inoperative posi-

tion as shown in FIGURE 7 and to this end, one end of a Bowden wire **335** is connected to the bunter plate **331**. The Bowden wire **335** extends around and behind the machine where its opposite end (FIGURE 4) is suitably connected to the rearmost end of a control lever **336**. The medial portion of the control lever **336** is pivotally supported on the shaft **133** and its forward end is adapted to at times engage the periphery of the pattern drum **70** and at other times to engage suitable cams **336***a* which are carried thereby.

In FIGURE 9, the forward end of the control lever **336** is on top of one of the cams **336***a* on the pattern drum **70** so that the Bowden wire **335** is pulled to maintain the left-hand needle raising cam **327** in the inoperative or outermost position during all the rotary knit portions of the panty girdle. Thus, during reciprocatory knitting the left-hand needle raising cam **327** is operated alternately from the cams **334***a* and **334***b* on the left-hand pattern wheel **155** and during rotary knitting it is maintained in an inoperative position by suitable cams on the main pattern drum **70**.

Referring particularly to FIGURE 10, it will be noted that the right-hand needle raising cam **326** is fixed on the inner end of a slide plate which is supported for radial sliding movement in a cam block **340**. The cam block **340** is suitably secured to the upper bed plate **75** and the needle raising cam **326** is normally urged to an outer inoperative position by a tension spring **340***a*, one end of which is connected to the slide plate and the other end of which is connected to the cam block **340**. The outer end of the slide plate has a bunter plate **341** fixed thereto which at times is engaged and moved by an adjustment screw **342** which is threadably supported in the free end of a control link **343**. The opposite end of the link **343** is pivotally supported for vertical movement on the medial portion of a control lever **345**. One end of the control lever **345** is pivotally supported on a pivot post **346** and its opposite end is positioned adjacent the right-hand pattern wheel and is at times engaged by suitable cams **346***a* and **346***b* carried thereby.

The lever **345** may at times be rendered inoperative by raising the free end of the pivoted control link **343** so that the screw **342** will not engage the bunter plate **341**. To this end, one end of a Bowden wire **350** is suitably connected thereto (FIGURE 10). The Bowden wire **350** extends down to the right-hand side of the machine (FIGURE 2) and its lower end is suitably connected to the rearmost end of a control lever **351**. The control lever **351** is pivotally supported as at **352** on the frame **20**. The forward end of the lever **351** is positioned adjacent a pattern wheel **353** which is fixed in the end of the main pattern shaft **40** and at times engages a cam **354** which extends outwardly from the pattern wheel **353**. When the cam **354** engages the lever **351**, the Bowden wire lifts the pivoted lever **343** so that the lever **345** (FIGURE 10) is not operative to move the needle raising cam **326** inwardly to operative position, during the knitting of the turned cuff at the free ends of the legs of the panty girdle, for purposes to be later described.

Again referring to FIGURE 10, it will be noted that the right-hand needle raising cam **326** is also at times moved inwardly to the operative position by a control lever **355**, which is pivotally supported intermediate its ends on the pivot post **346**. The forward end of the lever **355** is provided with an upstanding plate **355***a* (FIGURE 3) which supports an adjustment screw, the free end of which engages the bunter plate **341** carried by the outer end of the slide plate of the needle raising cam **326**. The rearmost end of the lever **355** (FIGURE 10) engages a cam surface **356** on one side of a thrust rod **357**. The thrust rod **357** (FIGURE 4) is maintained in an upright position by a pair of guide plates and its lower end at times engages and is raised by suitable cams **360** on the main pattern drum **70**. When the thrust rod **357** is raised by the cam **360**, the cam surface **356** will move the lever **355** clockwise to the position shown in FIGURE 10 to hold the needle raising cam **326** in an innermost operative position. When the thrust rod **357** is lowered, the needle raising cam **326** will be moved out by the spring **340***a* and will be periodically moved to operative position by the cams **346***a* and **346***b*, unless the pivoted lever **343** is raised by the Bowden wire **350**.

Thus, operation of the right-hand needle raising cam **326** is selectively controlled by the main pattern drum **70**, by the right-hand pattern wheel **154**, or by the pattern wheel **353** on the main pattern shaft **40**. Generally the right-hand needle raising cam **326** is maintained in an innermost position to engage and raise all needles during the knitting of the seamless leg portions of the panty girdle. The right-hand needle raising cam **326** is alternately moved in by the right-hand pattern wheel **154** far enough to engage the butts of all needles, except a group of inactive short butt needles, during reciprocatory knitting of the fashioned gussets of the panty girdle. The right-hand needle raising cam **326** is maintained in an outermost inoperative position by the pattern wheel **353** during the knitting of the turned cuffs at the free ends of each leg of the panty girdle.

Operation

It is believed that an understanding of the knitting machine can best be obtained through the description of the knitting of a complete seamless panty girdle blank such as that shown in FIGURES 32–34. In this girdle blank certain portions are knit of special stitches to form an open mesh type of fabric such as is illustrated in FIGURES 35 and 36. In order to knit this type girdle, on the present machine, the selector jacks J have their selector butts cut in a particular pattern, as illustrated in FIGURE 30, and they are arranged in the needle cylinder in the manner schematically illustrated in FIGURE 29.

Also, the needles are arranged in groups according to length of the butts as shown in FIGURE 28, in order to facilitate the switching of certain groups of needles into and out of action during the knitting of the fashioned gussets of the panty girdle, in a manner to be presently described. As shown in FIGURE 29, the selector jacks in the group indicated at L are used to form the open mesh fabric portions of the panty girdle and the selector jacks in the group indicated at K are used to form the plain knit portions which extend along the insides of the legs and through the crotch portion of the girdle. There are **78** selector jacks J in the group K, all of which have the butts *b*, *c*, and *d* left thereon with alternate ones of the jacks additionally having the butts *a* left thereon (FIGURE 30). In the group L, there are 450 selector jacks J and they are arranged in a repeated pattern which requires four selector jacks with the butts being arranged in the manner shown on the four jacks adjacent each side of FIGURE 30. The manner in which the selector fingers **120** and **121** engage the butts to raise these selector jacks will be described in connection with the knitting of the garment.

Referring particularly to FIGURE 28, it will be noted that the needles are arranged in the needle cylinder **60** in groups indicated at M, N, O, P, Q and R with the group M including 78 short butt needles, group N including 120 medium needles, group O including 90 long butt needles, group P including 30 medium butt needles, group Q including 120 long butt needles and group R including 90 medium butt needles. The group of short butt needles M is positioned in the needle cylinder above the group K of selector jacks. Also, as shown in FIGURE 30, the auxiliary jacks A are provided with alternating long and short butts and this arrangement is continued completely around the cylinder.

In this particular instance, the knitting machine has a needle cylinder which is nine inches in diameter and has a total of 528 needles. However, it is to be understood that the machine is not to be limited to this particular needle cylinder and that various other arrange-

ments of jacks and needles may be use if desired. Also, this machine is not limited to producing the particular open mesh type fabric shown in FIGURES 35 and 36 but may be used to knit other patterned or plain fabric throughout all or portions of the garment.

It is preferred that the garment be knit of a pair of stretchable yarns, one of which is a covered rubber or spandex type yarn E and the other yarn S is multi-filament nylon or the like which has been texturized to make it stretchable (FIGURES 35 and 36). As shown in FIGURES 32–34, the panty girdle blank includes a pair of seamless tubular legs **370** and **371**, the lower ends of which have turned welts or cuffs **372** and **373** which are integrally formed with the legs and turned on the knitting machine to form a selvage at each leg. Each leg is provided with upwardly extending fashioned extensions **374** and **375** and are joined to the respective seamless legs **370** and **371** along the corresponding dash-dot lines **376** and **377**.

A fashioned body gusset broadly indicated at **380** is positioned between the extensions **374** and **375** and is integrally formed therewith during the knitting of the blank. The body gusset **380** includes a front panel **382** and a rear panel **383**. As shown in FIGURE 32, the front gusset panel **382** is connected to the front inner edges of the extensions **374** and **375** along respective gore lines **384** and **385** which start at the upper end of a gore line **386** and diverge as they extend upwardly therefrom. The gore line **386** connects the front inner edges of the extensions **374** and **375** directly together beneath the front panel **382**.

As best shown in FIGURES 33 and 34, the rear fashioned gusset panel **383** is integrally connected to the rear inner edges of the extensions **374** and **375** along outwardly respective diverting gore lines **387** and **388**. The lower portions of the gore lines **387** and **388** start at the lower end of the rear panel **383** at the dash-pot lines **376**, **377**. Thus, in the rear of the garment blank, the inner rear edges of the extensions **374** and **376** are connected to the sides of the rear panel **383** and the rear panel **383** extends downwardly into the garment a greater distance than the front panel **382**.

The drawings of the garment blank shown in FIGURES 32–34 are shaded to indicate that the inside portions of the legs **370**, **371** and the central portion of the body gusset **380** are plain knit while the outer portions of the legs **370**, **371**, the extensions **374**, **375** and opposite sides of the body gusset **380** are knit with a special stitch to produce an open or mesh type fabric, of the type shown in FIGURES 35 and 36. The plain knit portions are formed by knitting the two types of stretchable yarn E and S together in plated relationship on every needle while the mesh type fabric is formed by knitting the stretch yarn S on every needle and selectively floating the stretch yarn E in a predetermined pattern across selected wales, in a manner to be presently described.

As shown in FIGURE 31, the texturized stretchable yarn S is fed to the hooks of all the needles N through a yarn feed finger **93***a* at a relatively low elevation in the throat opening **92**. The covered stretchable yarn E is fed through a yarn feed finger **93***b* at a relatively higher elevation than the yarn S. This yarn E is fed high enough to miss the hooks of any of the needles N which are not raised up into the notch of the center cam **262** so that they take and knit only the stretchable yarn S while the yarn E in their hooks floats across corresponding wales of the fabric. On the other hand, any needles which are raised up into the notch in the center cam **262** pick up both the yarns S and E in their hooks and then knit both yarns in plated relationship.

The knitting of the garment blank may be started at the lower end of either leg and in the present instance will be described as starting at the lower end of the leg **370** with the knitting of the turned welt or cuff **372**. The right-hand needle raising cam **326** (FIGURE 31) is moved inwardly to raise all needles to pass over the stitch cam **260** and take the yarn S while the selector finger **120***a* moves inwardly to raise alternate needles to also take the yarn E. After the first four courses are formed on all needles, the right-hand needle raising cam **326** is withdrawn (FIGURE 31) and the auxiliary jack raising cam **202** is moved inwardly far enough to engage and raise the auxiliary jacks A which have the long butts. Thus, every other auxiliary jack A and its corresponding needle is raised high enough to pass above the right-hand stitch cam **260** and knit while the intervening needles pass beneath the right-hand stitch cam **260** and retain their stitch loops thereon. Since every other selector jack J has a butt *a* theeron (FIGURE 30), the selector finger **120***a* will raise these selector jacks so that their butts **110** will engage and pass above the jack raising cam **111** and their corresponding needles are raised into the notch **262***a* in the center cam **262** to pick up and knit both yarns S and E while the intervening needles pass beneath the stitch cams **260** and **261** and do not knit but merely hold their stitch loops.

The cuff **372** (FIGURE 37) may be formed of any desired length by knitting on every other needle with both yarns S and E for the required number of courses. Then the right-hand needle raising cam **326** is moved in to raise all needle butts to pass above the stitch cam **260** and form stitch loops. As this full course is formed, the stitch loops which had been held on the intervening needles are jointed to the newly formed stitches to turn the welt. As shown in FIGURE 37, the make-up courses are indicated at **372***a*, the outer ply of the cuff **372** is indicated at **372***b* and the inner ply of the cuff is indicated at **372***c*.

In the first course of the leg **370**, the Bowden wire **138** (FIGURE 21) is released by the main pattern drum to turn the cam sleeve **137** and release the selector fingers **120***b*, **120***c* and **120***d* to be selectively operated by their corresponding cams on the right-hand pattern wheel **154** (FIGURES 16–18). The arrangement of cams on the pattern wheel **154** permits the selector finger **120***d* to move in and raise all needles to take and knit both yarns during alternate rotations of the needle cylinder while permitting the selector fingers **120***b* and **120***c* to alternately move in during intervening rotations of the needle cylinder. Thus, when the selector finger **120***b* moves in to engage and raise the alternate pairs of selector jacks in group L having butts *b* thereon (FIGURE 30), their corresponding needles are raised into the notch **262***a* in the center stitch cam **262** and these needles take and knit both yarns S and E while intervening pairs of selector jacks in group L are not raised and their corresponding needles pick up and knit only the yarn S, the yarn E being floated thereacross. As shown in FIGURE 30, all the selector jacks in group K have butts *b* thereon and their corresponding needles in group M (FIGURE 28) will be raised to pick up and knit both yarns S and E in plated relationship, forming the plain knit strip up the inside of the leg **370**.

As the selector jacks in group K pass the selector block **115**, the selector finger **120***b* is withdrawn and the selector finger **120***d* moves in and since all of the selector jacks have butts *d* thereon (FIGURE 30) every needle in the cylinder will be raised into the notch **262***a* of the center cam **262** to pick up and knit both yarns S and E, forming a plain course with both yarns knit in plated relationship in every wale. This plain course in which both yarns are knit in plated relationship is illustrated at C–**40** in FIGURES 35 and 36. In this course C–**40**, it will be noted that both of the yarns S and E are knit in plated relationship in every needle wale W–**1** through W–**10**.

As the group K of selector jacks passes the selector block **115** in the next revolution, the selector finger **120***d* is withdrawn and the selector finger **120***c* moves in to raise the intervening pairs of selector jacks in group L which have butts *c* thereon (FIGURE 30). Corresponding intervening

pairs of needles are raised into the notch **262***a* in the center cam **262** to pick up and kit both yarns S and E while alternate pairs of needles pick up and knit only the yarn S while the yarn E is floated across these alternate pairs of needles. This course is illustrated at C–**41** in FIGURES 35 and 36. Thus, in course C–**41**, the pairs of adjacent needles in wales W–**1** and W–**2**, W–**5** and W–**6**, W–**9** and W–**10** are raised to pick up and knit both yarns S and E in plated relationship while the pairs of adjacent needles in wales W–**3** and W–**4**, W–**7** and W–**8**, are raised high enough to pick up and knit only the yarns S while the yarn E is floated across these two wales. Since all of the selector jacks in group K (FIGURE 30) have butts *c* thereon, all of the needles in group M (FIGURE 28) will be raised to knit both yarns S and E and form the plain knit section of this course at the inside of the leg **370**.

As the group K of selector jacks passes the selector block **115** in the next revolution to knit the course C–**42**, the selector finger **120***c* is withdrawn and the selector finger **120***d* is moved in to raise all selector jacks and their corresponding needles into the notch **262***a* in the center cam **262**. Thus, all needles pick up and knit both yarns S and E in plated relationship in every wale W–**1** through W–**10** of course C–**42** (FIGURES 35 and 36).

In the next course C–**43** the selector finger **120***d* is withdrawn and the selector finger **120***b* is moved in to raise the selector jacks in group L which have butts *b* thereon (FIGURE 30). Thus, in course C–**43** the pairs of adjacent needles which form the needle wales W–**3** and W–**4**, W–**7** and W–**8** pick up and knit both yarns S and E while adjacent pairs of needles which form the wales W–**1** and W–**2**, W–**5** and W–**6**, W–**9** and W–**10** pick up and knit only the yarn S and the yarn E is floated across these wales.

The knitting of the four courses C–**40** through C–**43** constitutes one repeat of the open mesh stitch and courses C–**44** through C–**47** illustrate a second repeat of the pattern shown in the courses C–**40** through C–**43**. The pattern shown in FIGURES 35 and 36 is repeated on all the needles in groups N, O, P, Q and R (FIGURE 28) while both yarns are knit on every needle in group M of every course to form the plain knit strip extending up the inside of the leg **370**. While other knit and float patterns may be used, the pattern illustrated provides an open mesh fabric having a pleasing appearance and one which is porous and can "breathe" when the garment is worn.

When the desired number of complete courses are knit to provide the desired length to the leg **370**, at the dash-dot line **376**, the clutch fork **34** is shifted from right to left in FIGURE 1 to begin reciprocation of the needle cylinder **60**. During the first reciprocatory course of the extension **374**, which extends along the dash-dot line **376** of the garment blank (FIGURES 32–34), the stitch cam support bracket **263** is stepped back far enough that the short butt needle in group M miss the stitch cams and alternate inward movement of the needle raise cams **326** and **327** is controlled by the cams on the pattern wheels **154** and **155** (FIGURES 9 and 10) so that they do not move in far enough to engage the short butt needles in group M. Thus, this first reciprocatory course is formed on all of the needles except the 78 short butt needles in the group M (FIGURE 28). These short butt needles retain their stitch loops thereon and remain in a low inactive position during the complete knitting of both extensions **374**, **375** and the body gusset **380**.

When the machine is switched to reciprocatory motion, the pivotal position of the stitch cams **260** and **261** is controlled by the cams on the pattern wheels **154** and **155** (FIGURES 7 and 8) so that they are alternately lowered to stitch drawing position only when the active needles are being drawn down to stitch drawing level and as the leading needles which knit again pass beneath the stitch cams, the stitch cams are released to prevent an additional lowering of these needles and a resulting elongation of their stitch loops. In the first clockwise swing of the needle cylinder, the narrowing pick **301** will engage and raise the first active needle to pass above the center cam **262** at an inactive level. Movement of the narrowing pick **301** will cause the pick **300** to swing down into the notch in the upper surface of the stitch cam **260** where it will be in position to raise the first needle when the needle cylinder swings in a counterclockwise direction. Thus, during the knitting of the extension **374**, the narrowing picks **300** and **301** normally operate to raise the leading active needle to inoperative position above the center stitch cam **262** and thereby reduce the number of needles which knit with each swing of the needle cylinder. However, in the present instance, it is desired to narrow at a slower than normal rate during the knitting of the first portion of the extension **374**. Therefore, the left-hand narrowing pick **301** is raised to inoperative position before alternate clockwise swings of the needle cylinder by means of the lever **320** and the cam **320***a* on the pattern wheel **155** (FIGURE 11). When the lower portion of the extension **374** is completed, the Bowden wire **323** pulls the lever **320** (FIGURE 11) to inoperative position and the narrowing pick **301** operates to raise the leading needle during each clockwise swing of the needle cylinder.

During the knitting of the narrowed extension **374**, the needle raising cams **326** and **327** are alternately moved into operative position by the respective cams **346***a*, **346***b* and **334***a*, **334***b* on the pattern wheels **154**, **155** (FIGURES 9 and 10) to raise the active needles to pass over the corresponding stitch cams **260** and **261**. Also, the selector finger **120***g* is controlled by cams **130***g* on the pattern wheel **154** (FIGURE 15) and moves in during each counterclockwise swing of the needle cylinder to raise all active needles to pick up and knit both yarns S and E. The selector fingers **121***e* and **121***f* (FIGURES 13 and 14) are controlled from the pattern wheel **155** to alternately move in during clockwise swings of the needle cylinder to select pairs of needles to pick up and knit both yarns S and E in accordance with the pattern of the butts *e* and *f* on the selector jacks in group L (FIGURE 30).

The gradually narrowed mesh fabric of the extension **374** is continued to the upper ends of the gore lines **384** and **387**. Although the gore lines are not formed during the knitting of the extension **374**, the idled needles at the ends of each partial course hold their stitch loops along the inner front and rear edges of the fashioned extension **374**, which are later connected to the other parts of the garment along the front gore lines **384** and **386** and the rear gore line **387**.

At the upper end of the extension **374**, only a relatively small number of needles remain in action and knit the last partial course which extends from the upper end of the front gore line **384** to the upper end of the rear gore line **387**.

In the knitting of the first partial course of body gusset **380**, the narrowing picks **300** and **301** are rendered inoperative and the winding pick **180** (FIGURE 31) is moved up to the solid line operative position to begin lowering the endmost inactive needles to pass through the stitch cams and begin a widening operation at the beginning of the knitting of the body gusset **380**. The position of the widening pick **180** is controlled by the lever **191** and cams **193** on the pattern wheel **154** (FIGURE 4) to lower the pick **180** to inoperative position as the inactive group of needles M passes in each direction.

The selective knitting of the yarns is continued to form a widened mesh fabric to the dash-dot line **380***a* (FIGURES 32 and 33). During the next counterclockwise swing of the needle cylinder the switch cam **226** (FIGURE 31) is moved in to engage and lower all inactive needles in groups Q, P and O (FIGURE 28) to pass through the stitch cams. Because the needle groups

Q and O are not even on each side of the needle cylinder, a greater number of needles are introduced to form the vertical portion of the rear gore line **387** (FIGURE 33) than the number of needles which are introduced to form the vertical portion of the front gore line **384** (FIGURE 32). This greater number of simultaneously activated needles in the rear of the garment causes the rear panel **383** to extend further down into the garment than the front panel **382** and provides more width to the back of the garment. This greater width across the rear of the garment provides a better fit and helps prevent the top of the garment from riding down in the back when worn.

After the formation of the vertical portions of the gore lines **384** and **387**, in which groups of needles are brought into action simultaneously at each side of the active needles, the widening of the mesh fabric continues to the line **380***b* in the body panel. At this point, widening continues but now the selector fingers **120***g* and **121***g* operate on the butts *g* of the selector jacks in group L to raise all of the active needles to pick up and knit both yarns E and S and form plain stitches with each swing of the needle cylinder. As both yarns are knit on every needle, a panel of plain fabric is formed in the central portion of the body gusset **380**, between the lines **380***b* and **380***c* (FIGURES 32 and 33).

At the center of the plain knit panel of the body gusset **380**, the widening pick **180** is deactivated and the narrowing picks **300**, **301** are activated to begin a gradual narrowing operation. The mesh type fabric is again formed by selective knitting and floating of the yarns at the line **380***c* and the gradual narrowing operation continues up to the vertical portions of the front and rear gore lines **385** and **388** and the dash-dot line **380***d*. At this point and during a counterclockwise swing of the needle cylinder, the groups of needles Q and O are raised to inactive position by the inward movement of the switch cam **227** (FIGURE 31) and so that this partial course, indicated by the dash-dot line **380***d*, is knit on only the needles in group P. The narrowing operation is continued up to the upper ends of the front and rear gore lines **385** and **388**.

Then, the narrowing picks **300**, **301** are deactivated and the widening pick is activated to gradually increase the length of the partial courses and start the knitting of the extension **375**. The endmost stitches of these widened partial courses are drawn through the corresponding endmost stitches of the partial courses of the body gusset **380** to begin formation of the front and rear gore lines **385** and **388**. This widening operation continues throughout the knitting of the leg extension **375** and as the needles are brought back into action which have been holding the endmost stitch loops at the front edge of the extension **374**, the front vertical gore line **386** is formed below the body gusset **380**.

During the last reciprocatory course of the extension **375**, at the dash-dot line **377**, the clutch fork **34** is shifted back to the position shown in FIGURE 1 so that the needle cylinder is again rotated. In this first counterclockwise rotation, the cam **326** is moved inwardly to its innermost operative position to raise all of the needles to active or knitting position. The selector fingers **120***b*, **120***c* and **120***d* (FIGURES 16–18) again selectively raise the needles and again form the mesh fabric in the outer portion of the leg **371** while forming the plain knit strip extending up the inside of the leg.

After the leg **371** is the desired length, the needle raising cam **326** is withdrawn and the auxiliary jack raising cam **202** is moved in to begin knitting on only alternate needles. The intervening needles hold their stitch loops and remain at a low level during the knitting of the cuff **373**. At the end of the cuff **373** the needle raising cam **326** is moved inwardly to raise all needles to knit and turn the cuff. Then a few plain selvage courses are knit before the completed girdle blank is shed from the needles and drops through the tube **61**.

The type of girdle blank shown in FIGURES 38–40 is knit in substantially the same manner as the girdle blank shown in FIGURES 32–34 and contains substantially the same parts. Therefore, parts of the girdle blank shown in FIGURES 38–40 which correspond to like parts of the girdle blank shown in FIGURES 32–34 will bear like reference characters with the prime notation added. It will be noted that all parts of the girdle blank shown in FIGURES 38–40 are plain knit and that the front and rear body panels **382′** and **383′** of the body gusset **380′** extend down equal amounts in the front and rear of the girdle blank. Thus, in addition to the vertical front gore **386′**, which joins together the inner front edges at the lower ends of the extensions **374′** and **375′**, there is a vertical rear gore **386***a′* (FIGURE 39), which joins together the inner rear edges at the lower ends of the extensions **374′** and **375′**.

In order to make the front and rear panels **382′** and **383′** extend down equal amounts at the front and rear of the girdle blank, it is necessary to arrange the needles in the manner shown in FIGURE 27. Thus, there are 110 long butt needles in the groups Q′ and O′, 100 medium butt needles in the groups R′ and N′, 30 medium butt needles in the group P′ and 78 short butt needles in the group M′. Then when the groups of needles are activated at one side of the body gusset **380** and deactivated at the other side of the body gusset the vertical portions of the corresponding gore lines **384′**, **387′** and **385′**, **388′** will be equal in length at both the front and rear of the girdle blank. Either type of girdle blank may be made into a seamless girdle by merely slitting the upper end to form a waist opening and then sewing an elastic band or the like to the opening to prevent raveling of the material.

The knitting machine disclosed in the present application can also be utilized to knit various other types of seamless girdle blanks or the like, with or without mesh fabric in selected portions.

In the drawings and specification there has been set forth preferred embodiments of the invention and, although specific terms are employed, they are used in a generic and descriptive sense only and not for purposes of limitation, the scope of the invention being defined in the claims.

We claim:

1. A circular knitting machine for knitting articles having a plurality of fashioned and reciprocatorily knit interconnected gussets, said knitting machine comprising the combination of a needle cylinder having a series of independent needles supported for vertical movement in the cylinder and each having an operating butt thereon, one contiguous group of said needles having shorter butts than the remaining longer butt needles, drive means for imparting alternating forward and reverse movements to said needle cylinder, a knitting station supported adjacent said needle cylinder and including a top center cam, a forward stitch cam positioned at one side of said center cam and a reverse stitch cam positioned at the other side of said center cam, and means associated with said stitch cams for vertically positioning said forward stitch cam in stitch drawing position with said longer butt needles for only a selected portion of each of said forward motions of said needle cylinder and for vertically positioning said reverse stitch cam in stitch drawing position with said longer butt needles for only a selected portion of each of said reverse motions of said needle cylinder.

2. A knitting machine according to claim **1** including means operatively connected to both of said stitch cams for moving the same away from said needle cylinder to prevent engagement of the contiguous group of shorter butt needles therewith but permit engagement therewith of said remaining longer butt needles.

3. A circular knitting machine according to claim 2 including a narrowing pick associated with each of said stitch cams, and means operatively associated with said narrowing picks for controlling the operation thereof and to position said narrowing picks to raise the leading longer butt needle to inactive level during certain movements of said needle cylinder and to reposition said narrowing picks for preventing the raising of the leading longer butt needle during the remaining movements of said needle cylinder.

4. A circular knitting machine according to claim 3 including first and second pattern wheels rotated by said drive means and in timed relation to reciprocation of said needle cylinder, control means operable by one of said pattern wheels for deactivating one of said narrowing picks during certain movements of said needle cylinder in one direction and for activating said one narrowing pick during the remaining movements of said needle cylinder in said one direction, first stitch cam control means operable by said second pattern wheel for positioning said forward stitch cam in stitch drawing position for only a selected portion of each forward motion of said needle cylinder, and second stitch cam control means operable by said first pattern wheel for positioning said reverse stitch cam in stitch drawing position for only a selected portion of each reverse motion of said needle cylinder.

5. A circular knitting machine according to claim 3 including a first radially movable end cam positioned adjacent said reverse stitch cam, a second radially movable end cam positioned adjacent said forward stitch cam, and end cam control means for moving said first end cam inwardly to engage said longer butt needles for only a selected portion of each forward movement of said needle cylinder and for moving said second end cam inwardly to engage said longer butt needles for only a selected portion of each reverse movement of said needle cylinder.

6. A circular knitting machine according to claim 5 including first and second pattern wheels rotated by said drive means and in timed relation to reciprocation of said needle cylinder, and wherein said end cam control means is operable by said pattern wheels to selectively control said radially movable end cams.

7. A circular knitting machine according to claim 1 including means positioned above said top center cam for feeding a pair of yarns at different levels to said needles, pattern jacks positioned beneath each needle, and selector means positioned at each side of said knitting station for engagement with said pattern jacks during the forward and reserve motions of said needle cylinder to cause certain of the corresponding needles to take and knit both of the yarns and the remaining needles to take and knit only one of the yarns while floating the other yarn.

8. A circular knitting machine for knitting articles having seamless tubular rotary knit portions and a plurality of interconnected fashioned and reciprocatorily knit gussets, said knitting machine comprising the combination of a needle cylinder having a series of independent needles supported for vertical movement in the cylinder and each having an operating butt thereon, one contiguous group of said needles having shorter butts than the remaining needles, drive means for imparting rotary and reciprocatory motion to said needle cylinder, a knitting station supported adjacent said needle cylinder and including a top center cam, a forward stitch cam positioned at one side of said center cam and a reverse stitch cam positioned at the other side of said center cam, a rotatable main pattern drum, a pattern chain moved in a step-by-step manner by said drive means and controlling rotation of said main pattern drum, a pair of rotatable pattern wheels, one of said pattern wheels being positioned on each side of said knitting station, a first radially movable end cam positioned adjacent said reverse stitch cam, a second radially movable end cam positioned adjacent said forward stitch cam, primary end cam control means operable by said pattern wheels during reciprocatory motion for moving said first end cam inwardly to engage said longer butt needles for only a selected portion of each forward motion of said needle cylinder and for moving said second end cam inwardly to engage said longer butt needles for only a selected portion of each reverse motion of said needle cylinder, and secondary end cam control means operable by said main pattern drum for maintaining said first end cam inwardly to engage all of said needles during rotary motion of said needle cylinder.

9. A circular knitting machine according to claim 8 including an upper bed plate surrounding a medial portion of said needle cylinder, and a lower bed plate surrounding the lower portion of said needle cylinder, and wherein said pattern wheels extend upwardly from the level of said lower bed plate and above the level of said upper bed plate.

10. A circular knitting machine according to claim 8 including primary stitch cam control means operable by said pattern wheels for positioning said forward stitch cam in stitch drawing position with said longer butt needles for only a selected portion of each of the forward motions of said needle cylinder and for positioning said reverse stitch cam in stitch drawing position with said longer butt needles for only a selected portion of each of the reverse motions of said needle cylinder, and secondary stitch cam control means operable by said main pattern drum for maintaining said forward stitch cam in stitch drawing position during rotary motion of said needle cylinder.

11. A circular knitting machine according to claim 8 including means operatively connected to said stitch cams for moving the same away from said needle cylinder to prevent engagement of the contiguous group of shorter butt needles therewith but permit engagement therewith of said remaining longer butt needles during reciprocatory motion and for moving said stitch cams toward said needle cylinder to permit engagement with the butts of all of said needles during rotary motion of said needle cylinder.

12. A circular knitting machine according to claim 9 including means positioned above said top center cam for feeding a pair of yarns at different levels to said needles, pattern jacks positioned beneath each needle, and selector means positioned at each side of said knitting station for engagement with said pattern jacks to cause certain of the corresponding needles to take and knit both of the yarns and the remaining needles to take and knit only one of the yarns while floating the other yarn, said selector means being operable by said pattern wheels during reciprocation and rotary motions of said needle cylinder.

13. A circular knitting machine according to claim 12 including a jack raising cam positioned beneath said top center cam and being operable to raise selected ones of said pattern jacks and their corresponding needles high enough to receive and knit the yarns fed at both levels, and said pattern jack selector means being operable upon the pattern butts of said pattern jacks during both rotary and reciprocatory motion of said needle cylinder to raise certain of said pattern jacks to pass above said jack raising cam while the remaining pattern jacks pass beneath said jack raising cam, the needles corresponding to the pattern jacks which pass beneath said jack raising cam being raised high enough to receive and knit only the yarn fed at the lower level while the yarn fed at the higher level is floated.

14. A circular knitting machine according to claim 13 including means supporting said stitch cams for radial

movement, first stitch cam control means being operable by said pattern wheels during reciprocation of said needle cylinder for alternately maintaining said forward and reverse stitch cams in stitch drawing position for portions of each motion of said needle cylinder, and second stitch cam control means operable by said main pattern drum for maintaining said stitch cams in an innermost position to engage the butts of all needles during rotation of said needle cylinder and for maintaining said stitch cams in withdrawn position to engage the butts of all needles except said one contiguous group of shorter butt needles during reciprocation of said needle cylinder.

15. A circular knitting machine according to claim **14** including end cam control means operable by said main pattern drum during rotation of said needle cylinder for maintaining said first end cam in operative position to raise all of said needles to pass through said knitting station.

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