Aug. 7, 1956 H. E. CRAWFORD 2,757,526

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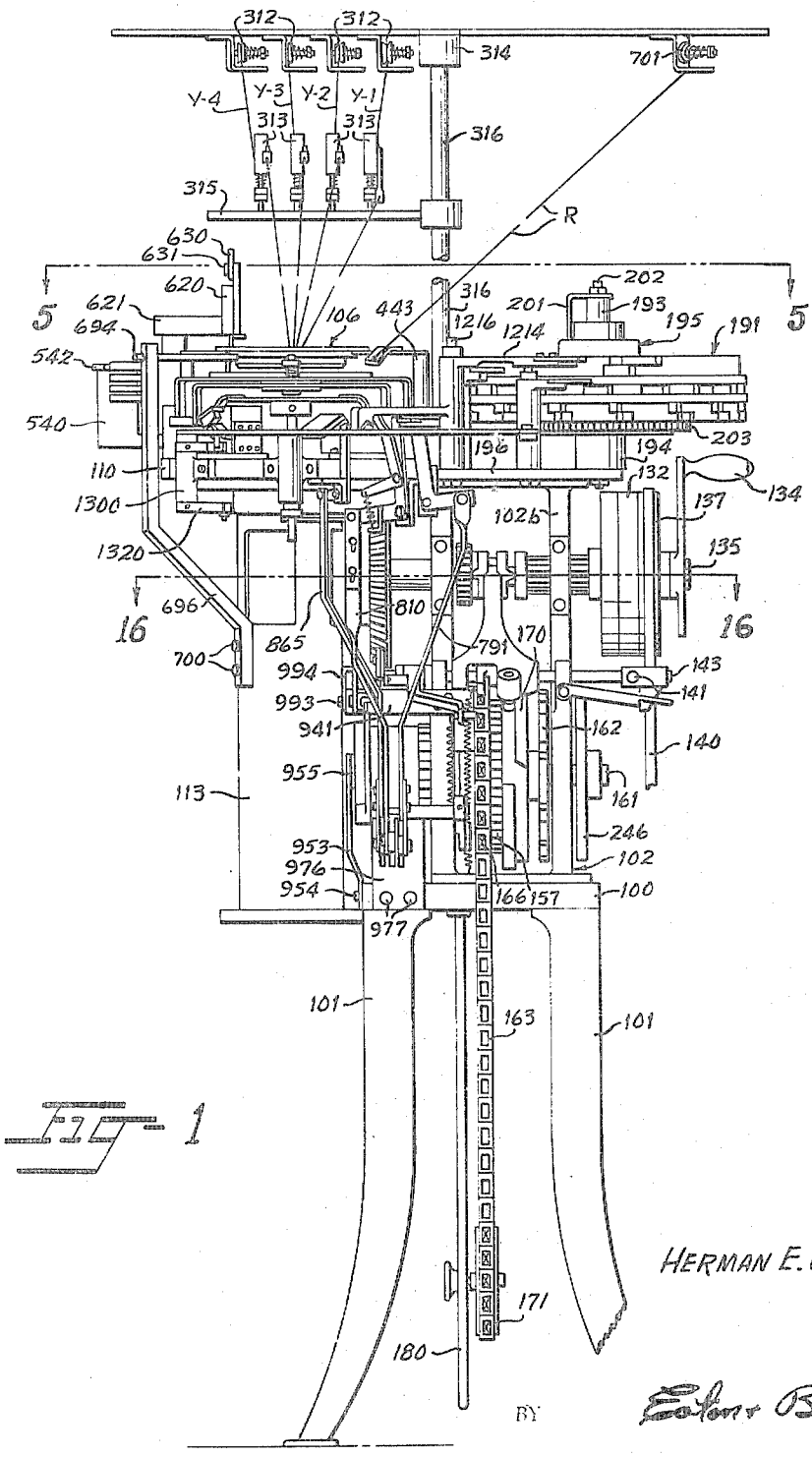

FIG. 1

HERMAN E. CRAWFORD,
INVENTOR.

BY Eaton & Bell

ATTORNEYS.

Aug. 7, 1956 H. E. CRAWFORD 2,757,526

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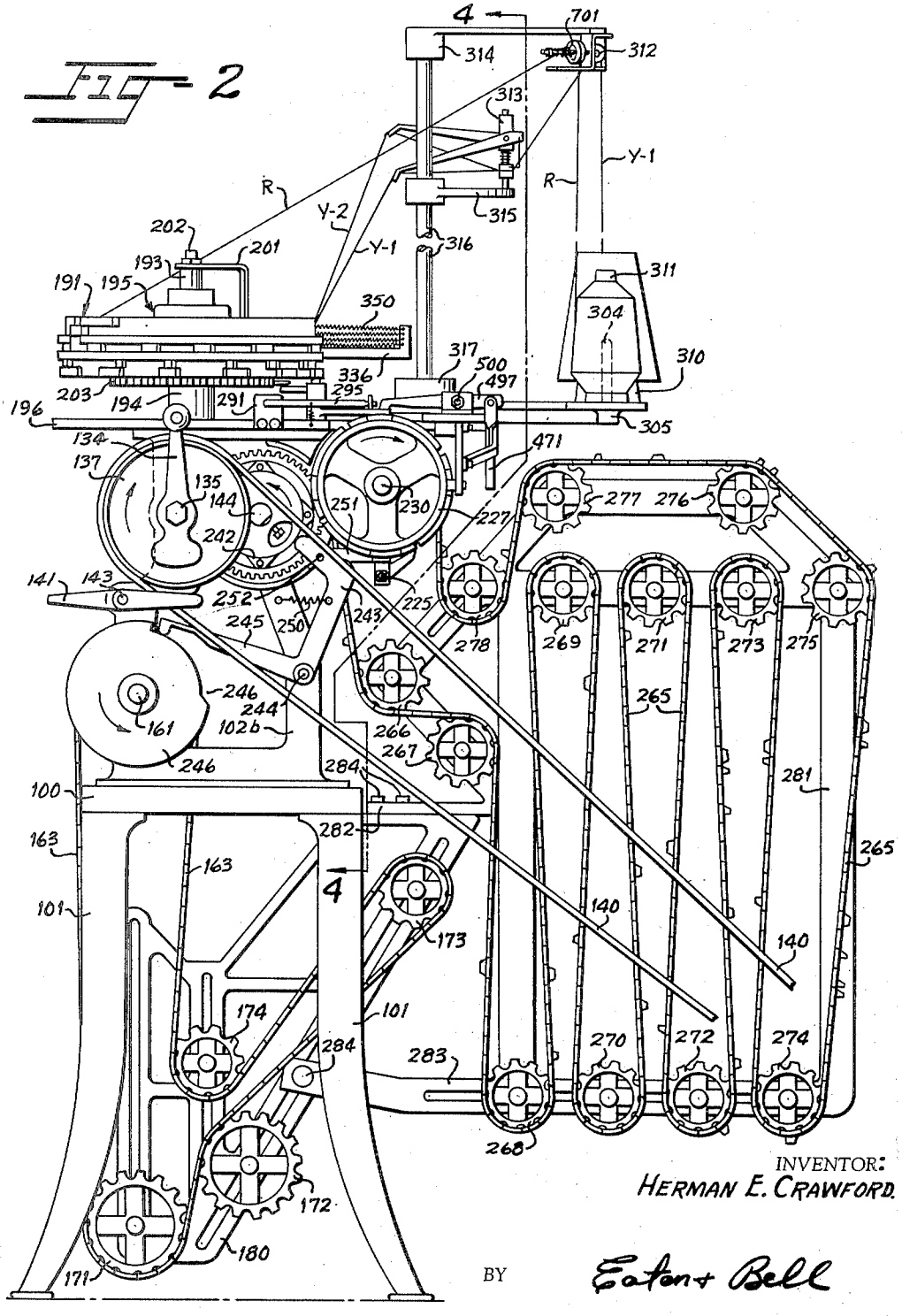
Fig. 2



INVENTOR:
HERMAN E. CRAWFORD.

BY Eaton & Bell

ATTORNEYS.

Aug. 7, 1956 H. E. CRAWFORD 2,757,526

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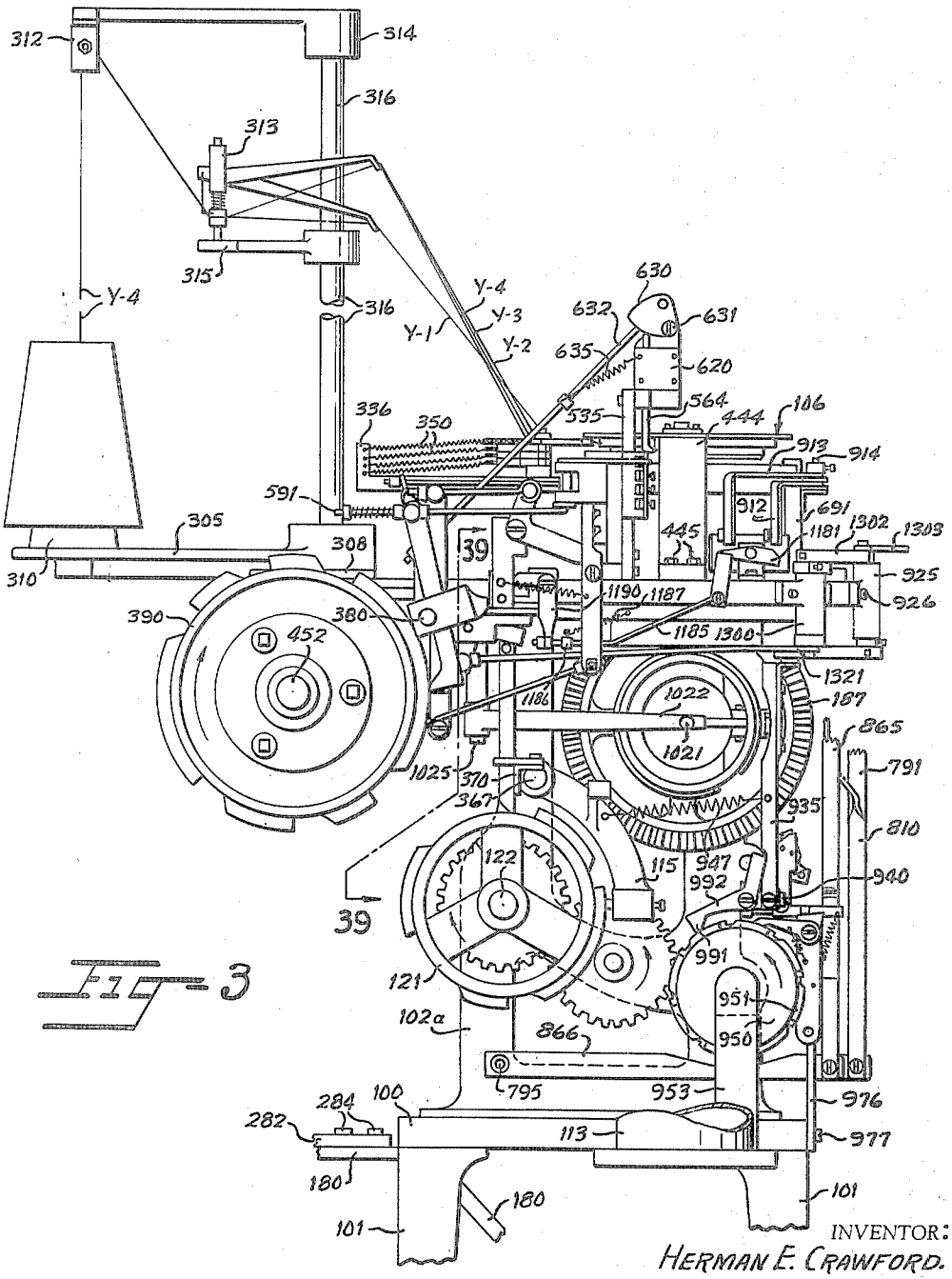

Fig. 3

INVENTOR:
HERMAN E. CRAWFORD.

BY Eaton & Bell

ATTORNEYS.

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KNITTING MACHINE

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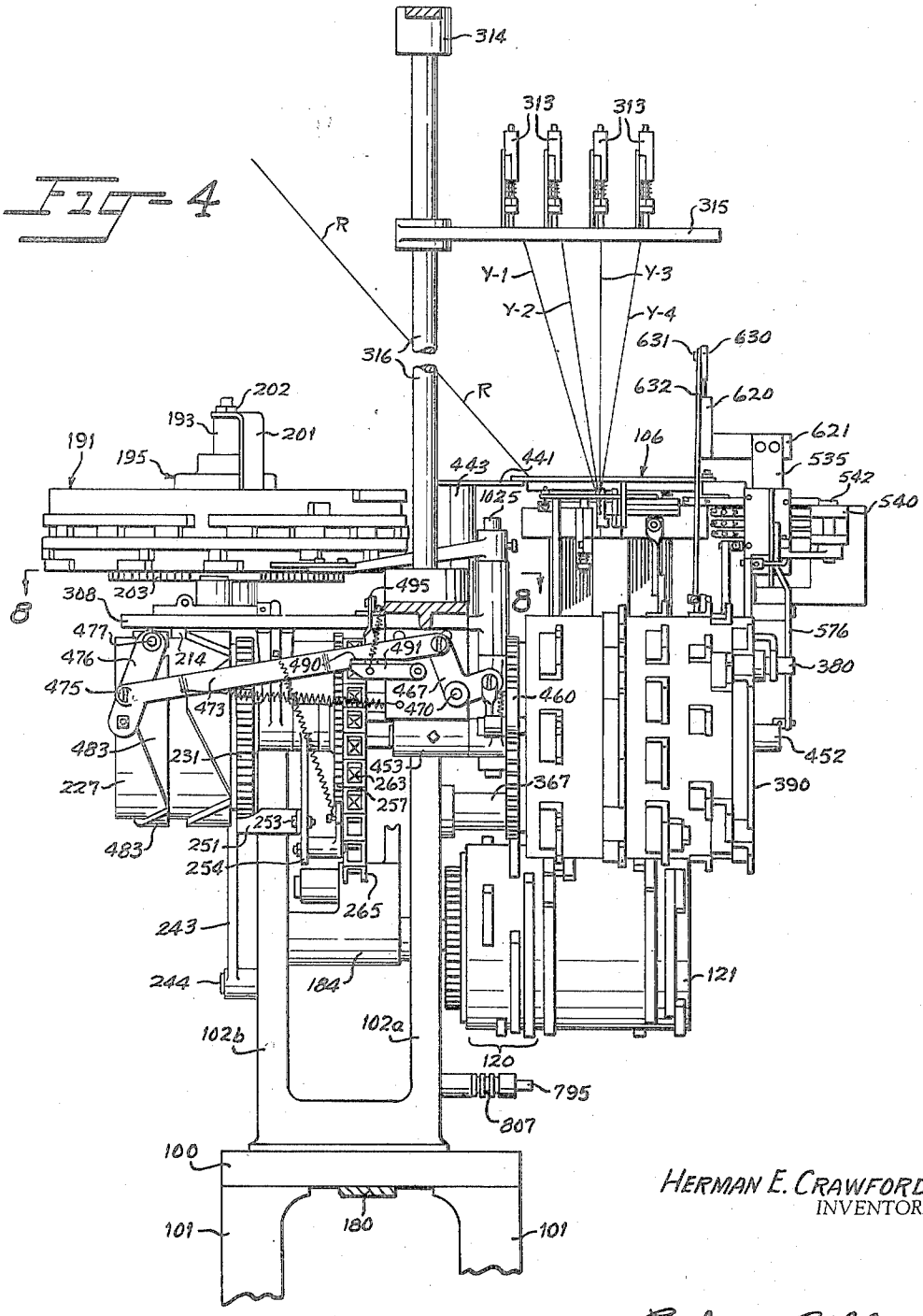
Fig. 4



HERMAN E. CRAWFORD,
INVENTOR.

BY Eaton & Bell

ATTORNEYS.

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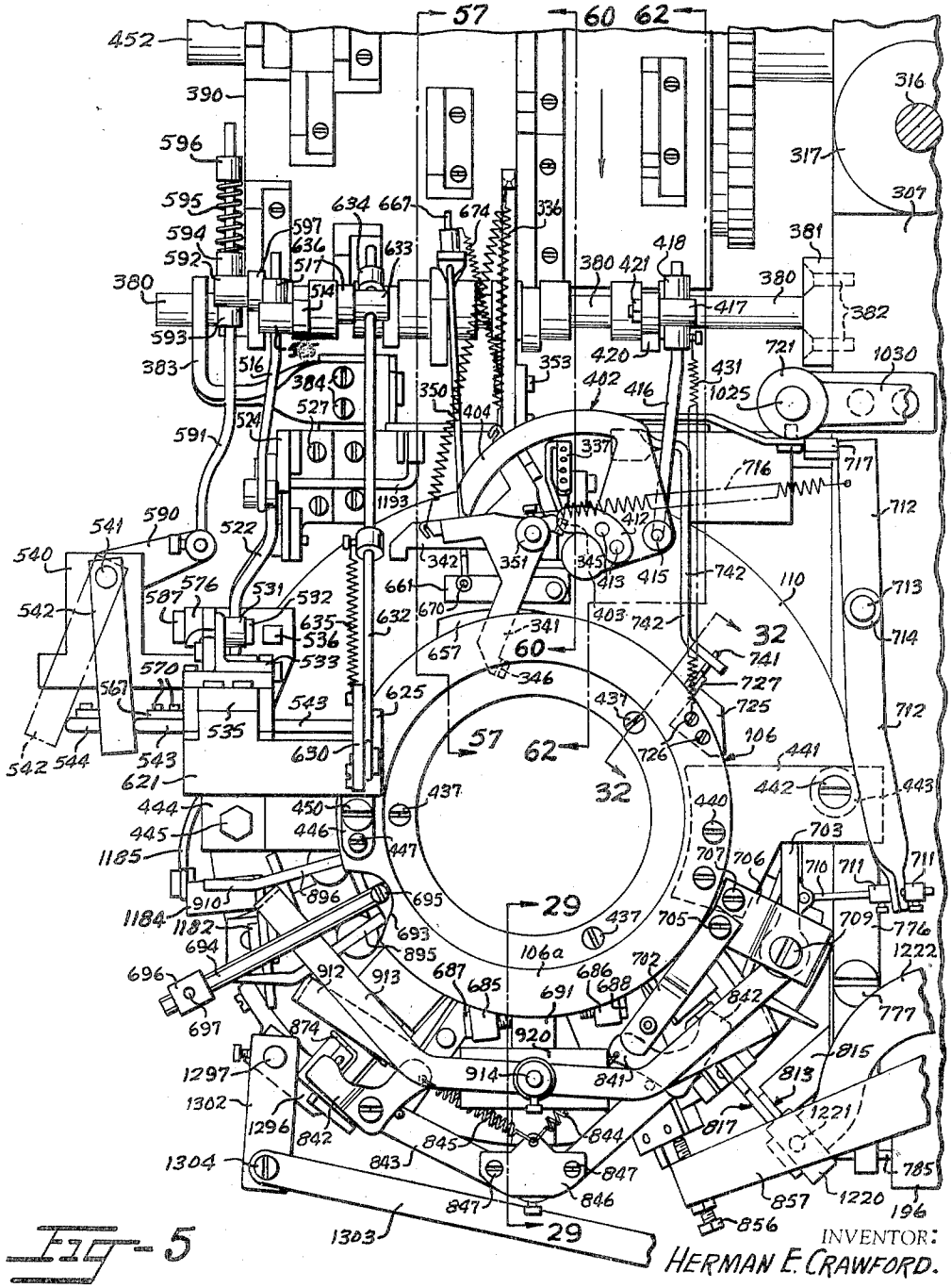

FIG. 5

INVENTOR:
HERMAN E. CRAWFORD.

BY Eaton & Bell

ATTORNEYS.

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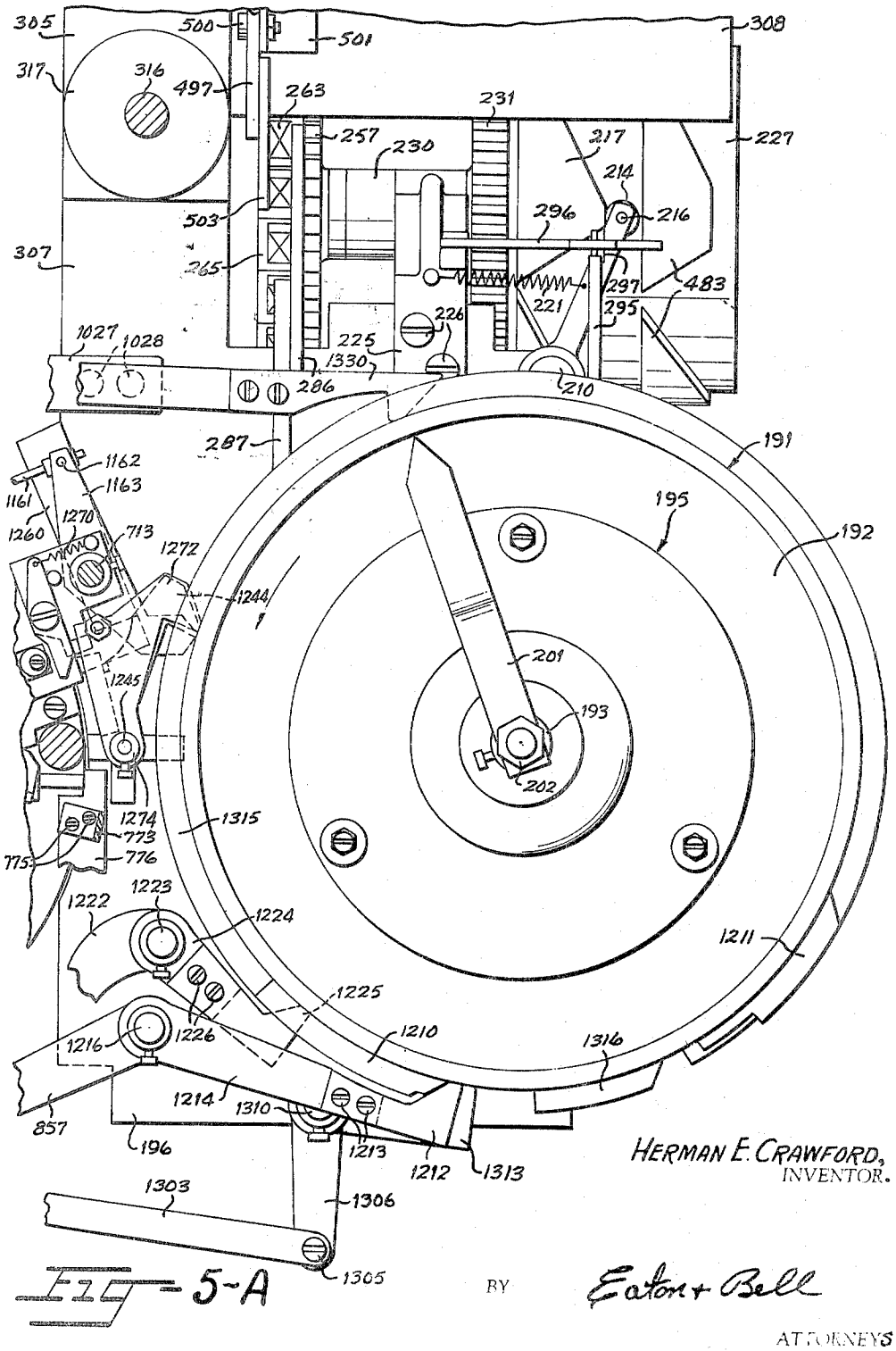

FIG. 5-A

HERMAN E. CRAWFORD,
INVENTOR.

BY Eaton & Bell

ATTORNEYS

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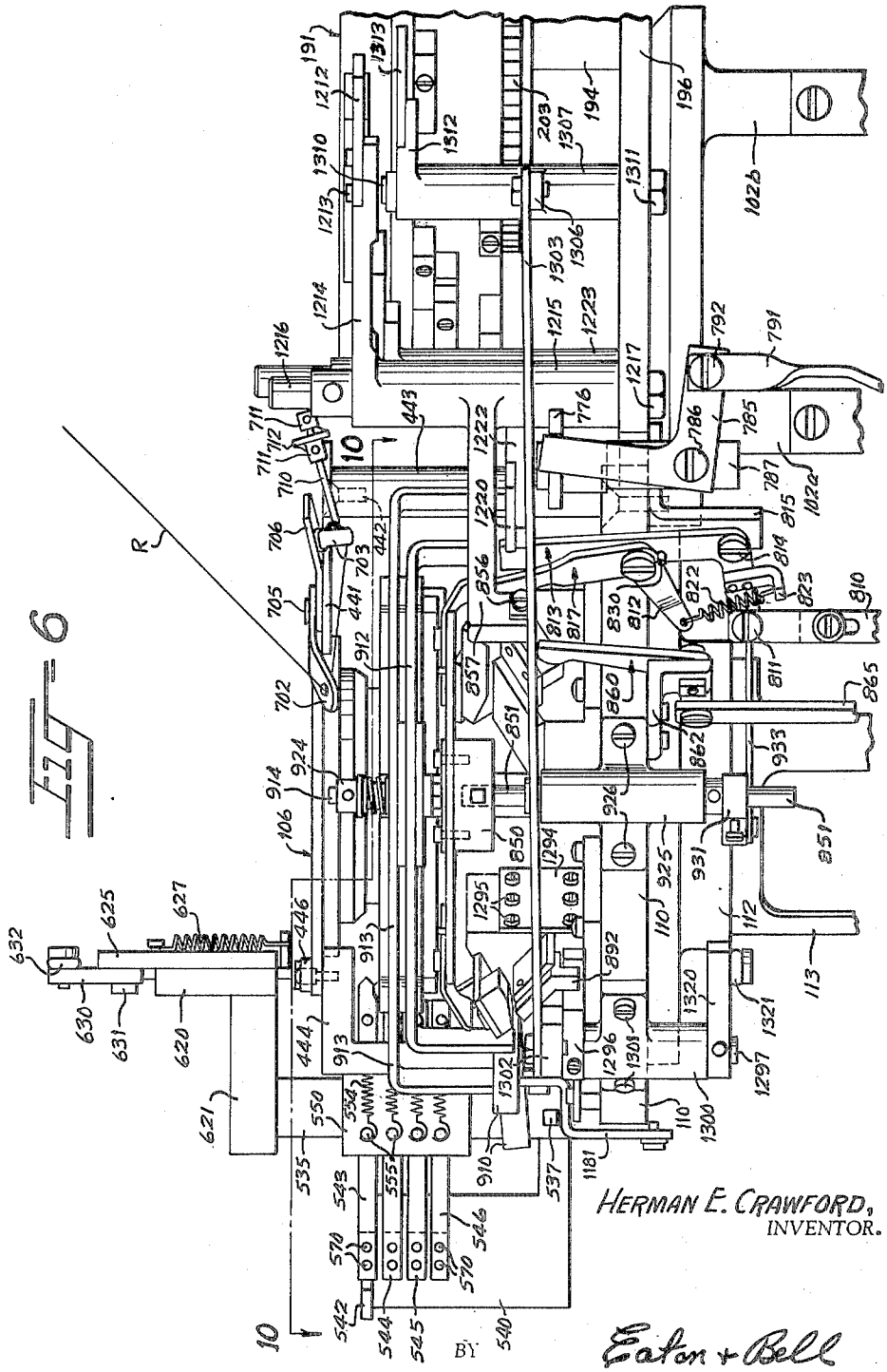

FIG 6

HERMAN E. CRAWFORD,
INVENTOR.

BY Eaton + Bell

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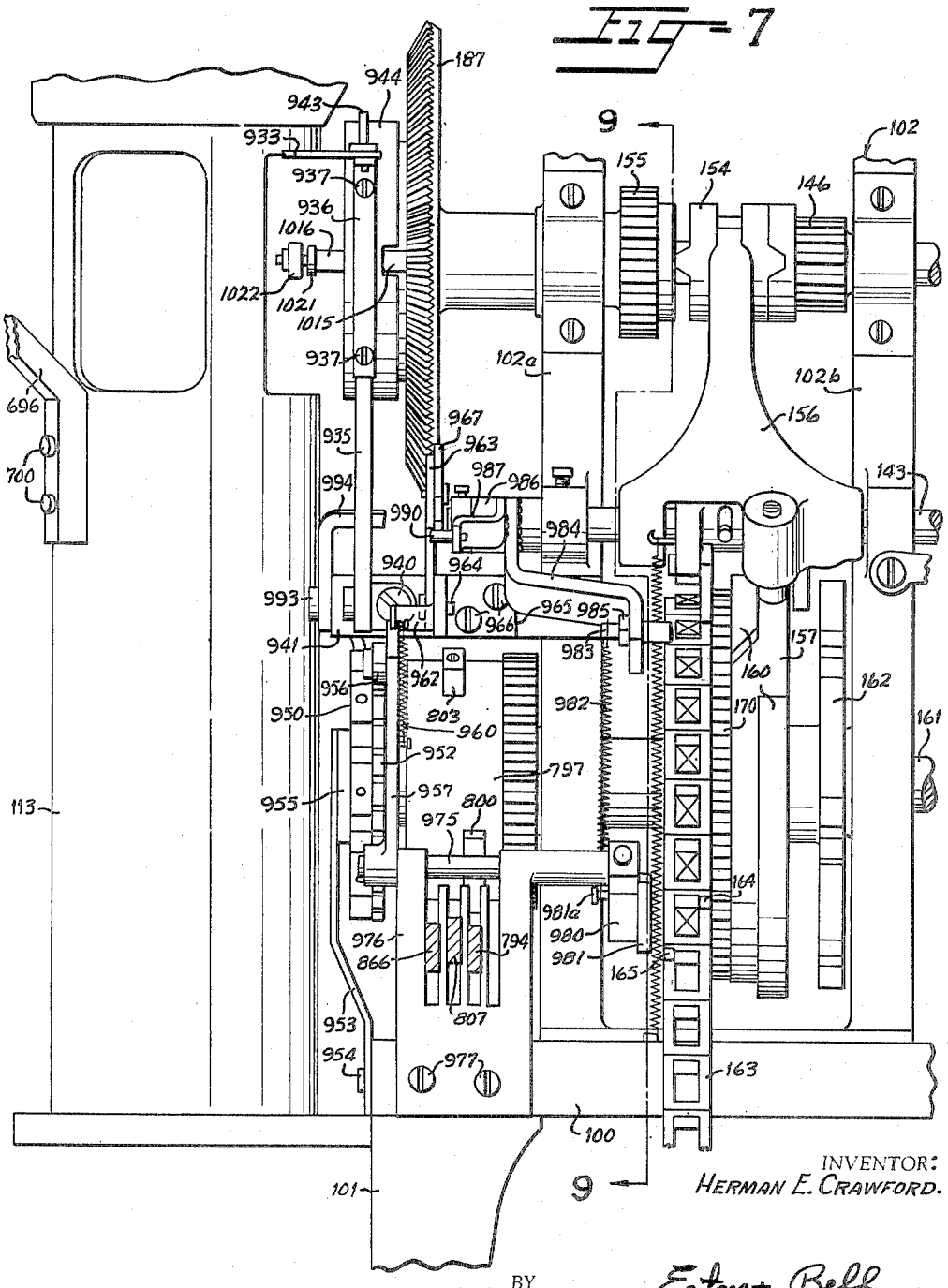
Fig. 7



INVENTOR:
HERMAN E. CRAWFORD.

BY Eaton & Bell

ATTORNEYS.

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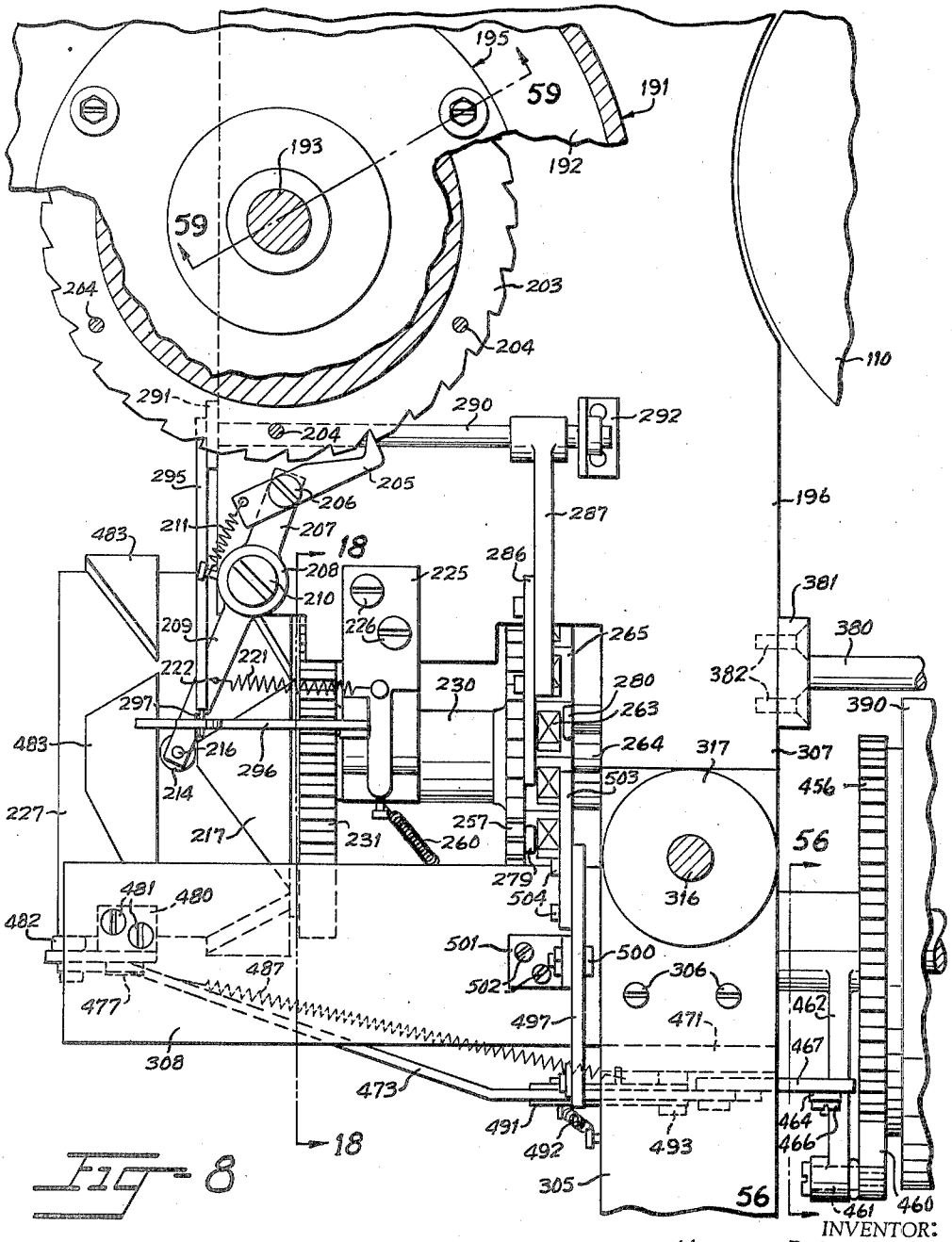

Fig. 8

INVENTOR:
HERMAN E. CRAWFORD.

BY Eaton & Bell

ATTORNEYS.

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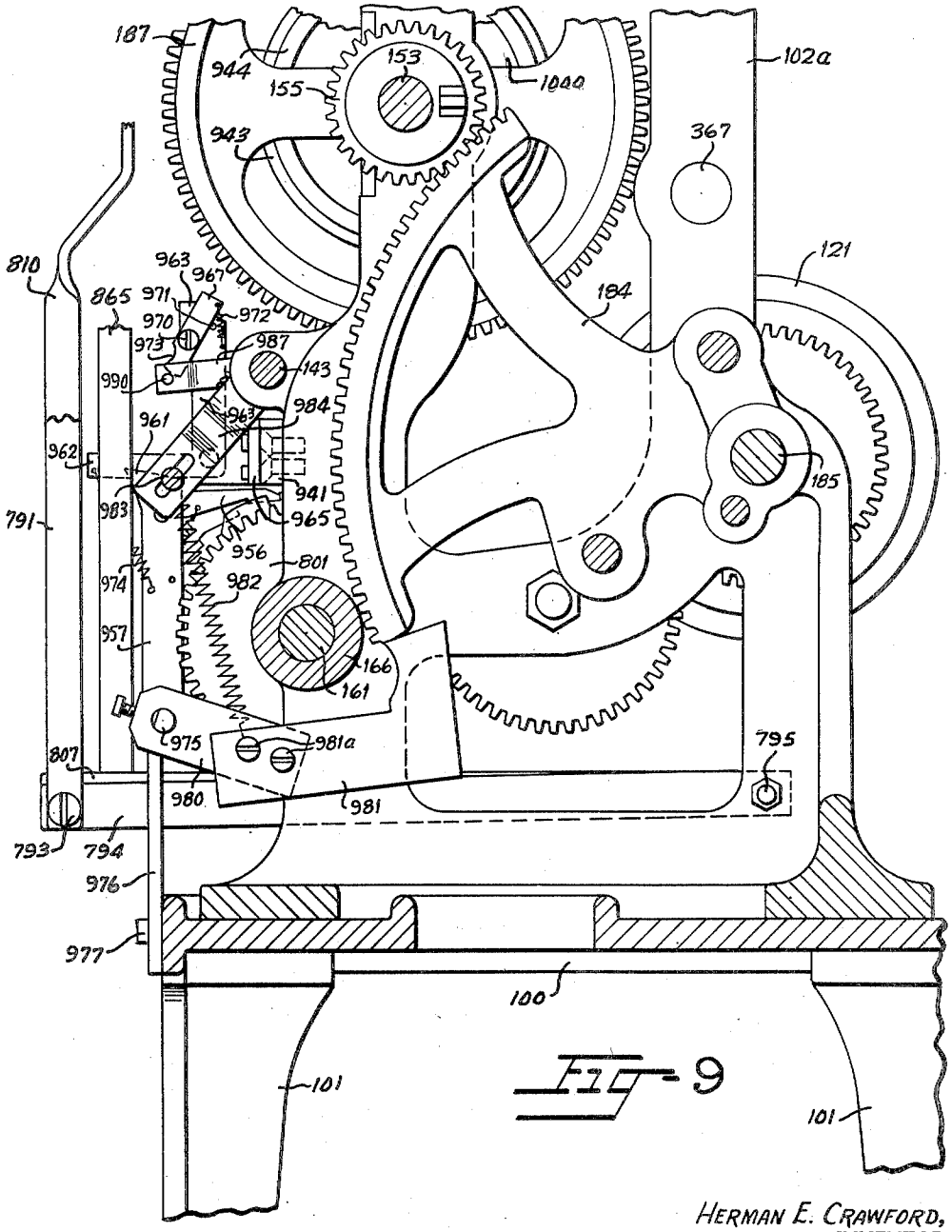

Fig. 9

HERMAN E. CRAWFORD,
INVENTOR.

BY Eaton & Bell

ATTORNEYS.

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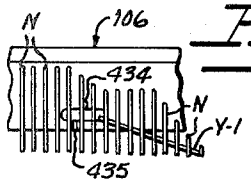
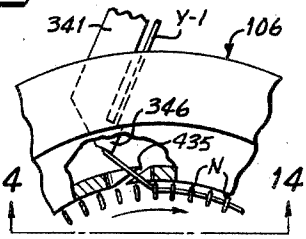
Fig-14





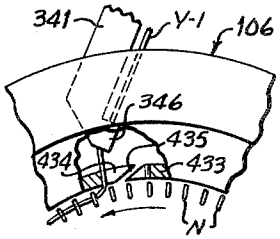


Fig-12

Fig-11

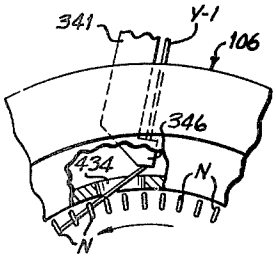


Fig-13

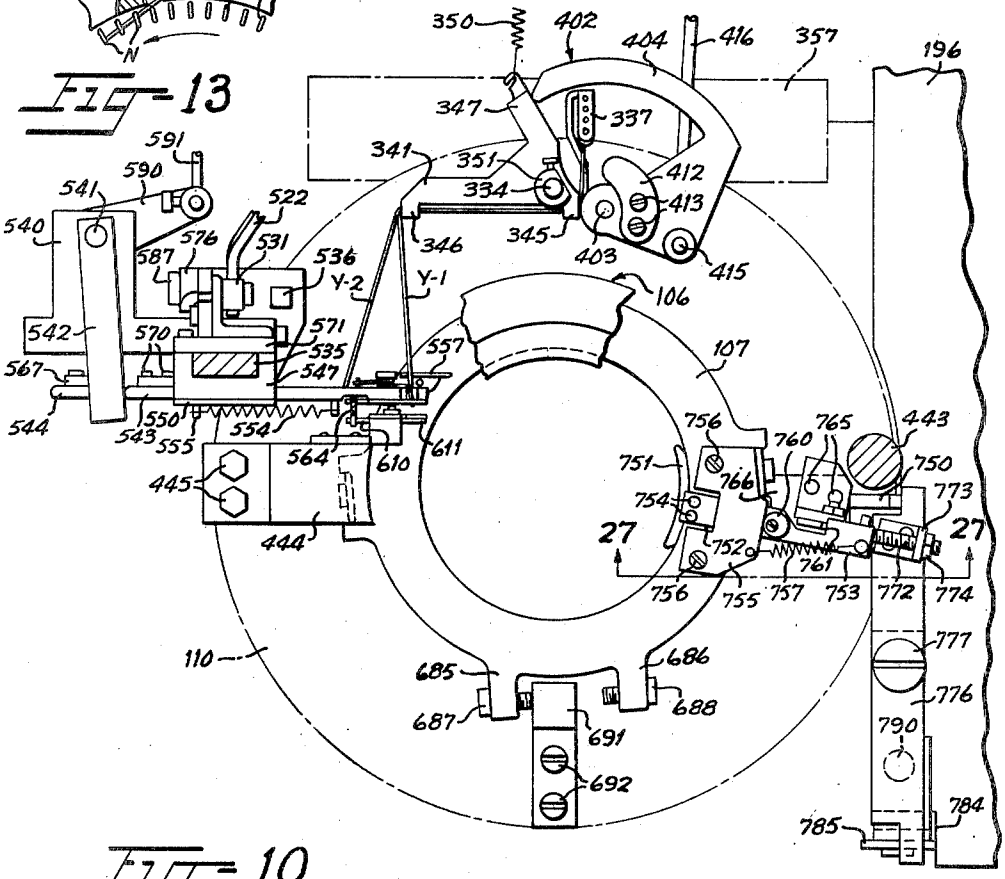


Fig-10

INVENTOR:
HERMAN E. CRAWFORD.

BY Eaton & Bell

ATTORNEYS.

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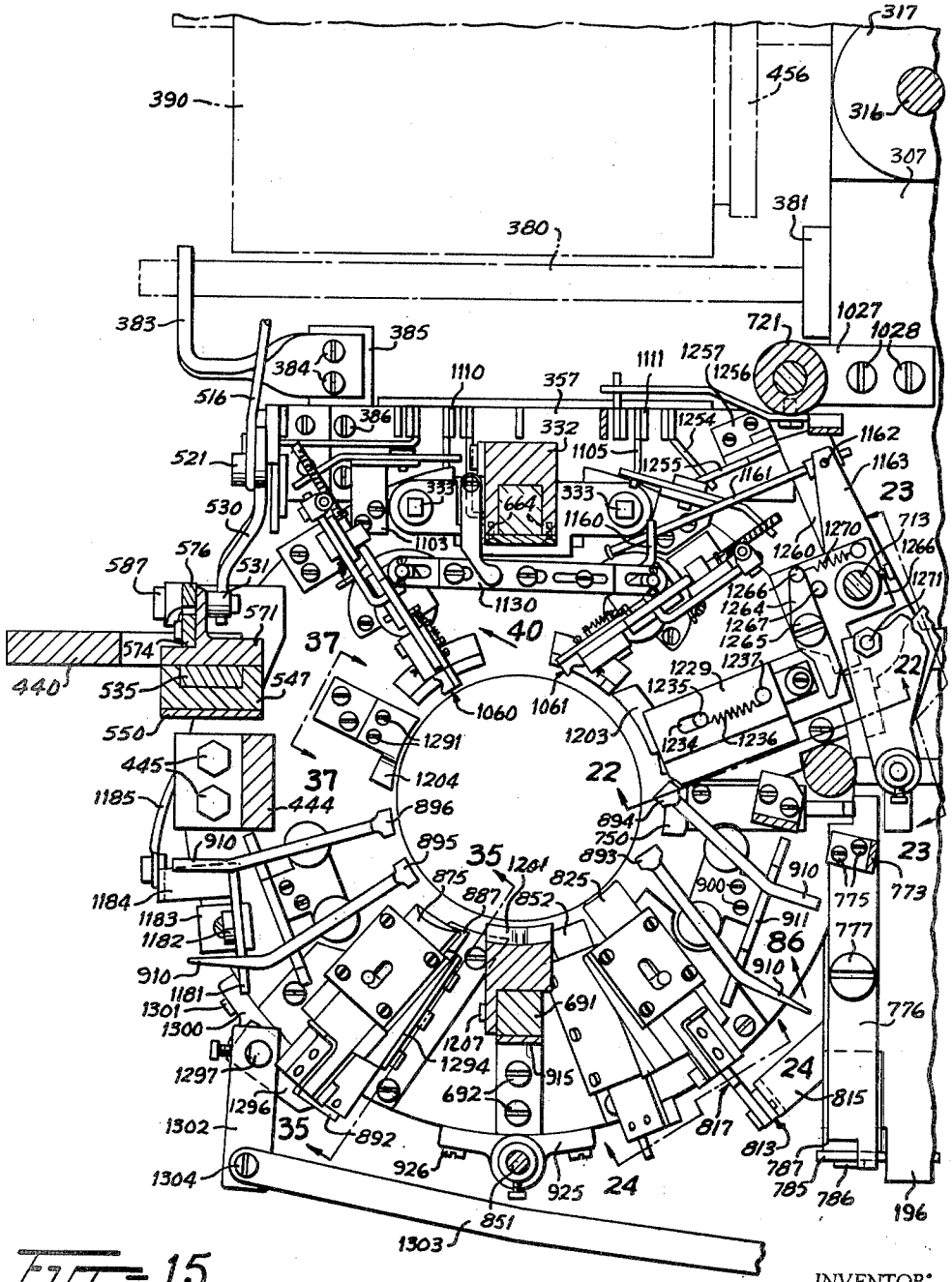

Fig. 15

INVENTOR:
HERMAN E. CRAWFORD.

BY Eaton + Bell

ATTORNEYS.

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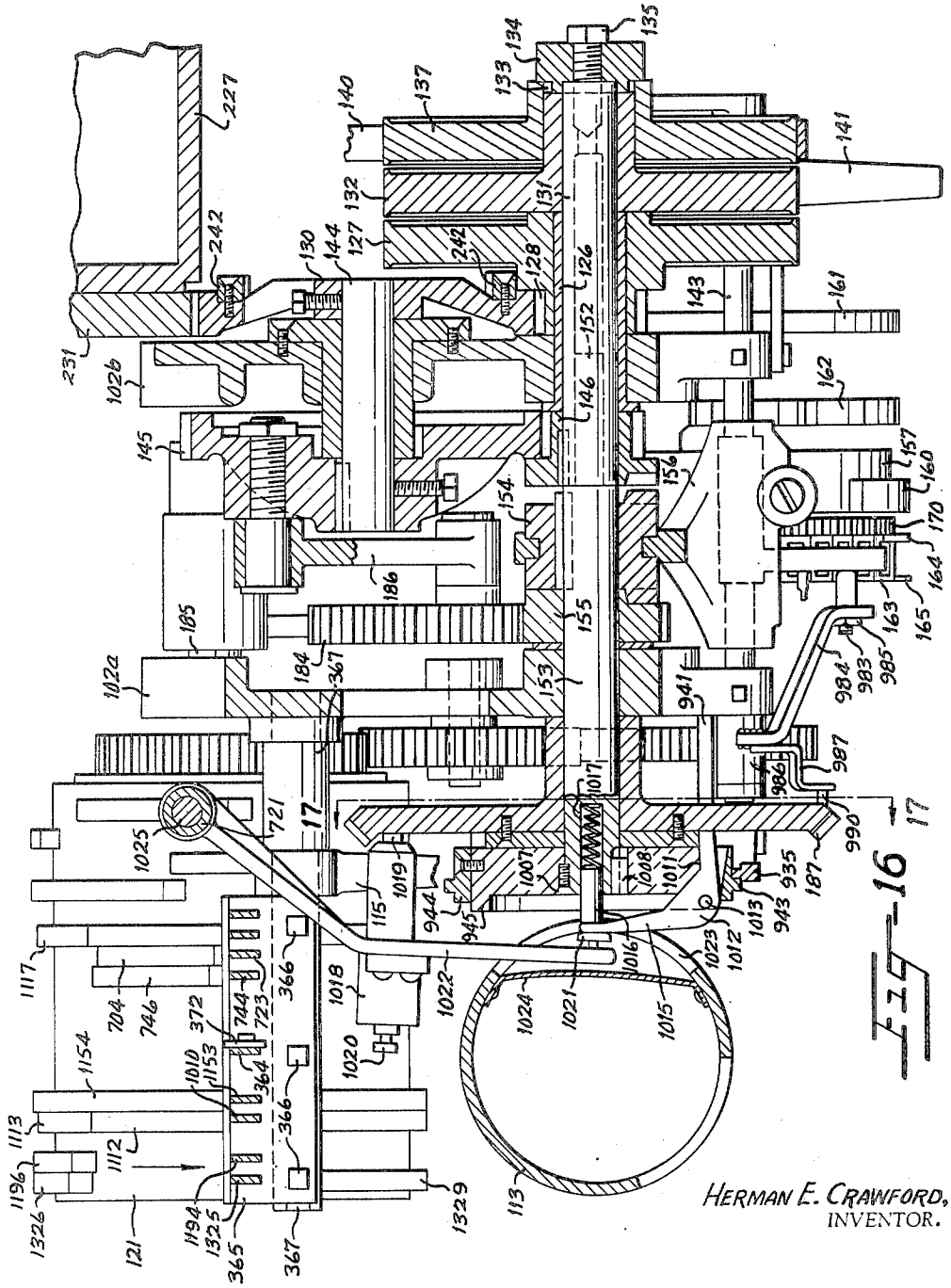

FIG. 16

HERMAN E. CRAWFORD,
INVENTOR.

BY Eaton & Bell

ATTORNEYS.

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Fig-17

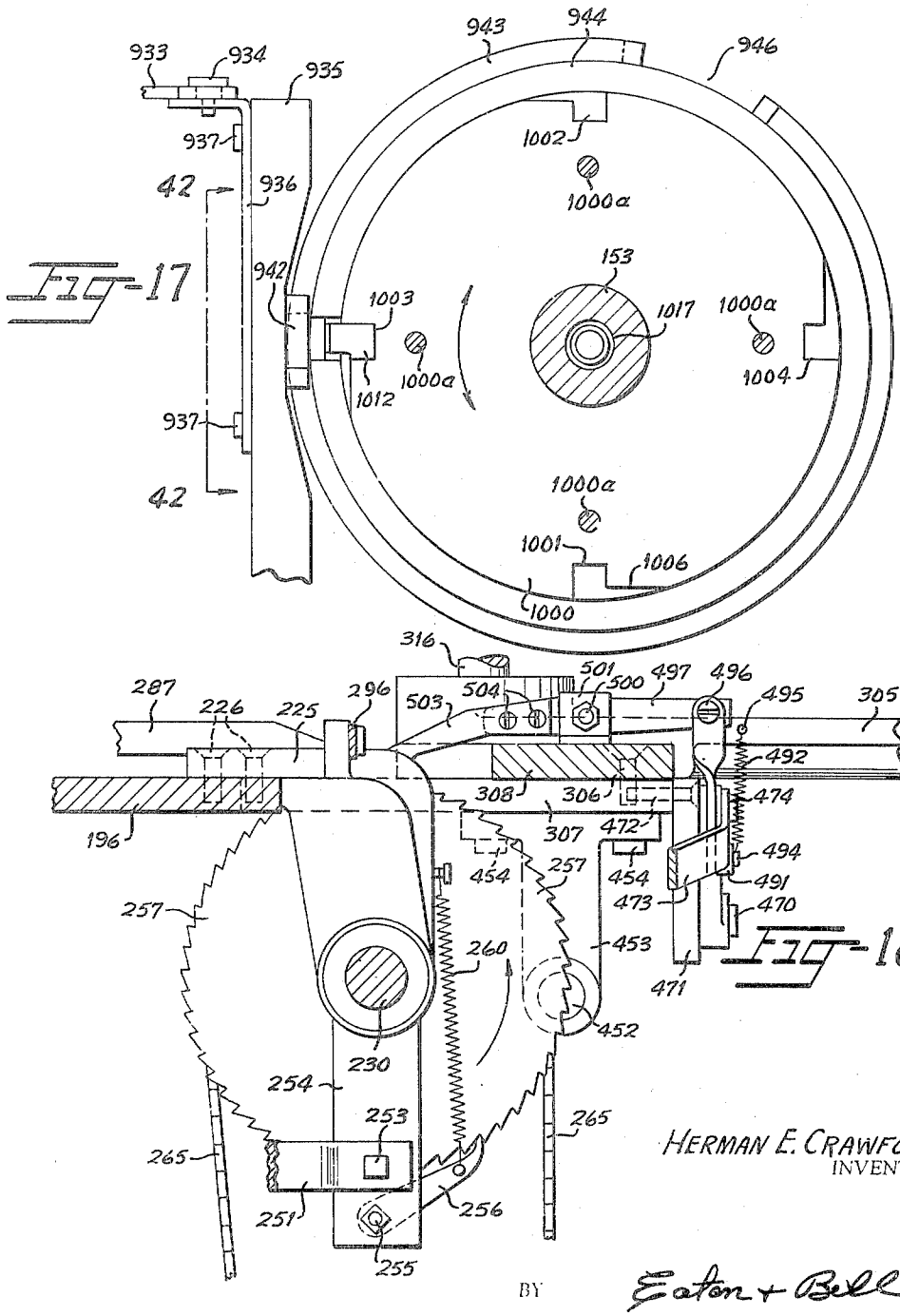

Fig-18

HERMAN E. CRAWFORD,
INVENTOR.

BY Eaton + Bell

ATTORNEYS.

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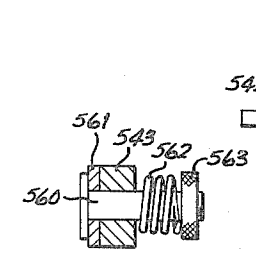

FIG 21

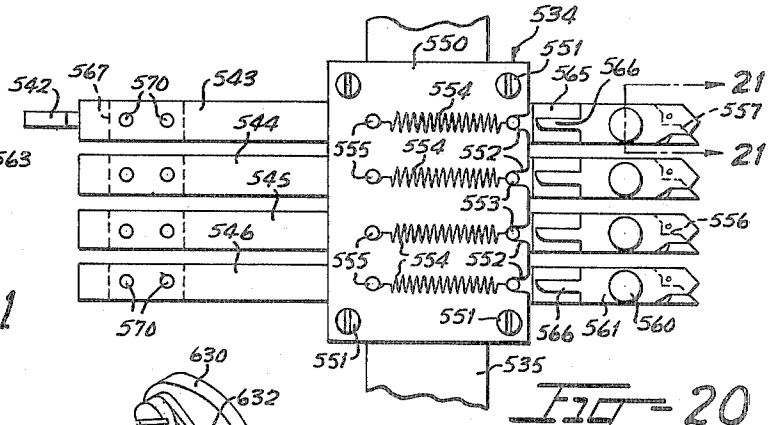

FIG 20

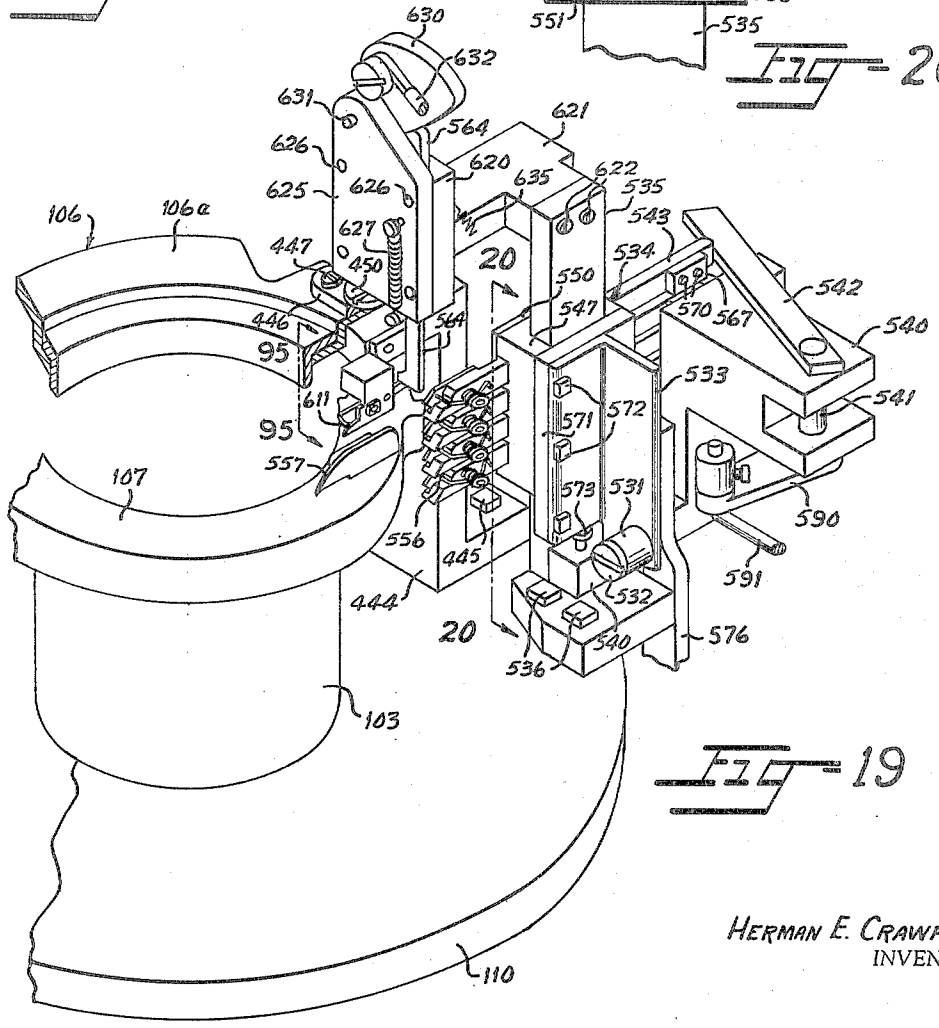

FIG 19

HERMAN E. CRAWFORD,
INVENTOR.

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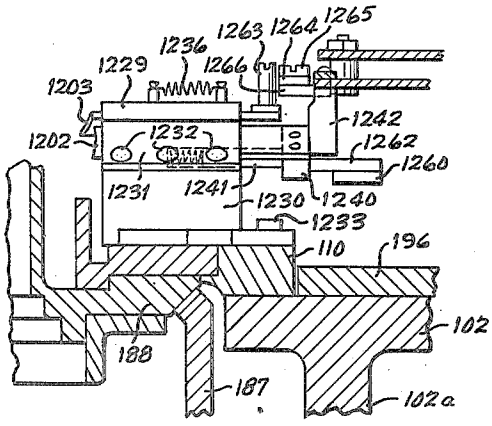


FIG-22

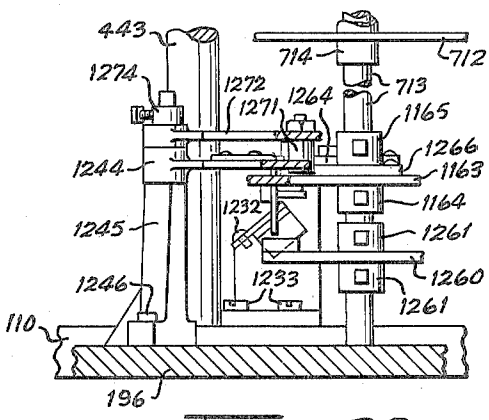
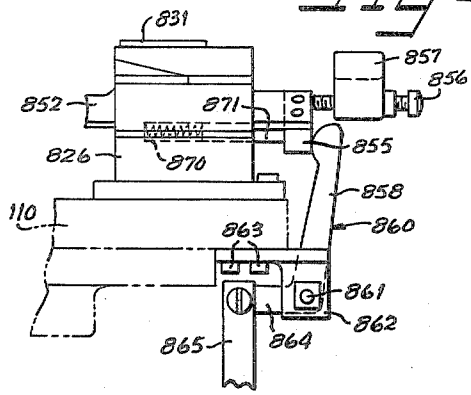


FIG-23

FIG-25



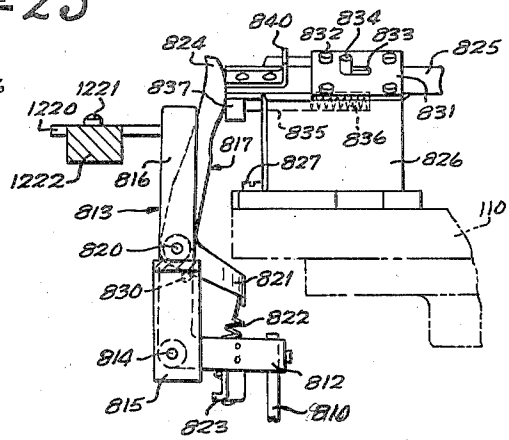


FIG-26

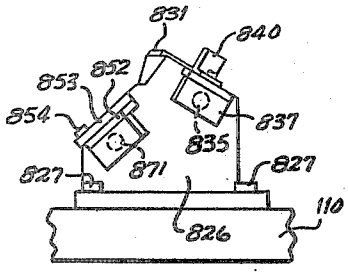


FIG-24

HERMAN E. CRAWFORD,
INVENTOR.

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Fig- 27

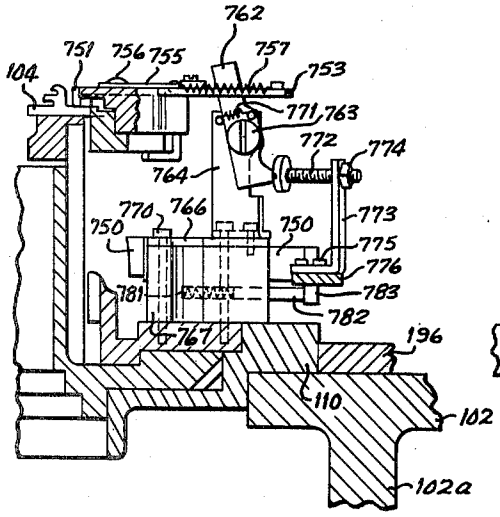


Fig- 28

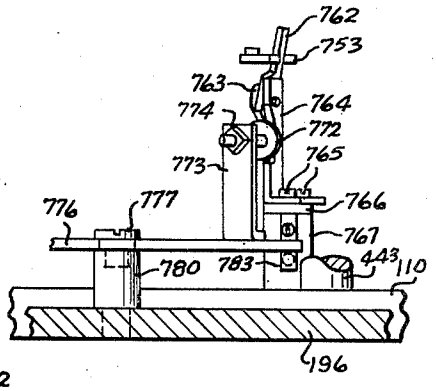
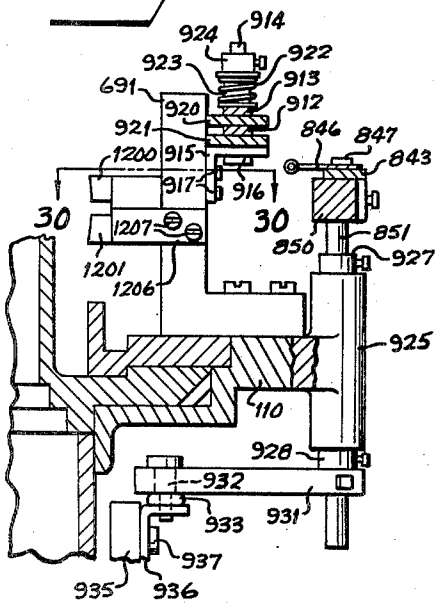


Fig- 29



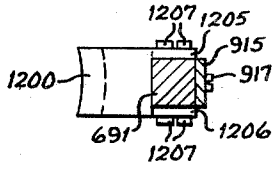


Fig- 30

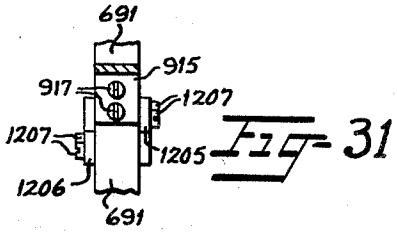


Fig- 31

HERMAN E. CRAWFORD,
INVENTOR.

BY Eaton & Bell

ATTORNEYS.

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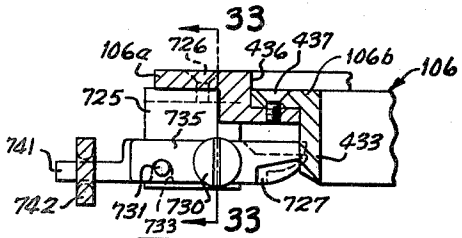

Fig - 32

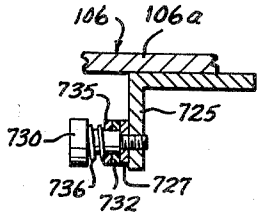

Fig - 33

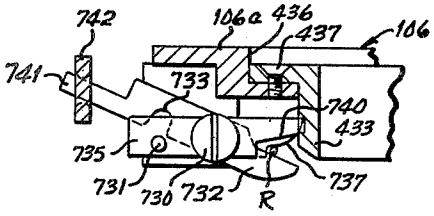

Fig - 34

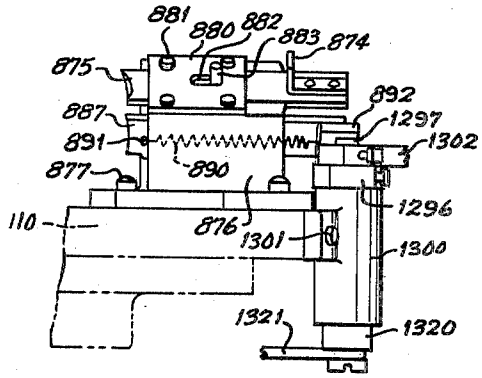

Fig - 36

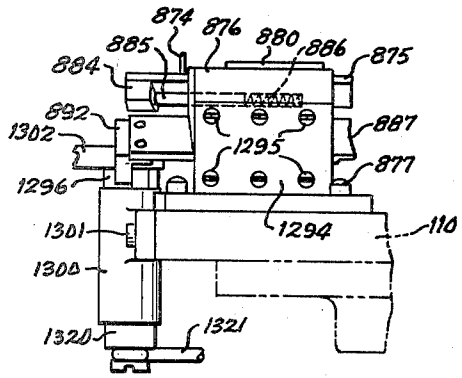

Fig - 35

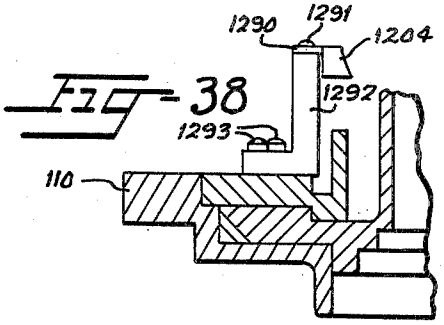

Fig - 38

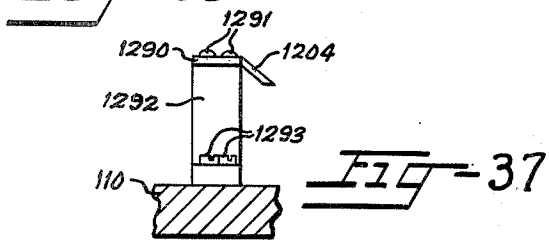

Fig - 37

HERMAN E. CRAWFORD,
INVENTOR.

BY Eaton Bell

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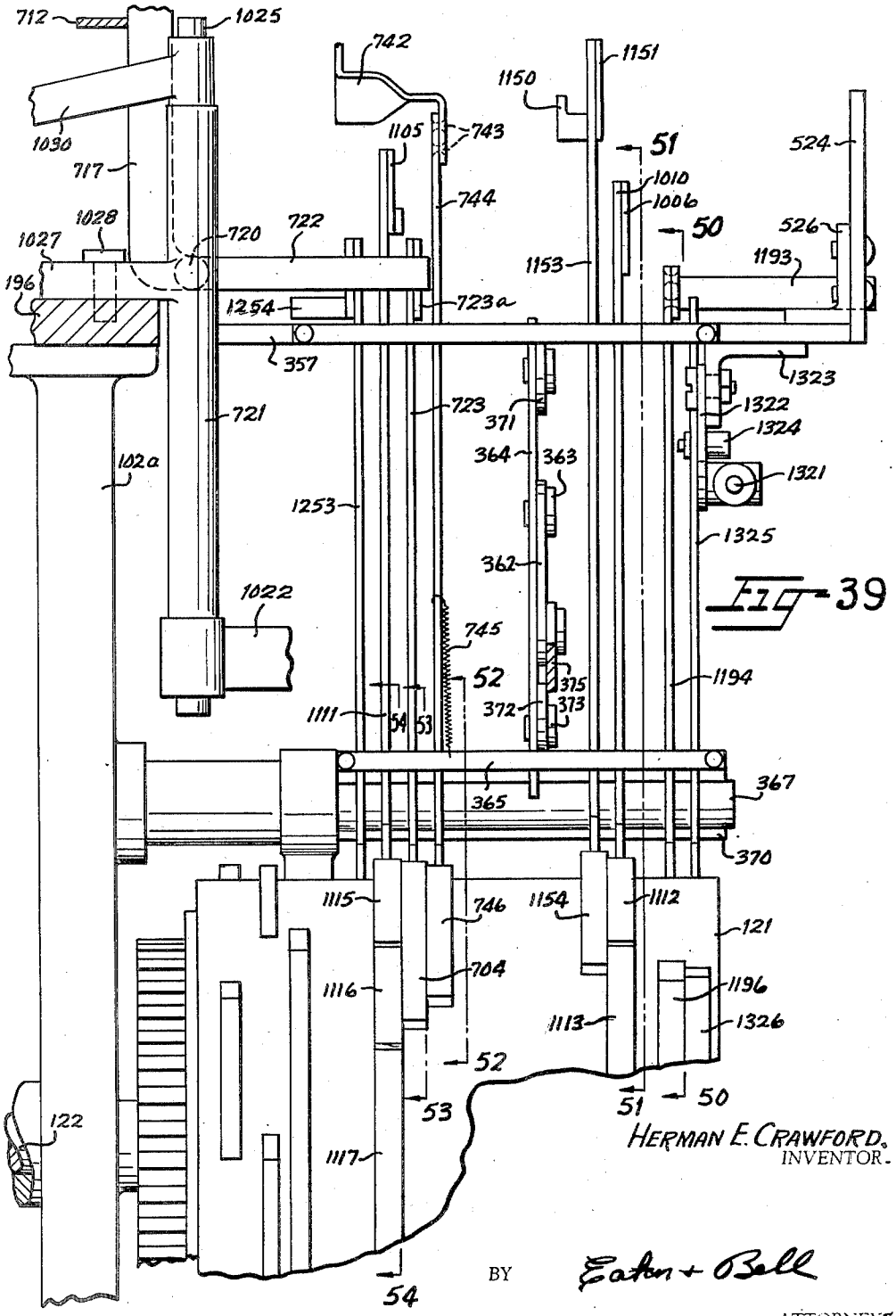

Fig. 39

Aug. 7, 1956 H. E. CRAWFORD 2,757,526

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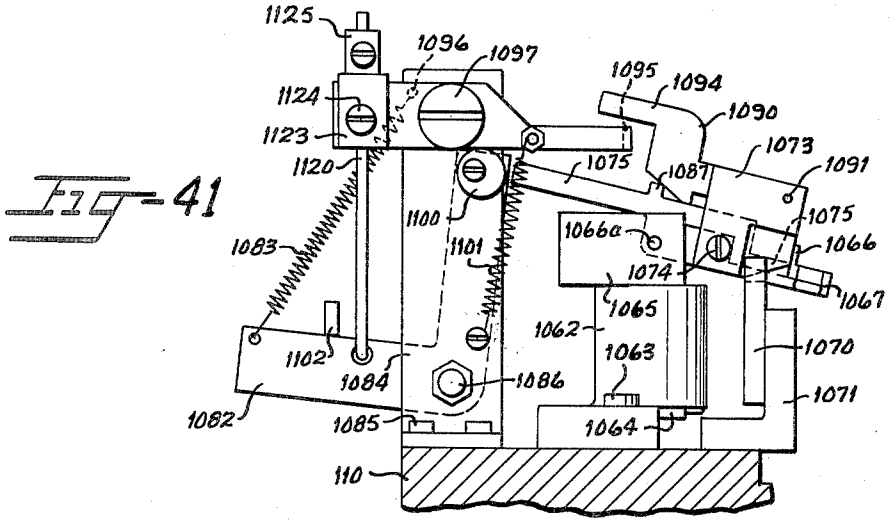

Fig. 41

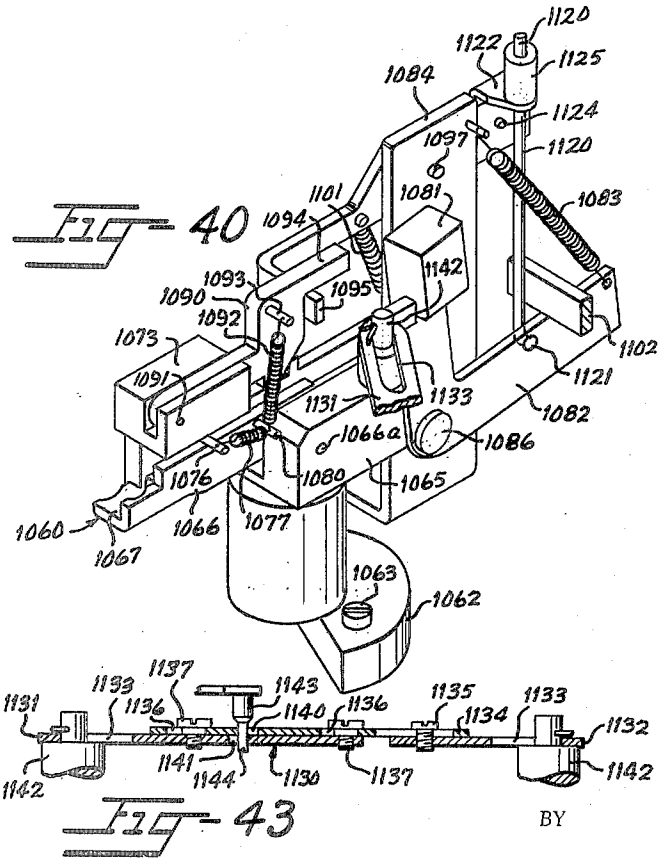

Fig. 40

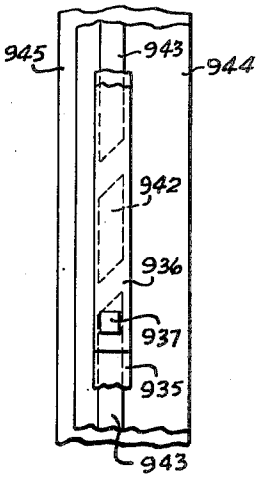

Fig. 42

Fig. 43

HERMAN E. CRAWFORD,
INVENTOR.

BY Eaton & Bell

ATTORNEYS.

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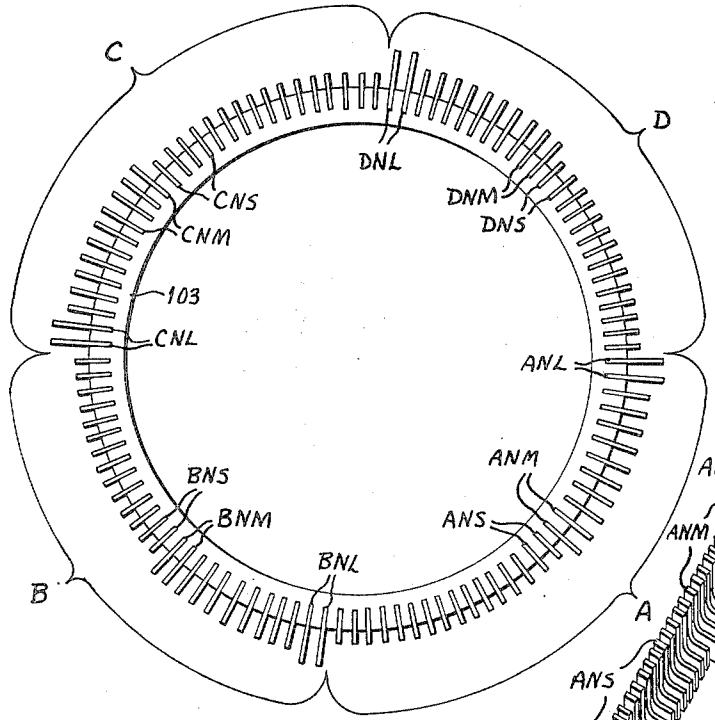

Fig. 44

Fig. 45

HERMAN E. CRAWFORD,
INVENTOR.

BY Eaton & Bell

ATTORNEYS.

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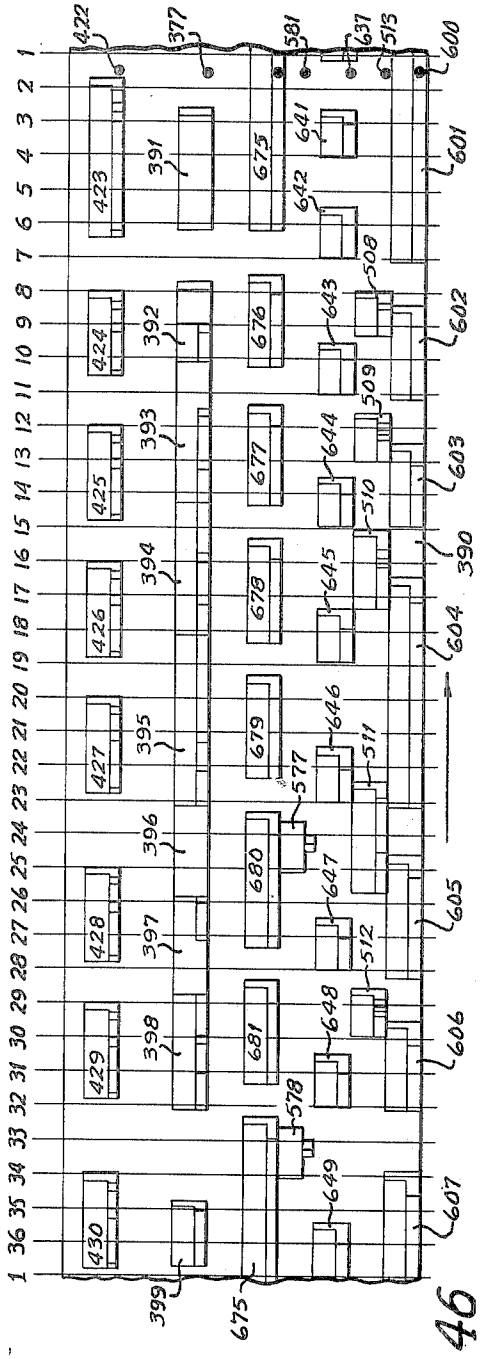

FIG. 46

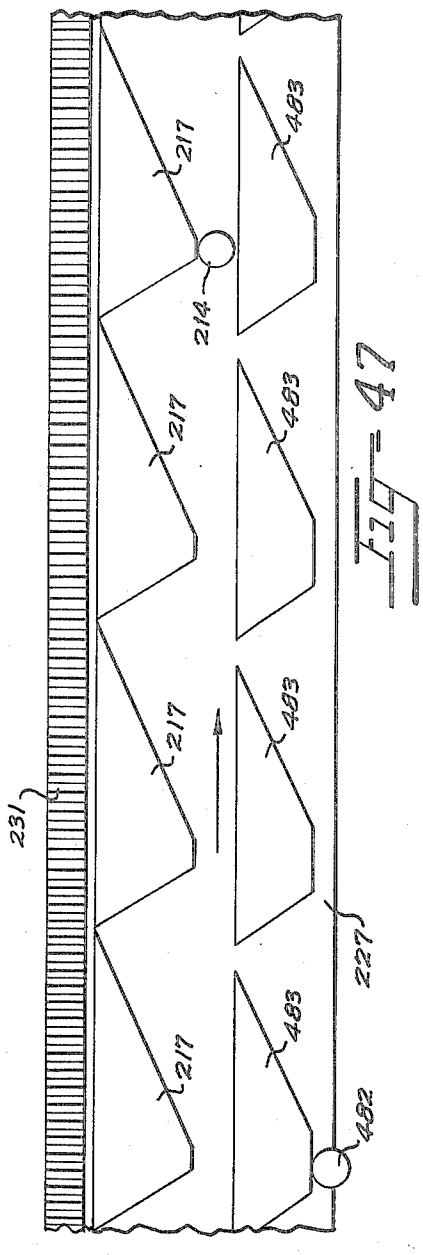

FIG. 47

INVENTOR:
HERMAN E. CRAWFORD.

BY Eaton + Bell

ATTORNEYS.

Aug. 7, 1956 H. E. CRAWFORD 2,757,526

KNITTING MACHINE

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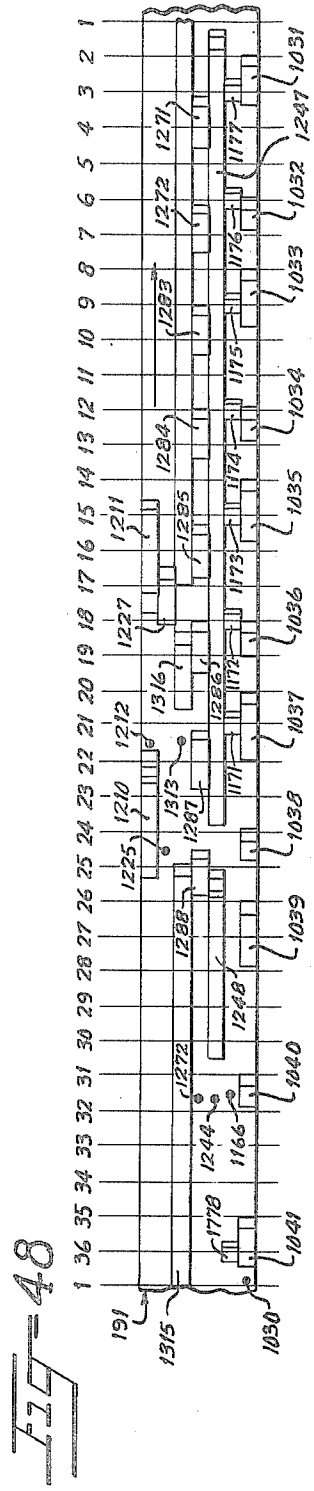

FIG. 48

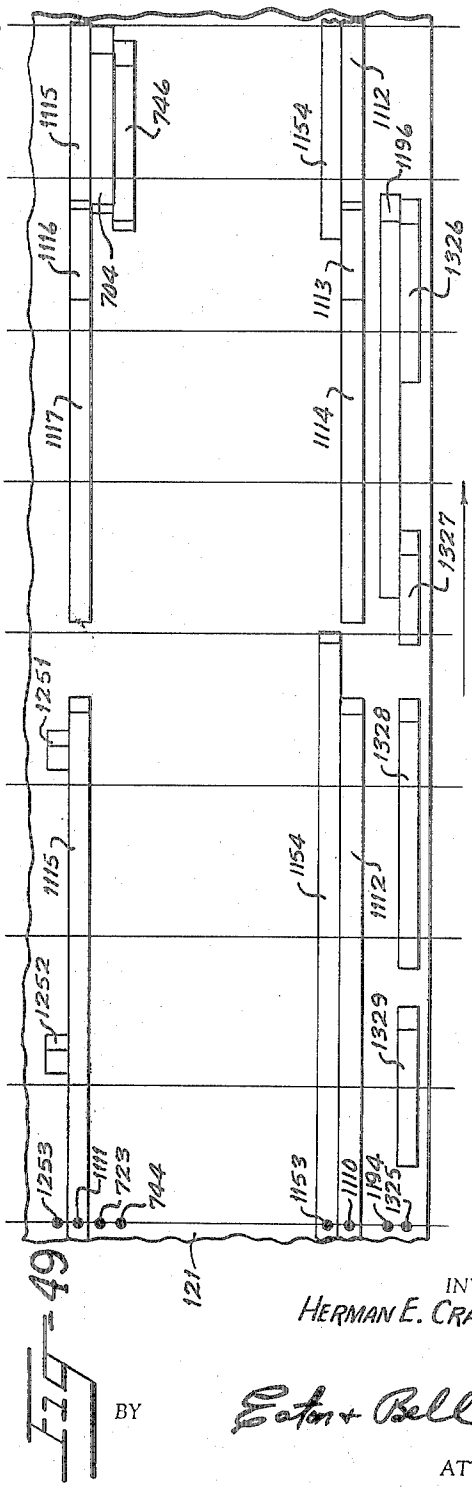

FIG. 49

INVENTOR:
HERMAN E. CRAWFORD.

BY Eaton & Bell

ATTORNEYS.

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Fig. 50

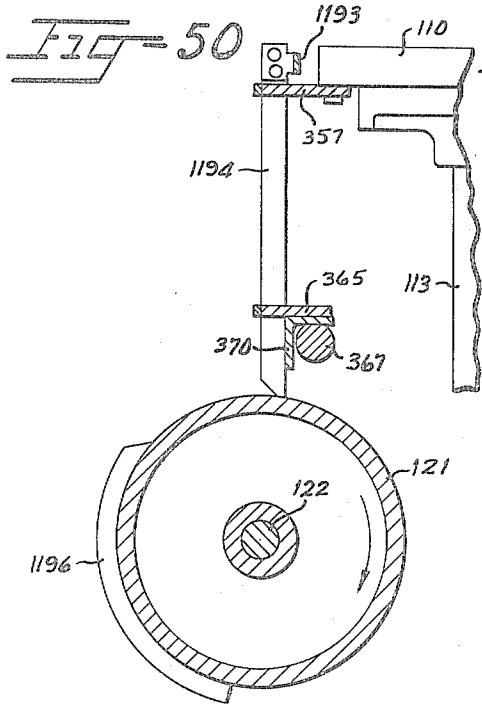


Fig. 51

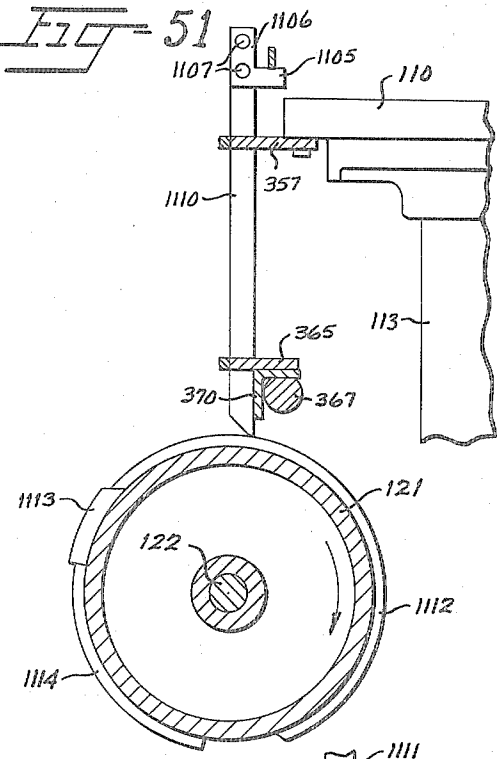


Fig. 52

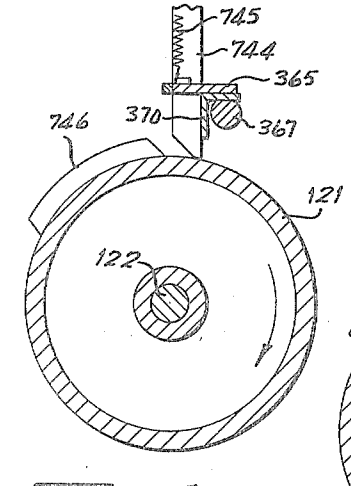


Fig. 53

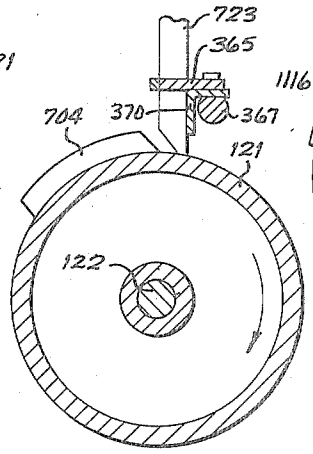
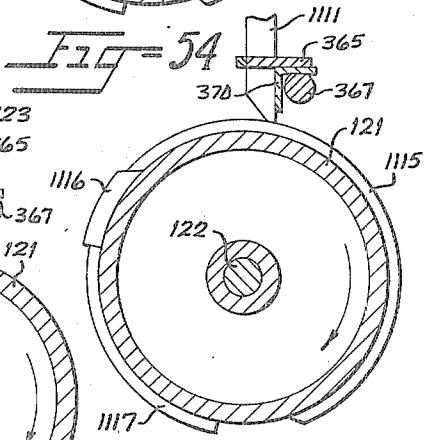


Fig. 54



INVENTOR:
HERMAN E. CRAWFORD.

BY Eaton & Bell

ATTORNEYS.

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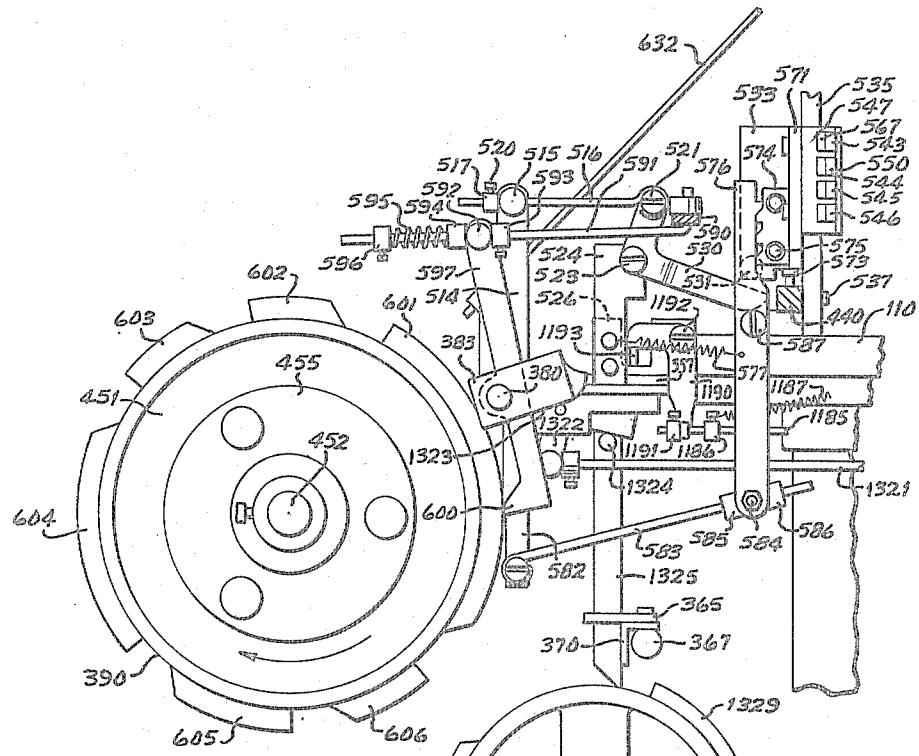

FIG. 55

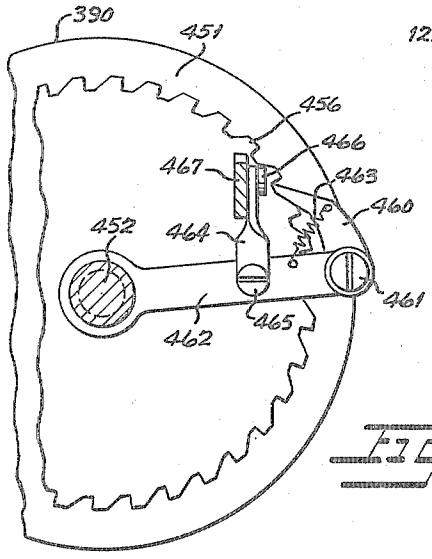

FIG. 56

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Fig-58

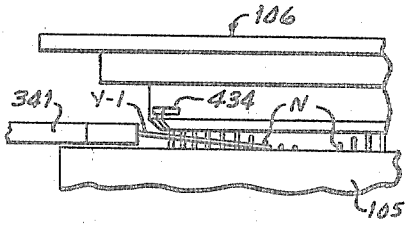

Fig-57

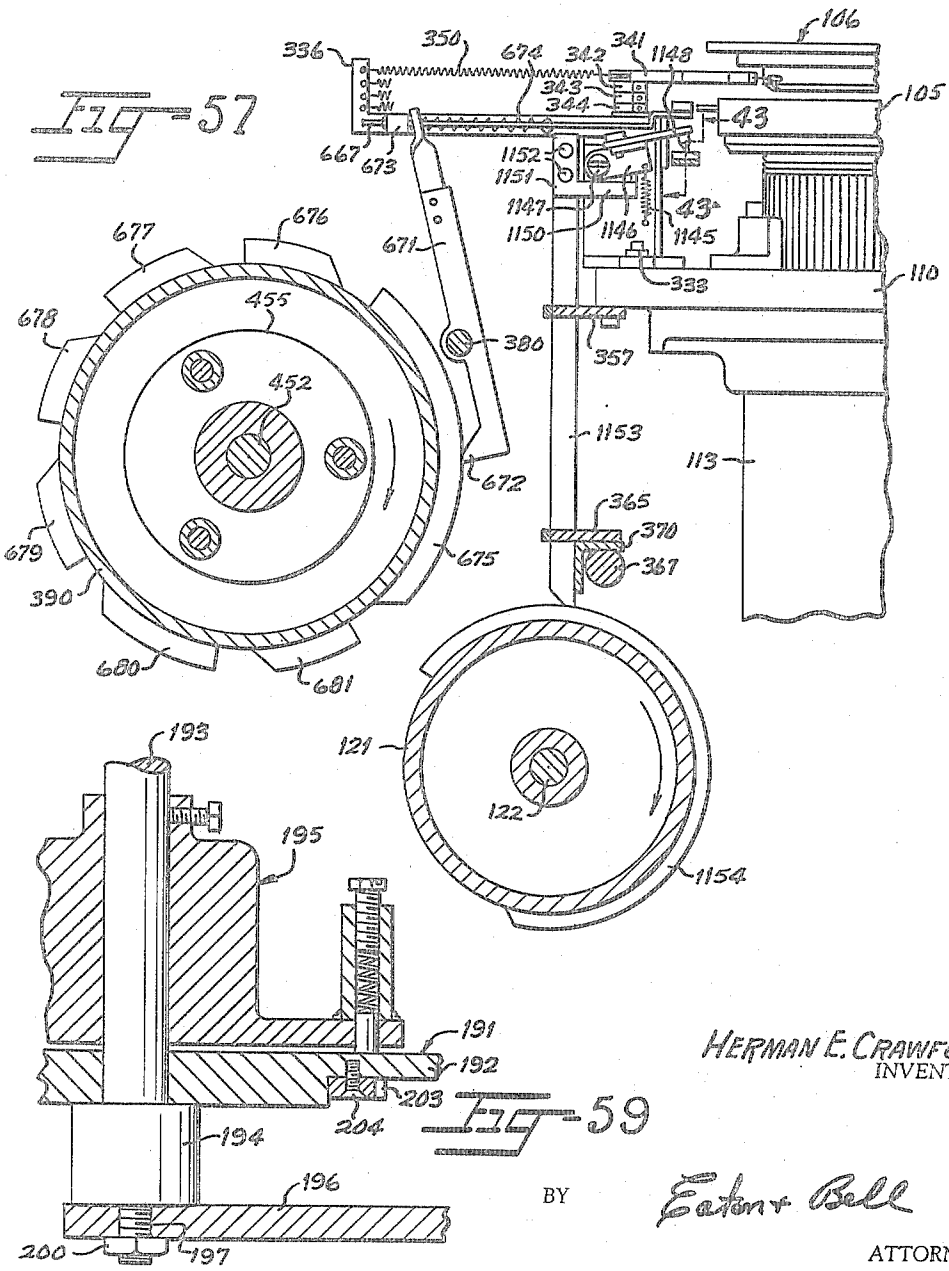

Fig-59

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Fig. 60

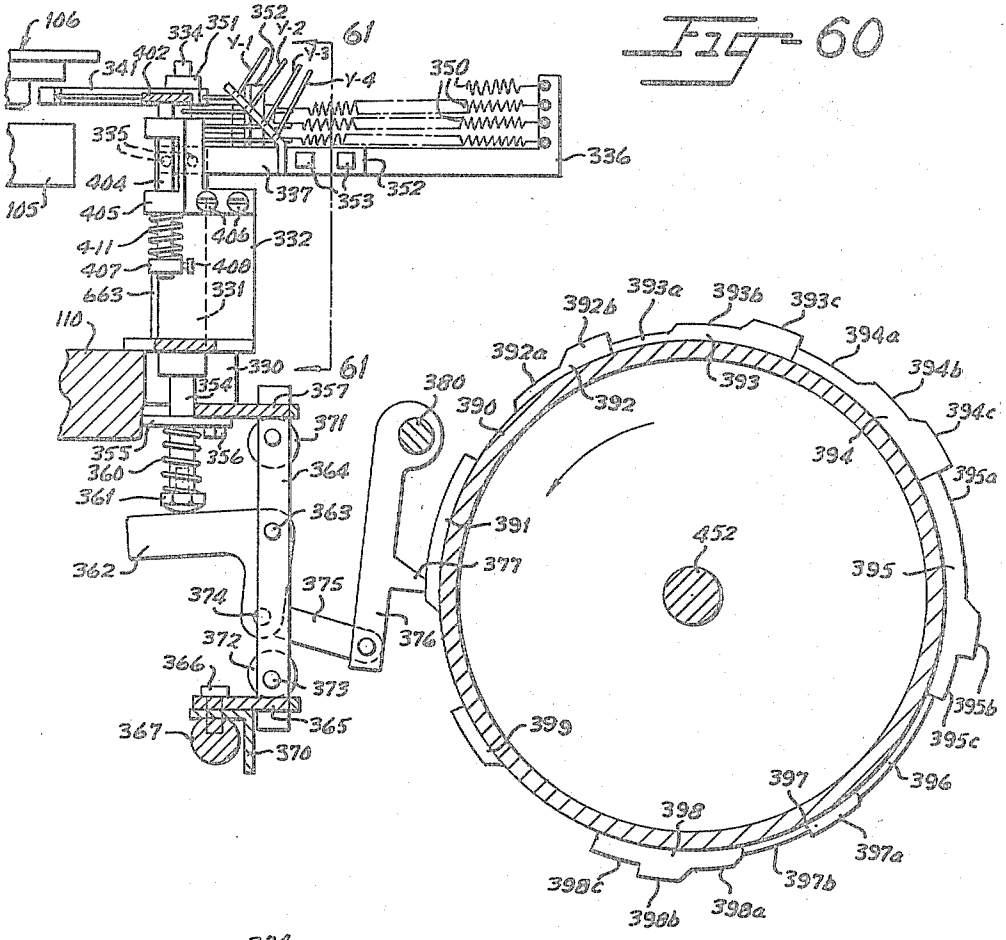
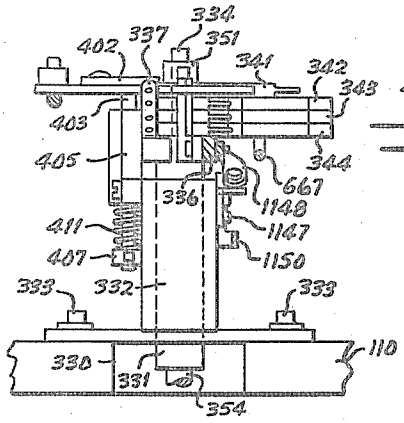


Fig. 61



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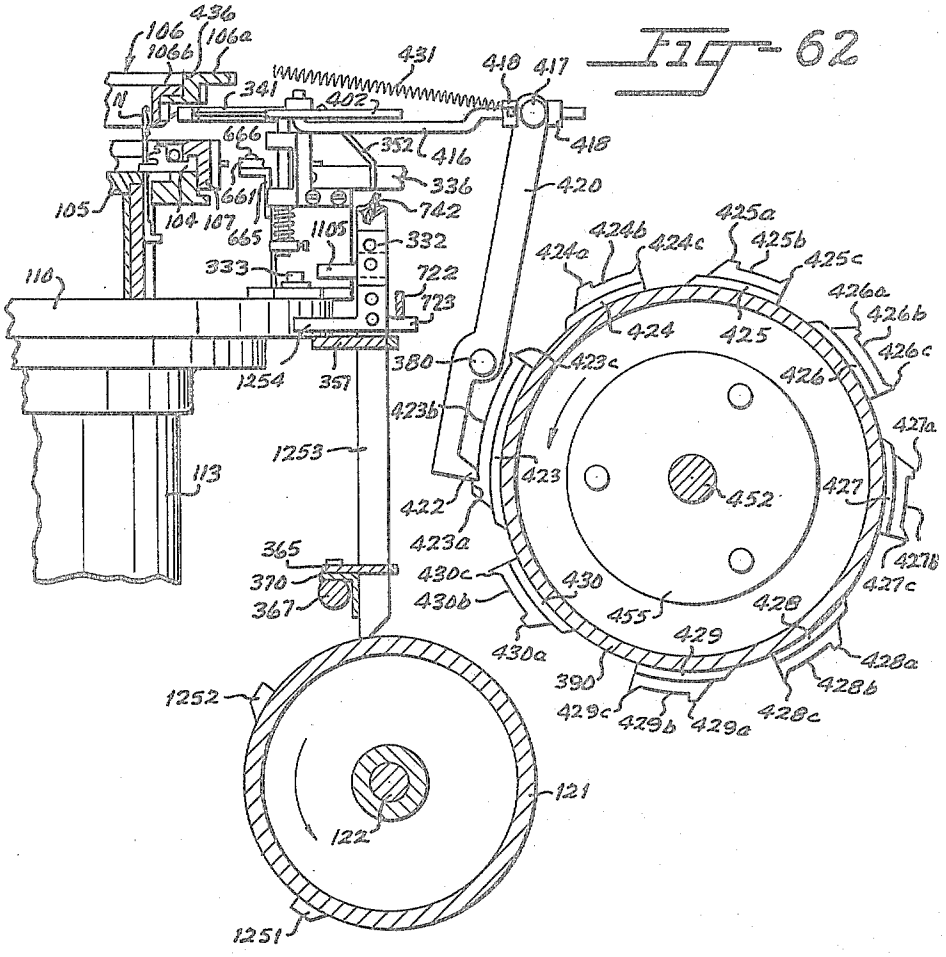

Fig. 62

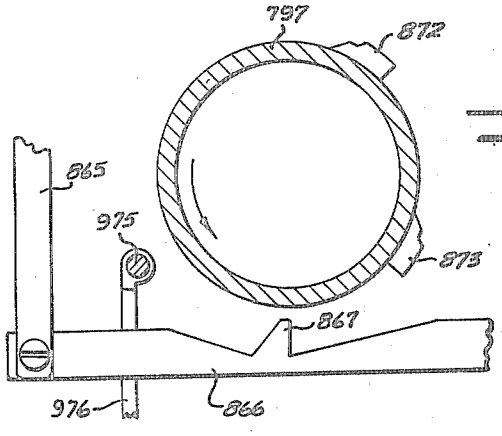

Fig. 63

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Fig-64

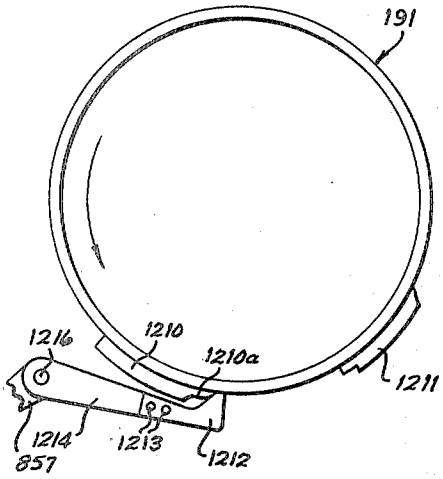


Fig-65

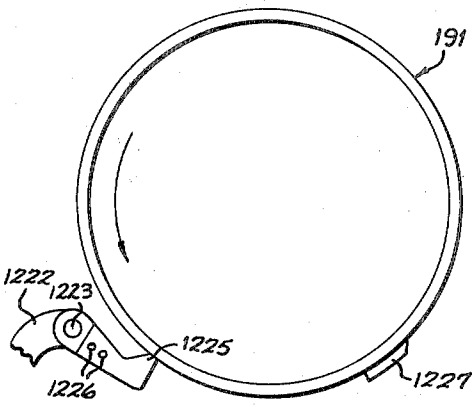
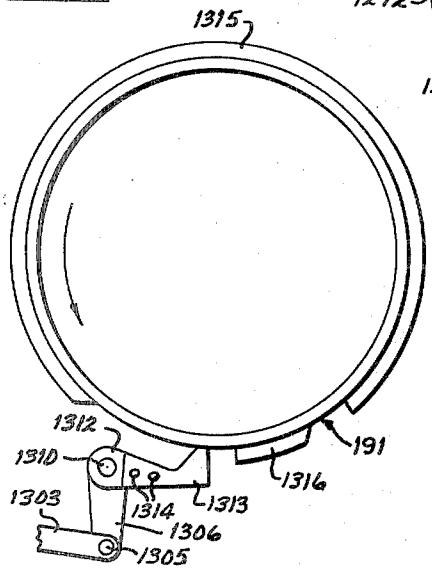


Fig-66



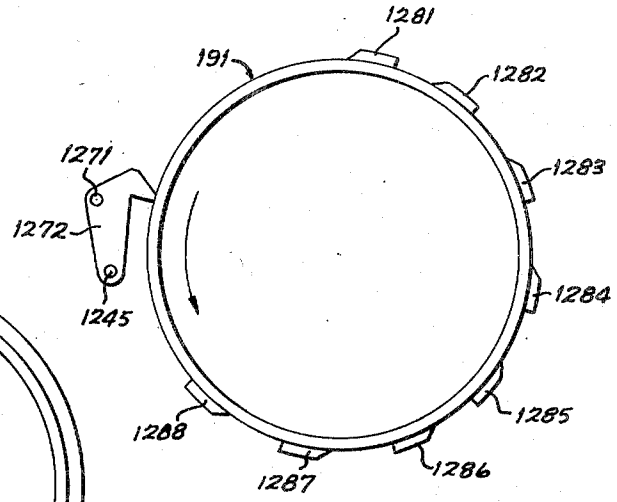


Fig-67

INVENTOR:
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Fig-68

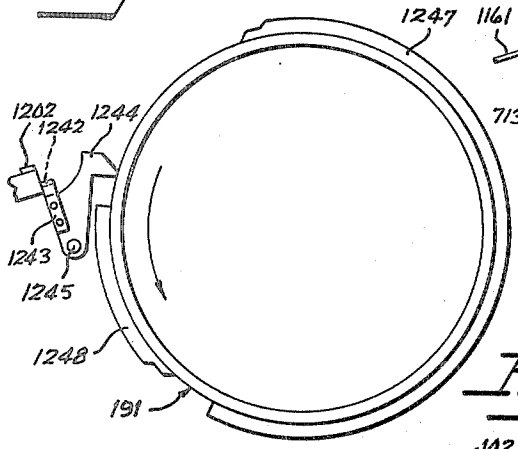


Fig-69

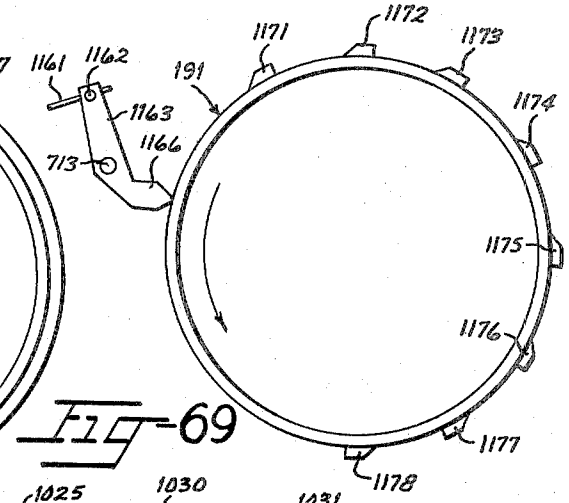
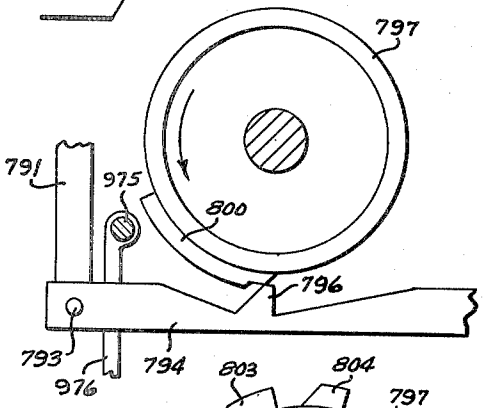


Fig-72



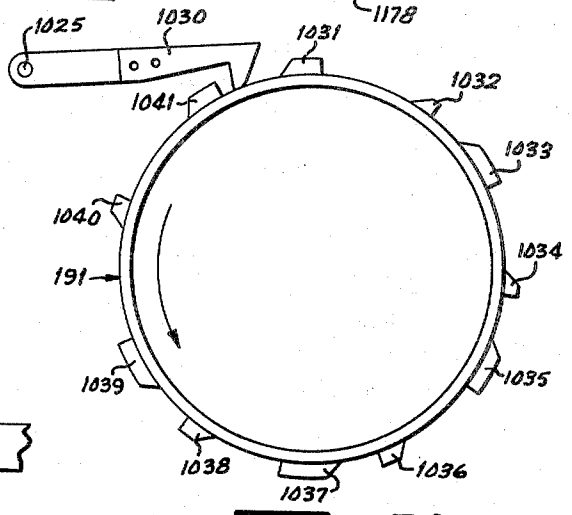


Fig-70

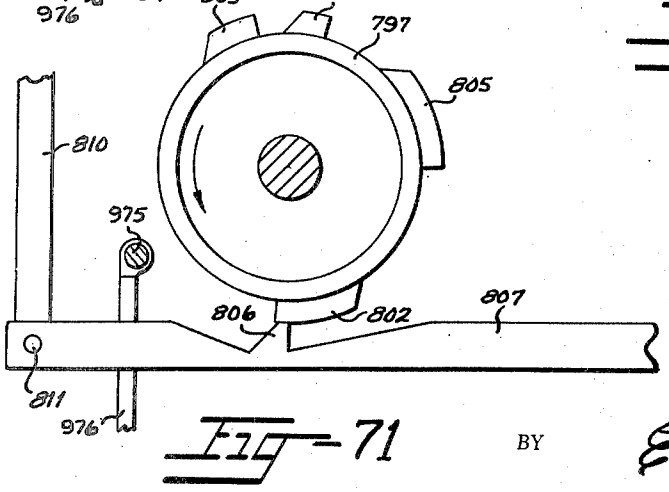


Fig-71

HERMAN E. CRAWFORD,
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Fig - 73

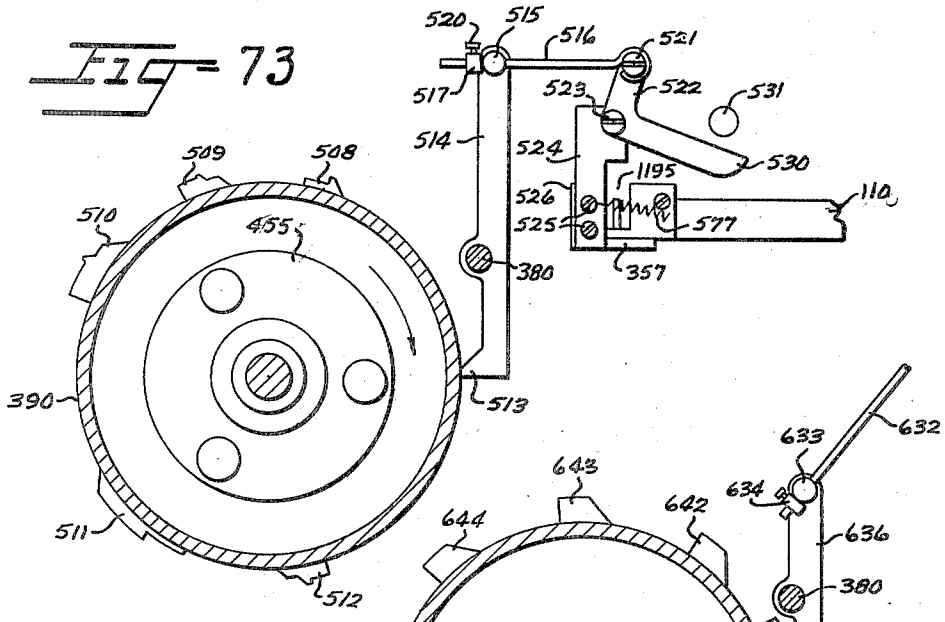
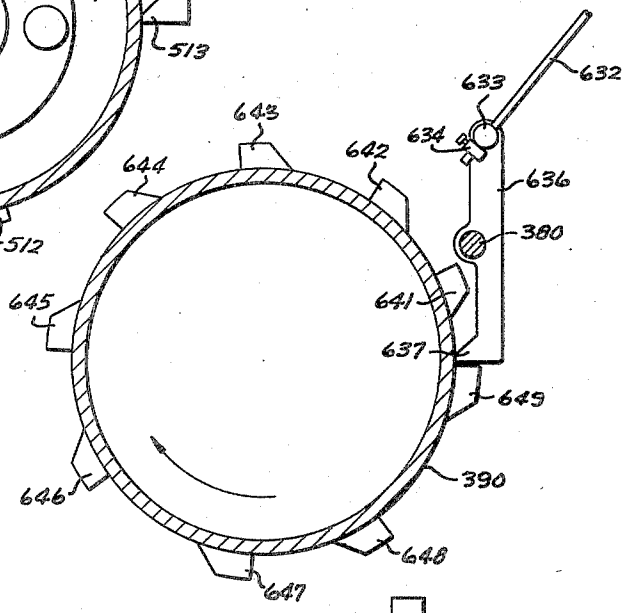


Fig - 74



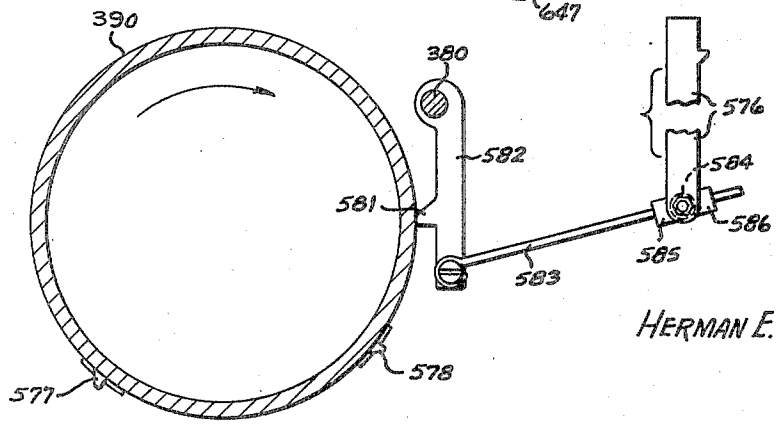


Fig - 75

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BY Eaton + Bell

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Fig. 76

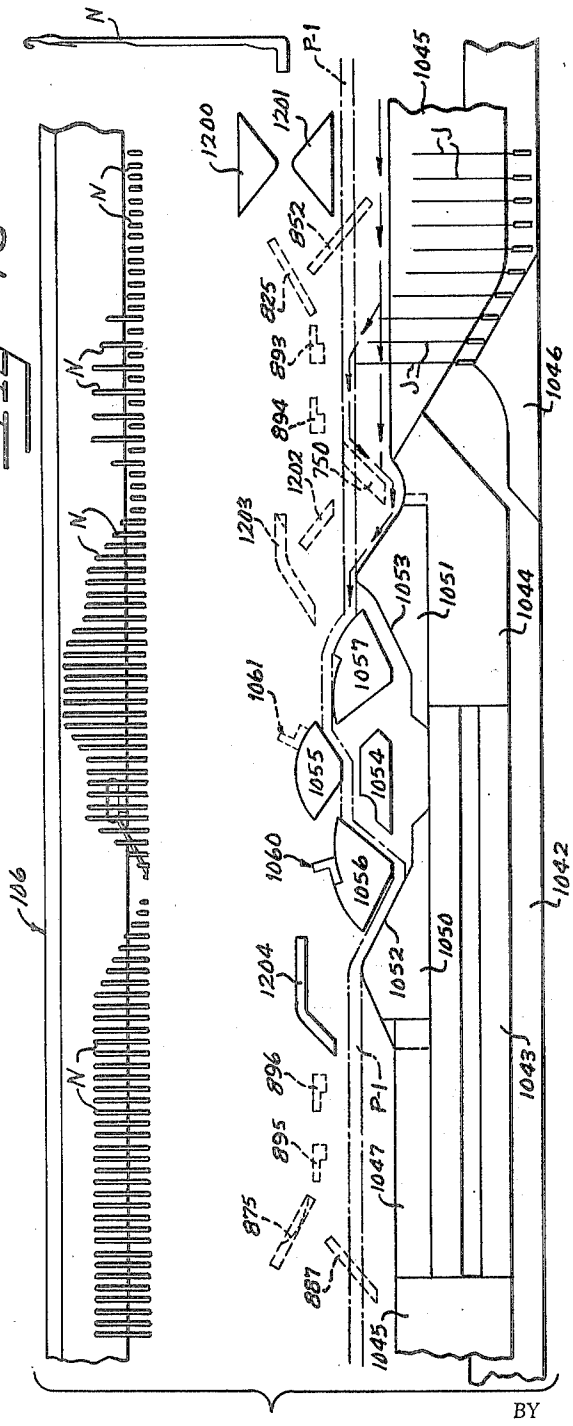
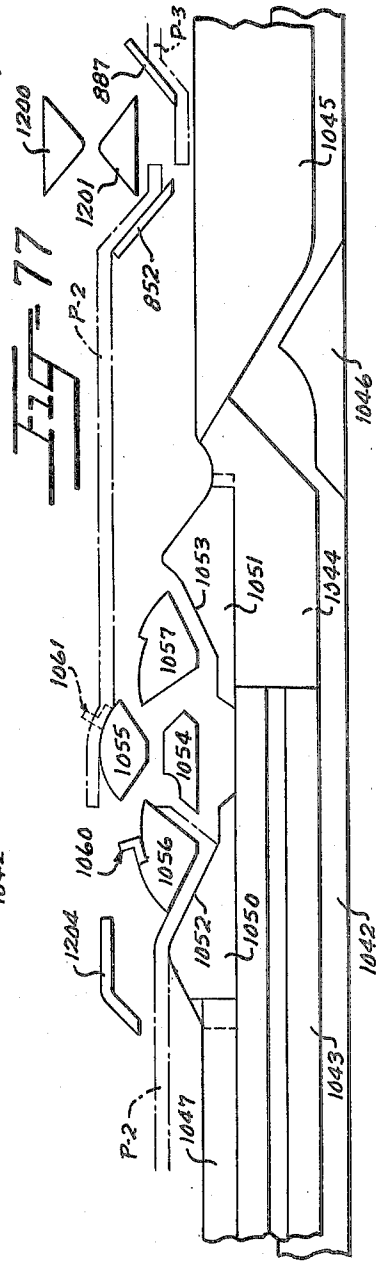


Fig. 77



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BY Eaton + Bell

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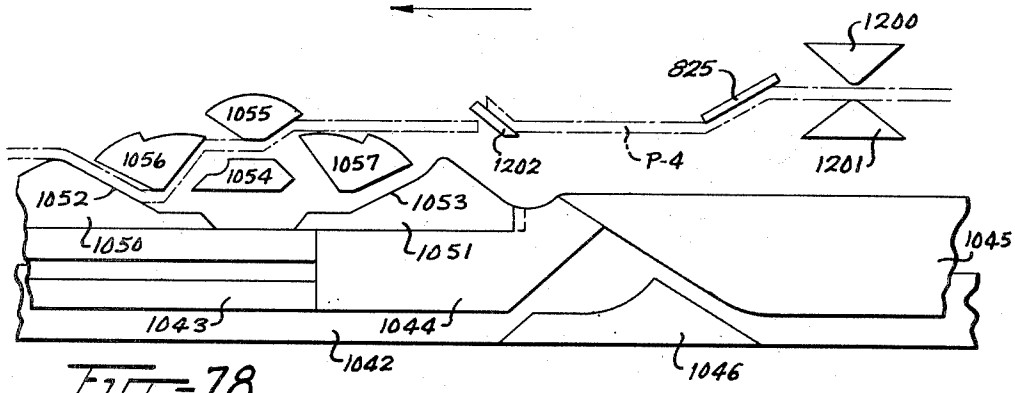

FIG-78

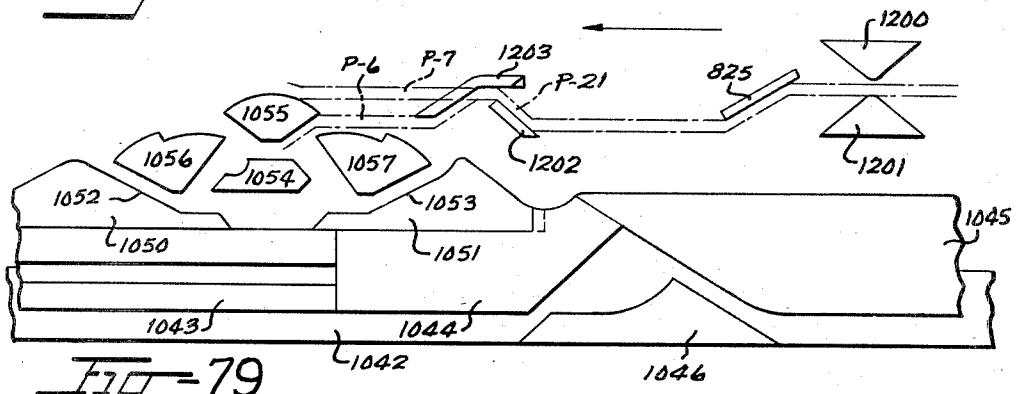

FIG-79

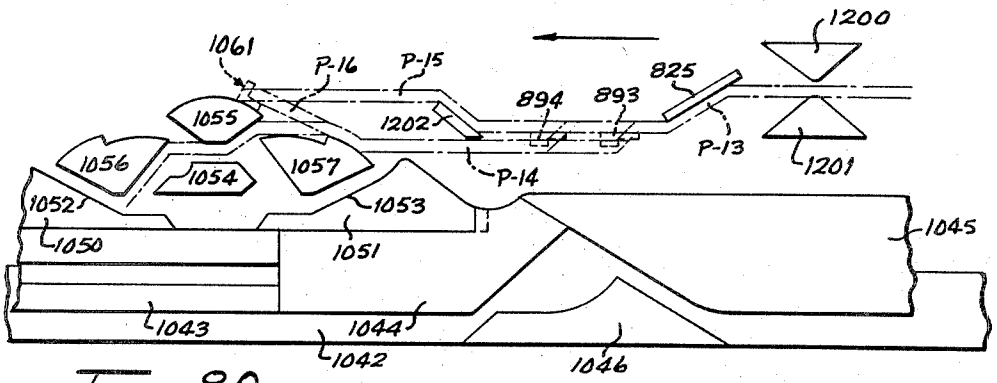

FIG-80

INVENTOR:
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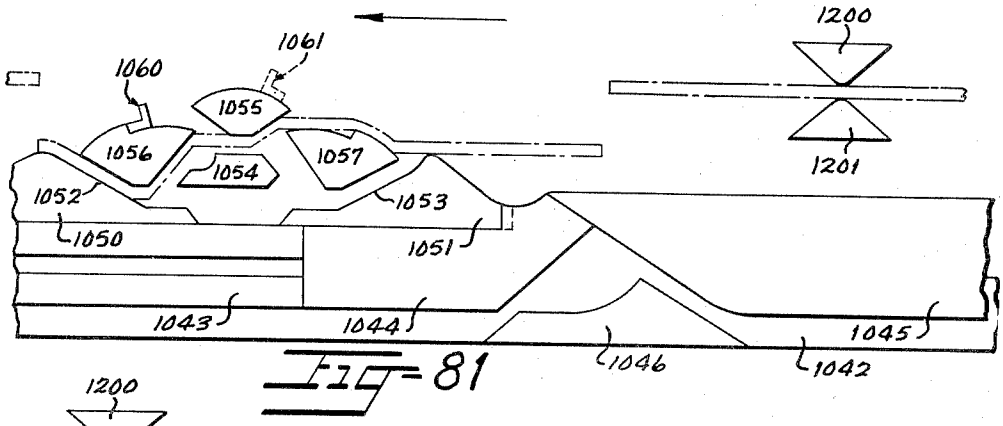

Fig. 81

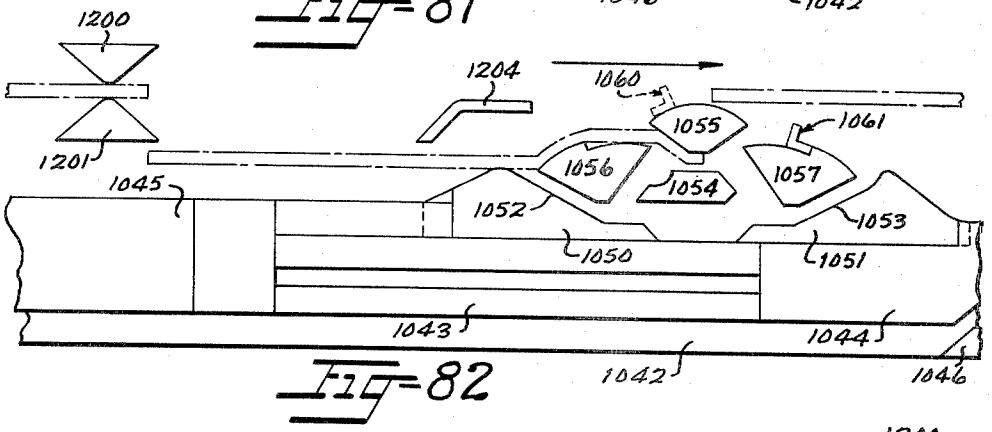

Fig. 82

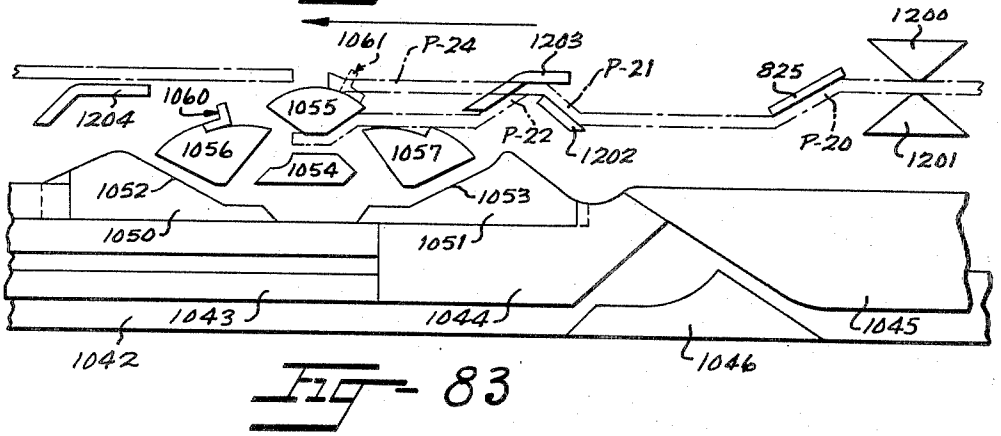

Fig. 83

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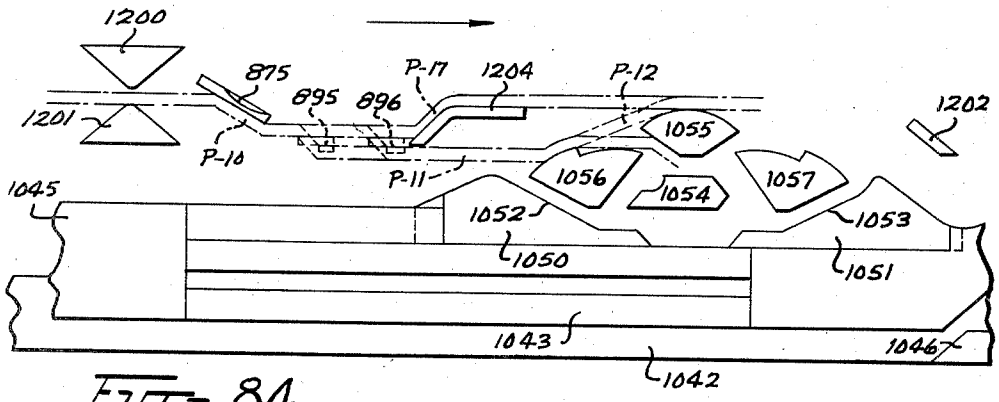
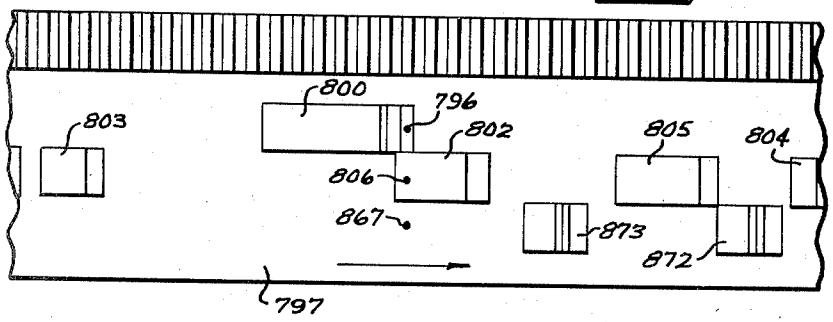


Fig- 84

Fig- 85



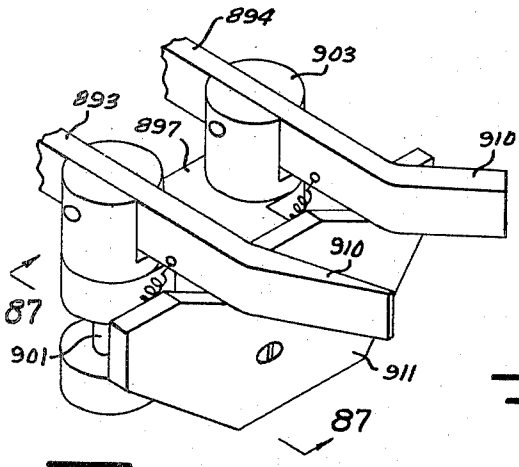


Fig- 86

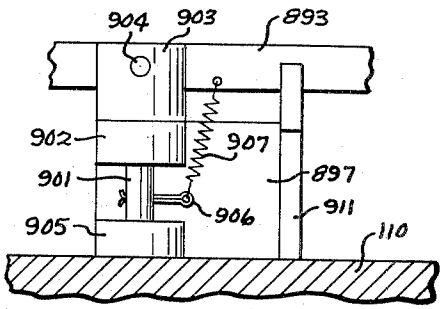


Fig- 87

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Fig-88

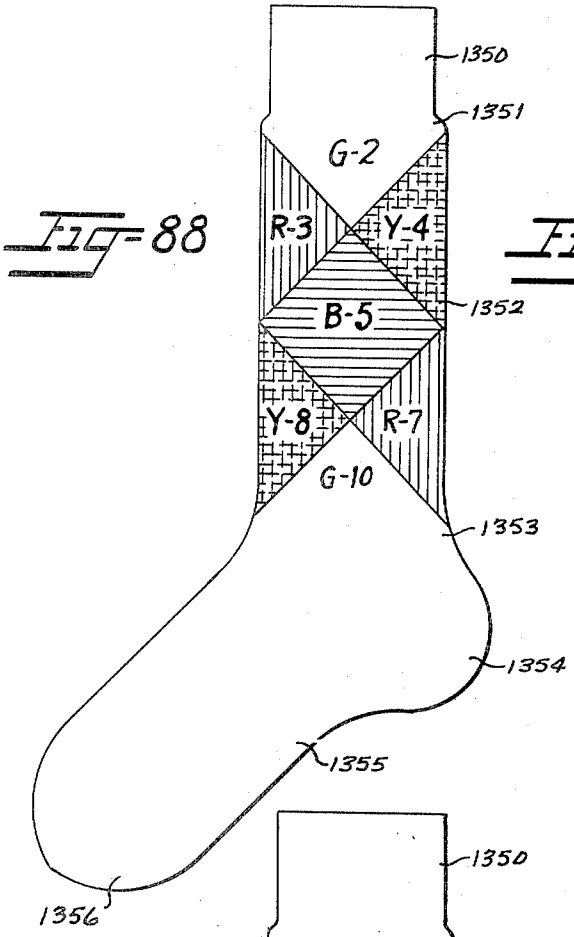


Fig-89

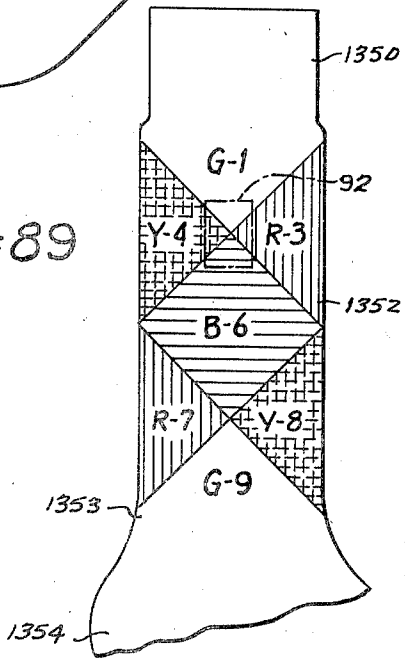


Fig-90

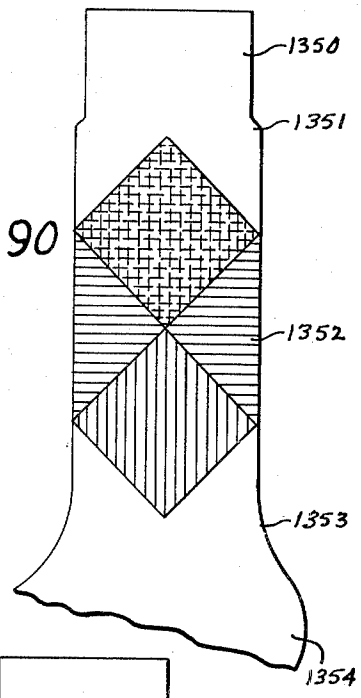
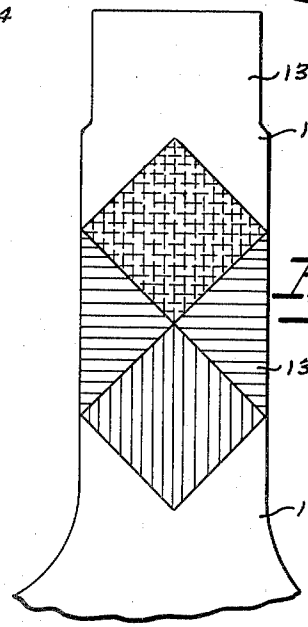


Fig-91



INVENTOR:
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BY Eaton & Bell

ATTORNEYS.

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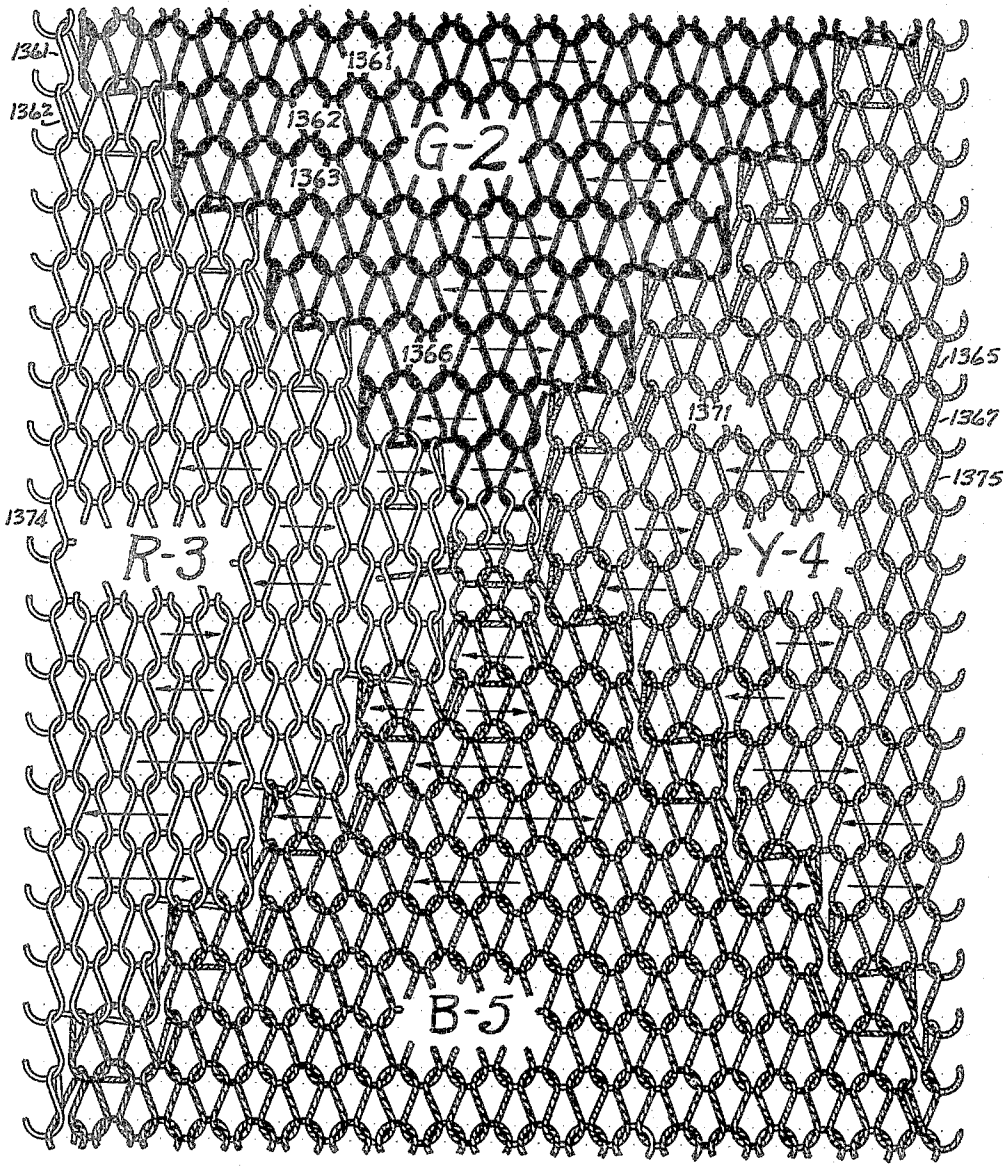

Fig-92

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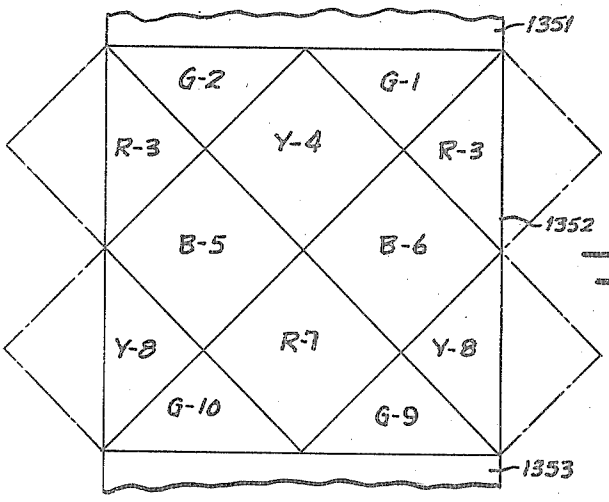

Fig. 93

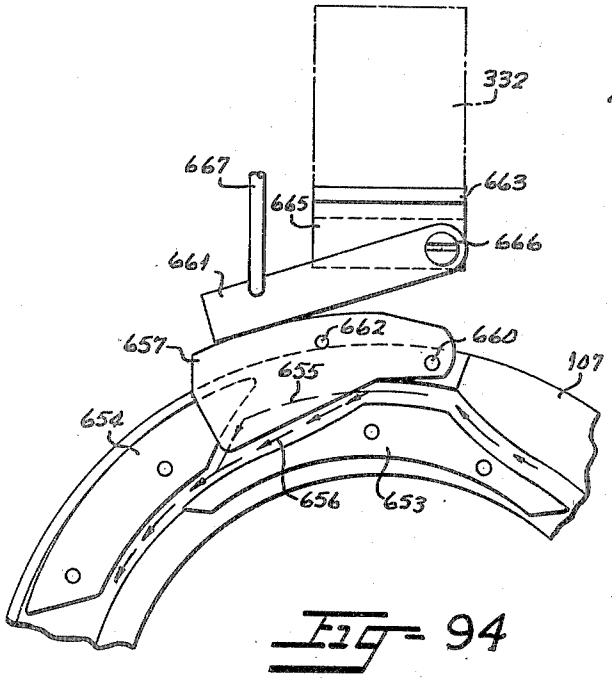

Fig. 94

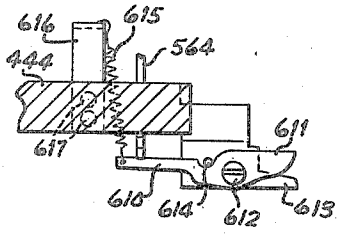

Fig. 95

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BY Eaton & Bell

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United States Patent Office

2,757,526

Patented Aug. 7, 1956

2,757,526

KNITTING MACHINE

Herman E. Crawford, Kernersville, N. C., assignor to H. E. Crawford Company, Incorporated, Kernersville, N. C., a corporation of North Carolina

Application October 30, 1950, Serial No. 192,935

31 Claims. (Cl. 66—48)

This invention relates to improvements in circular knitting machines of the type designed for producing variegated triangular or rectilinear pattern areas in tubular fabric, these areas being commonly termed as the "Argyle" patch in men's hosiery. This invention is a continuation in part of my co-pending application entitled Knitting Machine, Serial Number 118,964, filed September 30, 1949.

The knitting machine of said co-pending application has many features peculiar thereto which may not be found in association with other knitting machines, these features including means for automatically shogging the needle cylinder at predetermined intervals so as to position certain needles for moving equidistant past the knitting station during reciprocatory knitting. However, the knitting machine of said co-pending application has its limitations as to its flexibility and the primary object of this invention is to provide improvements in a machine of the type disclosed in said co-pending application to overcome said limitations.

More specifically, it is an object of this invention to provide improved means for controlling and selecting the feeding of different body yarns to the needle circle independently of the various other pattern controlled means which effect operation of the various other knitting instrumentalities and wherein individual means are combined with the means for controlling the feeding of the yarns for cutting and for clamping each of the yarns selectively.

The said co-pending application also includes means for widening in the fabric comprising widening picks which lower two needles upon each revolution of the needle cylinder during reciprocatory knitting and subsequently during each of these same revolutions one needle is raised by the narrowing picks.

It is therefore another object of this invention to provide two sets each including a pair of co-acting widening picks, each of which lowers two needles upon each revolution of the needle cylinder during reciprocatory knitting, the capacity of the narrowing picks also being increased so as to move two needles to inoperative position before the needles approach the stitch cams, resulting in the yarn knitted in a particular rectilinear area forming two additional wales in each succeeding course.

It is another object of this invention to provide means whereby all changes in operation of the knitting instrumentalities and the clutch mechanisms of the knitting machine, especially upon knitting the initial course in the forming of each rectilinear area, will occur upon movement of the needle cylinder in a common direction, such as counter-clockwise.

It is still another object of this invention to provide pattern controlled means for effecting operation of the widening pick feed cams, which operate independently of the patterning for controlling the shogging of the needle cylinder, the yarn feed fingers, and other patterning operations necessary to the production of a stocking of the type described, so the number of changes in

the operation of the widening pick feed cams may be varied in any desired manner during the knitting of a single stocking to thus produce a number of rectilinear areas knitted in a given length of tubular fabric substantially above that possible in machines of this type heretofore in use.

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 a knitting machine of the type shown in my said co-pending application embodying the improvements of the present invention and many of the parts being shown schematically;

Figure 2 is an enlarged side elevation of the improved knitting machine looking at the right-hand side of Figure 1;

Figure 3 is an enlarged side elevation of the improved knitting machine looking at the left-hand side of Figure 1 but omitting the lower portion of the machine and other parts being broken away for purposes of clarity;

Figure 4 is an enlarged rear elevation of the improved knitting machine with parts in cross-section and with other parts broken away and looking substantially along the line 4—4 in Figure 2;

Figure 5 and 5–A constitute an enlarged top plan view looking substantially along the line 5—5 in Figure 1, the rear portions of the machine being broken away, and in which Figure 5 shows the left-hand portion of the machine in Figure 1 and Figure 5–A shows the right-hand portion of the machine in Figure 1;

Figure 6 is an enlarged elevation of the upper central portion of Figure 1 with the right-hand portion thereof being broken away and other parts also being broken away for purposes of clarity;

Figure 7 is an enlarged elevation of the left-hand central portion of Figure 1 and showing the means for imparting rotation to the needle cylinder and for controlling reciprocatory movement thereof and some of the parts being shown in cross-section;

Figure 8 is an enlarged top plan view with parts in section and other parts broken away, looking substantially along the line 8—8 in Figure 4 and showing the means for effecting step-by-step rotation of a first auxiliary or first needle cam control pattern drum;

Figure 9 is a vertical sectional view, taken substantially along the line 9—9 in Figure 7, showing some of the conventional gearing of the machine and also showing the pattern controlled means for effecting step-by-step rotation of a widening pick control pattern wheel;

Figure 10 is an enlarged top plan view with parts in section and other parts shown schematically and looking substantially along the line 10—10 in Figure 6 and showing the upper end of the sinker cap and latch ring with portions thereof being broken away for purposes of clarity;

Figure 11 is an enlarged fragmentary plan view with parts in section showing the upper central portion of the latch ring shown in Figure 10 and showing the manner in which each of the body yarn feed fingers feeds the yarn to the needles during counter-clockwise movement of the needle cylinder;

Figure 12 is a view similar to Figure 11 and showing the manner in which the yarn is directed from the yarn feed finger to the needles during clockwise movement of the needle cylinder;

Figure 13 is another view similar to Figure 11 but showing the manner in which the yarn is introduced to the needle circle or withdrawn from the needle circle, as the case may be, and in which instance the needle cylinder rotates in a counter-clockwise direction;

Figure 14 is a fragmentary elevation looking substantially along the line **14—14** in Figure 12 and showing the upper ends of some of the needles as they move past the yarn feed point in the latch ring;

Figure 15 is a sectional plan view showing the arrangement of the needle cams which surround the needle cylinder, the needle cylinder being omitted for purposes of clarity and also showing many of the parts of the rear of the machine schematically and in phantom lines;

Figure 16 is an enlarged sectional plan view, taken substantially along the line **16—16** in Figure 1, showing the conventional means for driving the needle cylinder and the clutch means associated therewith for effecting reciprocatory or rotary knitting and also showing the main cam drum and the means for shogging the needle cylinder;

Figure 17 is an enlarged elevation with parts in section taken substantially along the line **17—17** in Figure 16 and showing the shogging clutch for the needle cylinder;

Figure 18 is a vertical sectional view taken substantially along the line **18—18** in Figure 8 and showing the ratchet mechanism for effecting step-by-step movement of the auxiliary pattern chain shown in Figure 2;

Figure 19 is an enlarged isometric view looking at the right-hand upper portion of Figure 4 and showing the improved individual clamping and cutting means for each of the body yarns employed in knitting a particular stocking;

Figure 20 is an enlarged fragmentary elevation of the clamping means for the body yarns looking substantially along the line **20—20** in Figure 19;

Figure 21 is an enlarged vertical sectional view taken along the line **21—21** in Figure 20;

Figure 22 is a fragmentary vertical sectional view, taken substantially along the line **22—22** in Figure 15, showing a second switch cam block in elevation;

Figure 23 is another elevation of the second switch cam block with parts in section and being taken substantially along the line **23—23** in Figure 15;

Figure 24 is a fragmentary elevation of a first switch cam block associated with a portion of the circular bed or cam plate and looking substantially along the line **24—24** in Figure 15;

Figure 25 is an elevation looking at the left-hand side of Figure 24 and also showing a part of the means for effecting movement of the first elevating switch cam radially of the needle cylinder;

Figure 26 is an elevation looking at the right-hand side of Figure 24 showing a portion of the circular bed plate in phantom lines and showing means for effecting radial movement of the right-hand widening pick feed cam;

Figure 27 is a vertical sectional view taken substantially along the line **27—27** in Figure 10 and showing the elastic yarn stitch cam block in elevation and also showing a portion of the sinker head in cross-section and showing means for controlling the action of the sinkers in conjunction with movement of the elastic stitch cam into operative position;

Figure 28 is a frgamentary elevation with parts in section looking at the right-hand side of Figure 27;

Figure 29 is a fragmentary vertical sectional view taken substantially along the line **29—29** in Figure 5;

Figure 30 is a sectional plan view taken substantially along the line **30—30** in Figure 29;

Figure 31 is a fragmentary elevation looking at the righthand side of Figure 30;

Figure 32 is an enlarged elevation of the clamping and cutting means for the elastic or rubber yarn, showing parts of the latch ring and associated parts in cross-section, and being taken substantially along the line **32—32** in Figure 5;

Figure 33 is a vertical sectional view taken substantially along the line **33—33** in Figure 32;

Figure 34 is a view similar to Figure 32 but showing the clamping and cutting means in a different position;

Figure 35 is a side elevation of a third switch cam block in association with the circular bed plate, the circular bed plate being shown in phantom lines, and being taken substantially along the line **35—35** in Figure 15;

Figure 36 is an elevation looking at the opposite side of the third switch cam block from that shown in Figure 35;

Figure 37 is an elevation looking at the outer end of an above-stitch leveling cam showing a portion of the circular bed plate associated therewith in cross-section and being taken substantially along the line **37—37** in Figure 15;

Figure 38 is an elevation with parts in section looking at the right-hand side of Figure 37 and also showing a portion of the needle cylinder in cross-section;

Figure 39 is an enlarged elevation looking substantially along the line **39—39** in Figure 3 and showing a portion of the main cam drum and the associated thrust rods and a part of the machine frame being in cross-section;

Figure 40 is an enlarged isometric view looking in the direction of the arrow **40** in Figure 15 and showing the lefthand narrowing pick and a part of the control means therefor;

Figure 41 is an elevation looking at the opposite side of the structure shown in Figure 40 and showing a portion of the circular bed plate in cross-section;

Figure 42 is a fragmentary elevation taken substantially along the line **42—42** in Figure 17 but showing the cam ring in a different position relative to the follower key from that shown in Figure 17;

Figure 43 is a longitudinal vertical sectional view through the narrowing pick connecting link shown in the upper central portion of Figure 15 and also taken substantially along the line 43—43 in Figure 57;

Figure 44 is a schematic top plan view of the needle cylinder showing the arrangement of the needle butts and illustrating the varying lengths of the butts on the needles for making the particular stockings shown in Figures 88 to 91 inclusive;

Figure 45 is a schematic developed view of the needles in the needle circle the upper portions of the needles being broken away for purposes of clarity;

Figure 46 is an enlarged schematic developed view of the cams on the yarn control pattern drum shown in the lefthand portion of Figure 3;

Figure 47 is an enlarged schematic developed view of the cams on the cam drum stepping cylinder shown in the upper central portion of Figure 2;

Figure 48 is an enlarged schematic developed view showing the arrangement of the cams on the first auxiliary or needle cam control pattern drum shown in the upper lefthand portion of Figure 4;

Figure 49 is an enlarged schematic developed view showing the arrangement of the most pertinent cams to the present invention on the main cam drum shown in the lower central portions of Figures 3 and 4;

Figure 50 is a vertical sectional view through the main cam drum taken substantially along the line **50—50** in Figure 39, showing the parts at a reduced scale and showing the arrangement of the segmental cam for controlling at least one of the widening picks during knitting of the heel and toe portions of the stocking;

Figure 51 is a view similar to Figure 50 taken substantially along the line **51—51** in Figure 39 and showing the arrangement of the cams for controlling at least one of the narrowing picks during reciprocatory knitting;

Figure 52 is a vertical sectional view at reduced scale through the main cam drum taken substantially along the line **52—52** in Figure 39;

Figure 53 is a view similar to Figure 52 and is taken substantially along the line **53—53** in Figure 39;

Figure 54 is another view similar to Figure 52 and is taken substantially along the line **54—54** in Figure 39;

Figure 55 is an enlarged fragmentary elevation of the lower left-hand portion of Figure 3 showing the main

pattern drum and the yarn control cam drum any many of the associated parts;

Figure 56 is a fragmentary elevation with parts in section taken substantially along the line **56—56** in Figure 8 and showing a part of the means for imparting step-by-step rotation to the yarn control pattern drum;

Figure 57 is an elevation with parts in section looking substantially along the line **57—57** in Figure 5 but showing the sinker head, the latch ring, the circular bed plate and the needle cylinder in elevation and also showing the means for controlling the length of stroke of the narrowing pick and for controlling the means for controlling certain of the sinkers upon changing from the knitting of one yarn to another;

Figure 58 is an enlarged fragmentary elevation of the upper right-hand portion of Figure 57 and showing one of the yarn feed fingers in a position it will assume immediately before being elevated to introduce the yarn to the yarn feed opening in the latch ring;

Figure 59 is a fragmentary vertical sectional view taken substantially along the line **59—59** in Figure 8 and showing a friction mechanism associated with the lower portion of the first auxiliary or needle cam control pattern drum;

Figure 60 is a vertical sectional view taken substantially along the line **60—60** in Figure 5 and showing the cam means on the yarn control pattern drum and the linkage for successively positioning the yarn feed fingers for introducing yarn through the yarn feed opening provided in the wall of the latch ring;

Figure 61 is a fragmentary elevation with parts in section looking substantially along the line **61—61** in Figure 60;

Figure 62 is a vertical sectional view, at a reduced scale, looking substantially along the line **62—62** in Figure 5 and showing the cams on the yarn control pattern drum for controlling the swinging of the yarn feed fingers and also showing the cams on the main cam drum for controlling the second elevating switch cam during the knitting of the heel and toe portions of a stocking;

Figure 63 is a schematic view of the third auxiliary pattern drum showing the arrangement of the cams thereon and associated linkage for controlling the right-hand widening pick feed cam during the knitting of the heel and toe of a stocking;

Figures 64 to 70, inclusive, show the arrangement of the cams on the first auxiliary or needle cam control pattern drum starting from the second set of cams from the top in Figure 1 and extending to the bottom of the pattern drum and also showing the ends of the respective control fingers actuated thereby;

Figures 71 to 72 are schematic views similar to Figure 63 showing the arrangement of the cams on the third auxiliary pattern drum in the lower central portion of Figure 7;

Figures 73 to 75, inclusive, are schematic views showing the arrangement of the cams on the yarn control pattern drum reading successively from right to left in Figure 4 from adjacent the first circular row of cams appearing on the right-hand side of the yarn control cam drum in Figure 4;

Figure 76 is a diagrammatic view showing the arrangement of the needle control cams which surround the needle cylinder, the stationary cams being shown in solid lines and the radially movable cams being shown in dotted lines and also showing the path of travel of the needle butts and the needles during rotary knitting, that is while forming the top, the ring top and foot of a stocking, and also showing the upper ends of the needles as though passing adjacent the inner surface of the latch ring;

Figure 77 is a view similar to Figure 76 showing the arrangement of only those cams which are actuated at

the needle cylinder immediately following the forming of the ring top of the stocking, that is, during the knitting of the latter portion of the last revolution of the needle cylinder in rotary knitting and prior to the needle cylinder going into reciprocatory knitting;

Figure 78 is a diagrammatic view showing some of the needle control cams adjacent the needle cylinder and showing the path of the needle butts wherein approximately half of the needles are elevated to pass above the stitch cams while the remaining needles are caused to pass through the stitch cams;

Figure 79 is a diagrammatic view similar to Figure 78 but showing the positions of the various movable cams after having knitted one or more portions of the stocking by reciprocatory knitting and then going into the knitting of a diamond or rectilinear area in the same courses as the previously knitted areas and wherein only two of the needles are caused to pass through the stitch cams while the remaining needles are caused to pass above the stitch cams;

Figure 80 is another diagrammatic view substantially the same as Figure 79 but showing the widening picks as they are initially brought into play;

Figures 81 and 82 are diagrammatic views showing the arrangement of the needle control cams adjacent the needle cylinder during narrowing operations upon movement of the needle cylinder in opposite directions as indicated by the arrows;

Figure 83 is still another diagrammatic view of some of the needle control cams as arranged during certain knitting operations in the ornamental pattern portion of a stocking;

Figure 84 is a view similar to Figure 80 but showing the arrangement of the left-hand widening picks and associated needle cams upon clockwise movement of the needle cylinder or movement of the needles past the cams from left to right as indicated by the arrow in Figure 84;

Figure 85 is a schematic developed view showing the arrangement of the cams on the third auxiliary pattern drum shown in the lower central portion of Figure 7;

Figure 86 is an enlarged fragmentary isometric view showing the tails on one of the pairs of widening picks and the associated cam and looking substantially in the direction of the arrow **86** in the lower right-hand portion of Figure 15;

Figure 87 is a fragmentary elevation with parts in section looking substantially along the line **87—87** in Figure 86;

Figures 88 and 89 are side elevations of opposed sides of a stocking showing one of the many ornamental pattern portions knitted in solid colors in the leg of the stocking, this pattern being the particular one described herein with respect to the operation of the machine;

Figures 90 and 91 are side elevations of stockings with the foot portions thereof being broken away and showing a few of the different variegated patterns which may be knitted into the leg or foot of a stocking on the present machine;

Figure 92 is a greatly enlarged view of the fabric typical of the juncture of four immediately adjacent diamond-shaped areas, this structure being included specifically in the area defined by dot dash lines and indicated at **92** in Figure 89;

Figure 93 is a diagrammatic layout of the leg or ornamental pattern portion of the stocking shown in Figures 88 and 89;

Figure 94 is a schematic plan view showing the arrangement of some of the sinker cams, including a movable sinker cam which is peculiar to the present invention and a part of the control means therefor;

Figure 95 is an enlarged detail of the improved body yarn cutting means with parts in section and is taken substantially along the line **95—95** in Figure 19.

Brief synopsis of the machine

The present machine, as is also the case with respect to the machine described in said co-pending application, has many of the principles of knitting machines heretofore in use, many of the parts being adapted to the machine from a machine of the type made by Scott & Williams under their model No. B–5, and shown in the Patent to R. W. Scott, No. 1,152,850 of September 7, 1915. The present machine employs much of the conventional type of driving and clutch mechanisms of said patent for shifting from rotary to reciprocatory knitting and vice versa and also employs the conventional type of main cam shaft having the usual pattern chain and main cam drum thereon for controlling the clutch mechanism. The usual type of needle cylinder having the usual latch needles which move in individual slots in the periphery of the needle cylinder are provided, the needle cylinder being driven, at times, to rotate and at other times to reciprocate. The usual type of sinker head is employed having conventional sinkers therein which are controlled by conventional cams in a sinker cap associated therewith. The present machine includes special sinker cams for controlling the sinkers as well as a unique latch ring.

The present machine also includes a top or first auxiliary pattern drum, also termed a needle cam control pattern drum, which is driven in a step-by-step manner identical to that of said co-pending application. The clutch mechanism for shogging the needle cylinder is disposed on one end of the main drive shaft of the machine, this clutch mechanism also being identical to and controlled in the same manner as that shown in said co-pending application.

In addition to the many features of the said co-pending application, an independently operable yarn control cam drum is provided at the rear of the machine to which step-by-step rotation is imparted in accordance with the patterning on an auxiliary pattern chain, this auxiliary pattern chain being substantially the same as that of said co-pending application. The present machine includes a plurality of horizontally swingable yarn feed fingers disposed adjacent the sinker cap in juxtaposed relation to each other and an individual yarn clamping mechanism is associated with each of the yarn feed fingers, there being a common cutting apparatus for all of the yarns from the yarn feed fingers. Now, these yarn feed fingers are controlled as to elevation and swinging movement by the cam arrangement on said yarn control pattern drum and the clamping and cutting means is also controlled by other cams on this yarn control pattern drum thus insuring that an efficient sequence in operations of the yarn feed fingers and the clamping and cutting means is provided and the yarn control means comprising the yarn control cam drum may operate independently of the needle cam control cams on the top or first auxiliary pattern drum.

Also, in order to increase the range of the present machine over that of the machine of said co-pending application, individual pattern controlled means is provided for effecting operation of the widening picks rather than having the cams for effecting operation of the widening picks mounted on the top or first auxiliary pattern drum and, therefore, the number of times that the widening picks are brought into operation during the knitting of a given length of tubular fabric may be increased substantially to thus provide for a greater number of rectilinear or diamond-shaped areas in a given length of tubular fabric than has heretofore been possible with a machine of the type disclosed in said co-pending application.

Summarily, the many features of the present invention, which will be later described in detail, are provided to lend to greater flexibility in operation of the various knitting instrumentalities than has been possible in other knitting machines, including that of said co-pending application and, consequently, greatly increasing the range of the machine in producing variegated patterned areas in knitted fabric and particularly in men's hose.

Although many of the parts of the present invention are identical to that of said co-pending application and are also operated in an identical manner, in order that a clear description as to the function of the knitting instrumentalities peculiar to the present invention may be had, it is deemed necessary that a repetition of the descriptive matter relating to those parts of the present machine which are identical to the corresponding parts of said co-pending application be given.

Now, referring more specifically to the drawings, the mechanism will be fully described in detail and also a disclosure of one example of the operation of the machine will be given with particular reference to the stocking shown in Figure 88.

Referring to Figures 1, 2, 3 and 4, the machine generally comprises a main base or frame **100**, having suitable legs **101**, and which supports a vertically disposed upper cast frame **102** having spaced vertically disposed standard portions **102***a* and **102***b*. The machine has a conventional needle cylinder **103** which is rotatable, as will later be described, and carries therein a plurality of vertically moved latch needles not shown in these figures but illustrated in some figures later to be described. These latch needles are of the conventional type and alternate ones of the needles have conventional jacks J (Figure 76) disposed therebelow which are employed in making the welt of a stocking and all of the needles cooperate with the usual sinkers in drawing stitches. The present invention includes an improved means for withdrawing the sinkers from operating position which will be later described in detail (Figure 10).

The conventional sinkers **104**, only one of which is shown in Figure 62, are mounted in a sinker head **105** and are controlled by suitable cams disposed in a sinker cap **107**. An improved latch ring designated broadly at **106** is provided which is mounted at the upper end of the needle cylinder **103**, and which will later be described in detail. The latch ring **106** differs particularly from the conventional type of latch rings in that the throat is not provided and, consequently, a throat plate and gap closure is not required in conjunction with this machine. The needle cylinder **103**, extends through a conventional circular bed or cam plate **110** suitably secured to the upper surface of the cast frame **102** (Figures 6, 10 and 27). This circular bed plate **110** supports the various needle cams, the yarn feed fingers and the clamping and cutting mechanism, all of which will later be described in detail, and also supports the posts, to be later described, to which the latch ring is secured.

The circular bed plate **110** has a reduced portion **112**, depending therefrom, which is integral therewith, and in which a conventional sock horn **113** has vertical sliding movement. The lower portion of this sock horn **113** is mounted for vertical sliding movement in a plate member **114** suitably secured to the lower surface of the base **100**. This sock horn **113** is raised and lowered in a conventional manner, which will be presently described, for effecting the desired amount of tension or length of stitches in the fabric being knitted.

Vertical movement of the sock horn **113**, is effected by a crank arm **115**, having conventional adjustment screws therein which are adapted to bear against circularly arranged cam members **120** (Figure 4) fixed on a conventional main cam drum **121**. This crank arm **115** is oscillatably mounted on a shaft **367** (Figure 3), the left-hand end in Figure 4, being embedded in the vertically disposed cast frame **102**. Since the adjustment screws on this crank arm **115** and the manner in which they are adjusted is well known to those familiar with the art, as well as being shown in said co-pending application, a further description and illustration of the same is deemed unnecessary. The main cam drum **121** is rotatably mounted on a shaft **122** to be later described.

Means for driving needle cylinder, etc.

Now, referring to Figures 1, 2, 3, 7 and 16, there is shown a conventional type of gearing usually associated with a machine of a type manufactured by Scott & Williams under their Model No. B–5 and which has been described in detail in said co-pending application and is also similar to that appearing in the patent to R. W. Scott No. 1,152,-850 of September 7, 1915. Since the driving means to be presently described, for transmitting rotation to the needle cylinder 103 and for shogging the needle cylinder is substantially identical to that of said co-pending application, only a brief description will be given as to the structure and manner of operation of the means for imparting rotation to the needle cylinder.

Fixedly mounted in the standard portion 102*a* of the base 102 is a sleeve bearing or bushing 126 on which a pulley 127, having a pinion 128, integral therewith, is rotatably mounted. The pinion 128 meshes with the gear 130, for imparting a normal rate of speed to the needle cylinder as will presently be described. A tubular shaft 131 is rotatably mounted in the bearing 126, and extends beyond opposed ends of the bearing 126, and its outer end, in Figure 16, has a conventional slow speed pulley 132, mounted thereon and keyed thereto, as by a key portion 133 integral with a manually operable handle 134, secured to the end of the shaft 131, as by a screw 135.

A conventional idler pulley 137 is rotatably mounted on the hub of the idler pulley 132 and is driven by a constantly moving belt 140 driven by conventional means not shown. The belt 140 is shifted between the three pulleys 127, 132 and 137, by a conventional forked shifting member 141 adapted to be manipulated by an operator and which has longitudinal sliding movement on a shaft 143 (Figure 1) fixedly mounted on suitable bearing portions projecting from the front vertical surfaces of the standard portions 102*a* and 102*b* of the upper cast frame 102.

Assuming the belt 140 to be in engagement with the pulley 127, a normal rate of speed will be imparted to the needle cylinder and the tubular shaft 131 through the pinion 128 and the gear 130. The gear 130 is fixedly mounted on a shaft 144 rotatably mounted in the standard portion 102*a* of the upper cast frame 102 and which has, keyed on the inner end thereof, a gear 145 of slightly larger diameter than the gear 130. The gear 145 meshes with a pinion 146 of slightly smaller diameter than the pinion 128 and which is keyed to the left-hand end of the shaft 131 in Figure 16.

When transmitting a slower than normal rate of speed to the shaft 131, the belt 140 is positioned in an engagement with the slow speed pulley 132 in which instance the pulley 127 will idle due to the intermeshing pinion 146 and gear 145 and the intermeshing gear and pinion 130 and 128 respectively.

A reduced end portion 152 of a main drive shaft 153 is mounted for relative rotational movement in the left-hand end of the tubular shaft 131. The shaft 153 is rotatably mounted intermediate its ends in the vertically disposed portion 102*b* of the upper cast frame 102.

The usual type of clutch 154 is keyed to the shaft 153 and has sliding movement thereon for alternate engagement with the pinion 146 and a pinion 155 by means of a shifting member 156 which is controlled as to position in a conventional manner including a clutch control cam drum 157 having suitable cam members 160 thereon. The clutch control cam drum 157 is fixedly mounted on a shaft 161 mounted for rotation in the upper cast frame 102, this shaft 161 also having a rack wheel 162 fixed thereon to which step-by-step rotation is imparted by conventional means, not shown, but being controlled by a conventional pattern chain 163.

The manner in which step-by-step rotation is imparted to the ratchet wheel 162 from the pattern chain 163 is clearly shown and described in said co-pending application as well as said Patent No. 1,152,850 and, since this is conventional, a further description thereof is deemed unnecessary. It might be stated that, in the present instance, one edge of the pattern chain 163 is provided with suitable cams or lugs 164 for controlling step-by-step rotation of the ratchet wheel 162 and the other edge thereof is provided with a plurality of lugs 165 for controlling step-by-step rotation of a widening pick feed cam pattern drum to be later described which, in turn, controls the operation of the widening pick feed cams also to be later described.

The pattern chain 163 is mounted on a sprocket wheel 166 rotatably mounted on the shaft 161. The sprocket wheel 166 has a ratchet wheel 170 integral therewith (Figures 1 and 16) which is also driven in a conventional manner as is clearly shown in Figure 5 of said patent.

The pattern chain 163 is also mounted on sprocket wheels 171, 172, 173 and 174 which are mounted for rotation on a suitable frame or pattern chain bracket 180 suitably secured to the frame 100 of the machine. The pattern chain 163 transmits step-by-step rotation to the clutch control cam drum 157 so as to cause the shifting member 156 to move the slidable clutch 154 longitudinally of the shaft 153 in either direction according to the desired pattern to thus cause reciprocatory or rotary motion to be imparted to the shaft 153 and thus to the needle cylinder 103 as will later be described.

When the clutch 154 is moved into engagement with the pinion or gear 146, rotary motion is transmitted to the shaft 153. Now, when the clutch 154 is moved to the left in Figure 16 into engagement with the pinion 155, reciprocatory motion will be transmitted to the shaft 153 by the pinion 155 to which reciprocatory motion is imparted by a quadrant or segmental gear 184 oscillatably mounted on an enlarged portion 185 (Figure 9) of the shaft 122, which is fixedly mounted in the standard portions 102*a* and 102*b* of the upper cast frame 102.

Continuous oscillation is imparted to the quadrant 184 by a conventional link 186 pivotally connected at one end thereof to the gear 145 and at its other end to the quadrant 184 substantially midway of its toothed portion and the rear shaft 185, all of which is clearly shown in said Patent No. 1,152,850.

A conventional beveled gear 187 is rotatably mounted adjacent the left-hand end of the shaft 153 (Figure 16) and this beveled gear 187 is, at times, driven in fixed relation to the shaft 153 by a shogging mechanism which is not claimed as a part of the present invention but is peculiar to this and to said co-pending application. The shogging mechanism will later be described in detail. The beveled gear 187 drives the needle cylinder 103 through a conventional beveled gear 188 (Figure 22), which is a usual part of the needle cylinder 103 as is clearly shown in Figure 12 of said Patent No. 1,152,850.

First or top auxiliary pattern drum

The parts heretofore described are substantially conventional parts of a knitting machine and it is with these parts that the present invention is adapted to be associated. The first or top auxiliary pattern drum is also referred to in this application as a needle cam control pattern drum since most of the cams on this pattern drum are provided for controlling movement of the needle control cams relative to the needle cylinder. Referring to Figures 1, 2, 4, 5–A, 6, 8 and 59, the needle cam control pattern drum is clearly shown and indicated broadly at 191. This pattern drum 191 is substantially identical as to structure and as to its driving means, as it is shown in said co-pending application with the exception that the side wall thereof is of lesser height since a lesser number of cams are used on the pattern drum 191 in association with the present machine.

As in said co-pending application, the pattern drum 191 is an open top drum having a vertical axis and its bottom is closed by a bottom plate 192. The plate 192 is rotatably mounted on a vertically disposed shaft 193 (Figure

8) having an enlarged portion **194** (Figure 59) against which the lower surface of the plate **192** is urged by a suitable friction means **195**, in Figure 59, to restrain movement of the needle cam pattern drum **191** on the shaft **193** but to permit the drum to be rotated on said shaft either by automatic means to be later described or manually. The friction means **195** may be of any desired structure, the type shown in Figure 59 being identical to that of said co-pending application and therefore, a further description thereof is deemed unnecessary. The shaft **193** also has a reduced lower end portion 197 which slidably pentrates a substantially rectangular horizontally disposed auxiliary bed plate **196**. The reduced portion **197** of the shaft **193** is threadably engaged by a nut **200** for securing the shaft **193** to the bed plate **196**.

The vertically disposed shaft **193** extends upwardly substantially above the upper edge of the needle cam control pattern drum **191** and has an indicating pointer **201** secured on the reduced upper end thereof by a suitable lock nut **202** threadably mounted on the upper end of the shaft **193** (Figures 1, 2, 4 and 5–A). The purpose of this indicating pointer **201** is to assist an operator in setting up the machine for operation since the inner surface of the pattern drum **191** will be provided with a series of numbers to also assist in positioning the drum **191** in proper relation to the position of the shaft **193**. The arrangement of the numbers and their purpose will later be described.

The needle cam drum **191** is driven through the medium of a ratchet wheel **203** (Figures 1, 2, 4 and 8) suitably secured, as by screws **204**, to the lower surface of the bottom plate **192** of the pattern drum **191**. Intermittent step-by-step rotation is transmitted to the ratchet wheel **203** and, of course, to the pattern drum **191**, by a spring pressed ratchet pawl **205** oscillatably mounted, as at **206** (Figure 8), on an arm **207** of a crank lever **208**. The crank lever **208** is oscillatably mounted intermediate its ends, as at **210**, on the auxiliary bed plate **196**. One end of the tension spring **211** is connected to the ratchet pawl **205** and the other end thereof is connected to the crank lever **208** to normally urge the ratchet pawl **205** into engagement with the teeth in the ratchet wheel **203**.

The free end of the arm **209** of the crank lever **208**, in Figure 8, has a cam follower **214** rotatably mounted thereon, as at **216**, which is normally urged against the side edges of a plurality of irregularly shaped cam members **217**, successively, there being four of the cam members **217** arranged around a stepping cylinder to be presently described. The cam follower **214** is urged against the cam members **217** by a tension spring **221**, the left-hand end of which (Figure 8) is connected to a medial portion of the arm **209** and its other end being connected to the upper surface of a bearing bracket **225** suitably secured, as by screws **226**, to the upper surface of the auxiliary bed plate **196**.

The irregular cam members **217** are suitably secured on the peripheral surface of a cam drum stepping cylinder **227** (Figures 2, 4 and 8) which is rotatably mounted on a shaft **230** fixedly mounted in the bearing bracket **225** (Figures 2 and 8). Continuous rotation is imparted to the stepping cylinder **227** by means of a gear **231** suitably secured to the right-hand end of the stepping cylinder **227** (Figures 4 and 8). This gear **231** engages the gear **130** (Figure 16) which is driven in the manner heretofore described by the pinion **128** on the pulley **127**. The cams on the first auxiliary or needle cam control pattern drum **191** will be later described when a description of the various needle cams is given.

Auxiliary pattern chain and driving means therefor

The auxiliary pattern chain to be presently described is disposed rearwardly of the knitting machine in Figure 2 and is driven in a manner identical to that of said co-pending application. However, a description of its structure and its manner of operation is believed necessary in order to clearly understand the function of this machine. Referring to Figures 2 and 16 it will be observed that the outer surface of the gear **130** has a plurality of equally spaced lugs or cam members **242** thereon.

As the gear **130** rotates in a counter-clockwise direction in Figure 2, the cam members **242** successively move into engagement with the angularly disposed upper end portion of a bell crank **243** oscillatably mounted, as at **244**, on the vertically disposed standing portion **102***b* of the cast upper frame **102**. This bell crank **243** also has a forwardly projecting arm **245** integral therewith, the free end of which is adapted to engage the peripheral edge of a cam wheel **246** fixedly mounted on the right-hand end of the shaft **161** in Figures 2 and 16. This cam wheel **246** (Figure 2) has a notch or recess **247** therein which extends through an arc of approximately 60 degrees and into which the free end of the bell crank arm **245** is adapted to fall during the knitting of an ornamental pattern portion of a stocking.

In operation, each time the upper end of the bell crank **243**, in Figure 2, is engaged by one of the lugs or cam members **242**, the bell crank **243** is moved in a clockwise direction in Figure 2 and, upon any one of the cam members **242** passing by the bell crank **243**, it is moved a partial counter-clockwise revolution, by a tension spring **250** connected at one end thereof to the standard portion **102***b* of the upper frame **102**, and at its other end to the arm **245**. It is thus seen that during the knitting of the ornamental pattern portion of the stocking, to be later described, intermittent oscillation is transmitted to the bell crank arm **245**.

Now, the bell crank **243** has the front end of a link **251** connected thereto, as at **252** in Figures 2 and 18. This link **251** extends rearwardly and is then bent at substantially right angles in Figures 4 and 18, and is then bent to extend rearwardly and is pivotally connected, as at **253**, to a pawl carrying arm **254** (Figure 18) oscillatably mounted on the shaft **230** and its lower end has pivotally mounted thereon, as at **255**, the front end of a ratchet pawl **256**.

This ratchet pawl **256** is normally urged against the periphery of a ratchet wheel **257** by a tension spring **260** (Figure 18), the lower end of which is connected to the ratchet pawl **256** and the upper end of which is connected to the bracket **225**. The ratchet wheel **257** has a sprocket wheel **263** integral therewith (Figures 4 and 8), and the ratchet wheel **257**, with the sprocket wheel **263**, is mounted for rotation on the shaft **230**. A suitable friction device **264** is provided on the right-hand end of the shaft **230** in Figures 4 and 8 and this friction device **264** is substantially the same as the friction device **195** shown in Figures 4, 8 and 49, it being evident that the friction device **264** may be relatively smaller than the friction device **195**. The purpose of the friction device **264** is to prevent the sprocket wheel **257** from rotating freely on the shaft **230**.

It is thus seen that, upon each of the cam members **242** engaging the upper end of the bell crank arm **245** (Figure 2), it is moved in a clockwise direction and the link **251** (Figures 2, 4 and 18) will transmit movement in a counter-clockwise direction to the pawl carrying arm **254** to thus transmit step-by-step rotation to the ratchet wheel **257** and the sprocket wheel **263** (Figures 4 and 18) during knitting of the ornamental pattern portion of a stocking.

The sprocket wheel **263** has an endless auxiliary pattern chain **265** mounted thereon. This pattern chain **265** extends downwardly from the front portion of the sprocket wheel **263**, which is disposed rearwardly of the cylinder **227** in Figure 2, and then passes beneath a sprocket wheel **266** and over another sprocket wheel **267** and then downwardly and upwardly repeatedly in engagement with sprocket wheels **268** to **275**, inclusive, after which the auxiliary pattern chain **265** extends upwardly and forwardly at an angle and passes over sprocket wheels **276** and **277**.

The auxiliary pattern chain 265 extends downwardly passing in engagement with another sprocket wheel 278 and then passes over the sprocket wheel 263. The pattern chain 265 and its manner of being driven is substantially the same as that of said co-pending application with the exception that lugs are provided adjacent each edge of the pattern chain 265, the lugs for effecting step-by-step movement of the needle cam control pattern drum 191 being disposed on the left-hand side of the chain in Figure 8, and being indicated at 279, and the lugs at the right-hand side of the pattern chain in Figure 8 being indicated at 280, the purpose of these lugs 280 being to transmit step-by-step movement at spaced predetermined periods to a yarn control cam drum to be later described.

As in said co-pending application, the entire length of the auxiliary pattern chain 265 is adapted to pass by a given point during the time that the machine is knitting the ornamental pattern portion of a stocking, which is during all reciprocatory knitting other than the knitting of the heel and toe of a stocking.

All of the sprocket wheels 266 to 278, inclusive, are identical and are mounted for rotation on a suitable skeleton frame 281 disposed rearwardly of the machine and which may be of any desired shape and size, the shape and size of the frame 281 being determined by the number of courses and variations in the courses forming the ornamental pattern portion of a stocking. The skeleton frame 281 has a pair of vertically spaced forwardly projecting portions 282 and 283 (Figure 2) integral therewith both of which are secured to the main pattern chain bracket 180 by any suitable means such as bolts 284. Now, as step-by-step movement is imparted to the auxiliary pattern chain 265, the lugs 279 are moved successively into engagement with an auxiliary pawl controller 286 (Figure 8). The auxiliary pawl controller 286 is suitably secured to a crank arm 287 which extends forwardly and is fixed mounted on a shaft 290 oscillatably mounted in bearing members 291 and 292 suitably secured to the auxiliary bed plate 196.

A latch lifting finger 295 is fixedly mounted on the left-hand end of the shaft 290 (Figure 8) and extends rearwardly and has a reduced rounded portion on its free end which slidably penetrates a pivoted latch 296. The latch 296 normally engages the arm 209 of the crank lever 208 and has a shoulder adjacent the free end thereof, not shown in the present application but being clearly shown in said co-pending application, which is adapted to engage the right-hand surface of a notch 297 (Figure 8) in the arm 209 of the crank member 208. It is thus seen that the latch 296 normally prevents the free end of the arm 209 in Figure 8 from being moved in a counterclockwise direction by the tension spring 221 and thereby prevents the crank 208 from being actuated by the cam members 217 for intermittently transmitting step-by-step rotation to the ratchet wheel 203 and the first auxiliary pattern drum 191.

Now, upon any one or more of the lugs 279 on the auxiliary pattern chain 265 engaging the auxiliary pawl controller 286, it is obvious that the latch lifting finger 295, in the left-hand portion of Figure 8, would be caused to move toward the observer at its lower end in Figure 8. This would move the left-hand end of the latch 296 toward the observer thus moving the shoulder thereof out of engagement with the notch 297 in the arm 209. This will permit the tension spring 221 to pull the lower end of the arm 209 to the right, in Figure 8, as the high point of any one of the cam members 217 moves out of engagement with the cam follower 214. This will, of course, cause the ratchet pawl 205, in Figure 8, to move from right to left and, upon the next succeeding of the cam members 217 engaging the cam follower 214, the arm 209 will again be projected outwardly at its lower end in Figure 8 and will, of course, cause the ratchet pawl 205 to transmit partial rotation to the ratchet wheel 203 and the pattern drum 191.

It is thus seen that step-by-step rotation is transmitted to the top auxiliary pattern drum 191 only when one of the lugs 179 on the auxiliary pattern chain 265 is in engagement with the auxiliary pawl controller 286. At all other times, the auxiliary pattern drum 191 remains in a fixed position.

Yarn feeding control mechanism

In the drawings there are shown means for admitting four different yarns to the needle cylinder as well as means for admitting rubber yarn thereto. However, it is to be understood that any reasonable number of different colored yarns may be independently admitted to the needle cylinder if desired by making changes in the control means therefor and by adding additional yarn fingers. In the present instance, only four different yarns are admitted to the needle cylinder 103 as in knitting the stocking shown in Figure 88.

Referring to Figures 2 and 3, there is shown a plurality of spindles or stands 304, the lower ends of which are suitably secured, as by a pressed fit in a suitable frame 305 suitably secured, as by screws 306 (Figures 8 and 18) to a rearwardly extending portion 307 of the auxiliary bed plate 196. These screws 306 also secure a transversely extending plate 308 to the rearwardly extending portion 307 of the auxiliary bed plate 196. The plate 308 serves as a support for a part of the driving means for the yarn control pattern drum to be later described.

The spindles 304 may be of any desired construction and are adapted to support the usual type of cones 310 and 311, there being a plurality of the cones 310 from which body yarns Y–1, Y–2, Y–3 and Y–4 are withdrawn. The cone 311 may be of the same structure as the cone 310 except that an elastic or rubber yarn R is withdrawn from the cone 311. The yarns Y–1 to Y–4, inclusive, extend upwardly from the corresponding cones 310 and each of the yarns passes through a first yarn tension device 312, all of these yarn tension devices 312 being identical. Since the yarn tension devices 312 are of the conventionay type used on many knitting machines, a detailed description thereof is deemed unnecessary. After the yarns have passed over the yarn tension devices 312, they extend downwardly and each of the yarns passes through a second yarn tension device 313, these yarn tension devices being substantially the same as those of said co-pending application and a further description thereof being deemed unnecessary.

The yarn tension devices 312 are supported on a suitable support or bracket 314, the second yarn tension devices 313 being mounted in a different vertical plane than the first yarn tension devices 312 and being supported on a support bracket 315. Both of the support brackets 314 and 315 are fixedly secured, in any desired manner, on a yarn tension support post 316. The yarn tension support post 316 extends downwardly in Figure 1 and its lower end penetrates a boss 317 integral with the rearwardly extending frame 305 (Figure 8) and has a reduced portion penetrating plates 307 and 308 and has a nut on its lower end.

The yarns Y–1 to Y–4, inclusive, extend downwardly and forwardly at an angle from the second yarn tension devices 313 and pass through individual yarn feed fingers, these yarn feed fingers being peculiar to the present application and being entirely different from those shown in said co-pending application. The structure relating to the yarn feed fingers is most clearly shown in Figures 5, 10, 57, 60 and 61.

The circular bed plate 110 has an opening 330 therein (Figure 60), this opening being utilized on the usual Scott and Williams machines for passage of the usual thrust rods therethrough for controlling conventional yarn feed fingers. However, in the present instance, there is mounted for movement through this opening 330, a vertically movable yarn feed finger support or

guide post 331, preferably polygonal in cross-section. A guide block 332 bridges the opening 330 and is secured, as by screws 333, to the upper surface of the circular bed plate 110. The guide post 331 extends substantially above the upper end of the guide block 332 (Figure 60) and has a reduced portion 334, which is circular in cross-section, integral therewith.

The post 331 in polygonal in cross-section so as to prevent rotation thereof in the guide block 332. It is to be understood, however, that a shaft which is circular in cross-section may be keyed in the guide block 332, if desired, so as to have vertical sliding movement therein. Secured on opposed sides of the guide post 331, by any suitable means such as bolts 335, is a spring support bracket 336 and a yarn guide bracket 337.

Oscillatably mounted on the upper reduced portion 334 (Figure 61) of the guide post 331 is a plurality of yarn feed fingers all of which are identical, there being four yarn feed fingers shown in the drawings indicated at 341, 342, 343 and 344. The yarns Y—1 to Y—4, inclusive, pass through the yarn guide bracket 337 and then extend through eyes 345, there being an eye 345 adjacent the reduced portion 334 of the guide post 331 in each of the yarn feed fingers 341 to 344, inclusive (Figure 10), and there being a similar eye 346 adjacent the free end of the yarn feed fingers 341 to 344 inclusive.

Each of the yarn feed fingers 341 to 344 has an outwardly projecting tail portion 347 integral therewith which is disposed at substantially right angles relative to the yarn feed fingers 341 to 344 and to each of which one end of a tension spring 350 is connected, the other end of the tension spring 350 being connected to the substantially L-shaped spring support bracket 336. The lowermost of the yarn feed fingers, which is the yarn feed finger 344 in Figures 60 and 61, has sliding movement against the shoulder formed in the guide post 331 at its juncture with the reduced portion 334, and those yarn feed fingers disposed thereabove have sliding rotational movement against each other. The uppermost of the yarn feed fingers 341 is held in position against the next adjacent yarn feed finger 342 by a suitable collar 351 fixedly mounted on the upper end of the reduced portion 334 of the guide post 331.

Referring to Figures 5 and 60, it will be observed that the springs 350 normally urge corresponding yarn feed fingers 341 and 344, inclusive, against a stop 352 which is substantially L-shaped and is secured, by any suitable means such as screws 353, to one side of the L-shaped spring bracket 336. The lower end of the guide post 331 has a reduced portion 354 which is circular in cross-section and extends through a guide plate 355 (Figure 60) suitably secured, as by a screw 356, to the lower surface of the circular bed plate 110. The screw 356 also secures a medial portion of a thrust rod guide bar 357 to the lower surface of the circular bed plate 110.

The lower portion of the reduced portion 354 of the guide post 331 is surrounded by a compression spring 360, the lower end of which bears against a screw 361 of greater cross-sectional area than the lower end of the portion 354 of the guide post 331 and against which the lower end of the compression spring 360 rests to thus normally urge the guide post 331 downwardly and to urge the lower surface of the screw 361 against the upper edge of an actuating member in the form of a bell crank 362. The bell crank 362 is oscillatably mounted intermediate its ends, as at 363, on a vertical disposed bar 364, the upper end of which is slidably mounted in the thrust rod guide bar 357 and the lower end of which is slidably mounted in a second thrust rod guide bar 365. The second thrust rod guide bar 365 is secured, by any suitable means such as a screw 366 to a guide bar support member 367 (Figures 3, 4 and 60) which is secured at one end thereof, as by a pressed fit, in the standard portion 102*a* of the upper cast frame 102 and extends above the main cam drum 121 at the front of the machine. This member 367 also supports the crank arm 115 which has heretofore been described as controlling the tension in the fabric being knitted.

The screw 366 also serves to secure an angle bar 370 to the upper surface of the member 367 (Figure 16). This angle bar 370 serves to insure that the thrust rods passing through the lower or second thrust rod guide bar 365 will remain in the same plane during rotation of the main cam drum 121 in engagement therewith. In order to hold the bar 364 in vertically adjusted position between the proximate surfaces of the thrust rod guide bars 357 and 365, the rod 364 has a pair of eccentrics 371 and 372 secured thereto, as by screws 373, and may be rotated on the screws 373 so their remote surfaces snugly engage the proximate surfaces of the thrust rod guide bars 357 and 365.

Pivotally connected, as at 374, to the bell crank 362 is a link 375, the outer end of which is connected to the free end of a control finger 376 having a follower portion 377 integral therewith and disposed intermediate the ends thereof. The upper end of the control finger 376 is pivotally mounted on a shaft 380 (Figure 60) disposed in spaced parallel relation to the shaft 367 and is secured at one end thereof, as by a pressed fit, in a plate 381 (Figures 5, 8 and 15) suitably secured, as by screws 382, to the vertical edge of the auxiliary bed plate 196 adjacent the circular bed plate 110. The outer end of the shaft 380 is mounted in one end of a support 383 which is clearly shown in Figure 15 as being in the form of strap iron bracket which extends forwardly and is then bent spirally at right angles and is secured, as by screws 384, to a plate 385 which is, in turn, secured, by any suitable means such as screws 386, to the lower surface of the thrust rod guide bar 357.

Referring again to Figure 60, it will be observed that the follower portion 377 of the control finger 376 at times bears against the peripheral surface of a yarn control pattern drum 390 and, at other times, the follower portion 377 successively bears against a plurality of circularly spaced cams 391 to 399, inclusive, some of these cams being provided with steps and the cams also being of varying heights. The cam 392 is provided with stepped surfaces 392*a* and 392*b* of different heights, the cam 393 being provided with steps 393*a*, 393*b*, and 393*c* of different heights. The cam 394 is provided with steps 394*a*, 394*b* and 394*c* of different heights and the cam 395 is provided with steps 395*a* and 395*c* of the same height between which is a step 395*b* of greater height than the surfaces 395*a* and 395*c*. The cam 397 has steps 397*a* and 397*b* and the cam 398 has steps 398*a* and 398*c* between which is a step 398*b* of greater height than the steps 398*a* and 398*c*.

The cams 391 and 399 as well as the stepped surfaces 393*b*, 394*a*, 395*a*, 395*c*, 397*a*, 398*a* and 398*c* are of the same height. The cam 396 and the surfaces 392*a*, 393*a*, and 397*b* are of the same height but are of lesser height than the cams 391 and 399.

It is to be noted that the steps 392*a*, 393*a* and 397*b* of the respective cams 392, 393 and 397 are of substantially the same height as the cam 396. The steps 393*b*, 394*a* and 397*a* are of substantially the same height as the cams 391 and 399. The steps 392*b*, 395*a*, 395*b*, 398*a* and 398*c* are of slightly greater height than the cams 391 and 399. The cam steps 393*c*, 394*b* and 398*b* are of greater height than the step 392*b* and the steps 394*b* and 395*b* are of greater height than the step 393*c*. The purpose of the various heights of the cams and the steps will be later described.

It might be stated that the heights of the cams shown in Figure 60 are varied in accordance with a particular stocking being knitted for elevating the guide post 331 and the associated yarn feed fingers 341 to 344 to selected positions so they may be swung inwardly towards the latch ring 106 and then upwardly into operative position, such as the position occupied by the first yarn feed finger

341 in Figure 60. In order to independently swing the selected yarn feed fingers 341 to 344 to operative position, there is provided a yarn finger actuator (Figures 5, 10 and 60) which is also controlled by a plurality of cams, to be later described, on the yarn control pattern drum 390. The manner in which the yarn control pattern drum is mounted and driven will also be later described.

The yarn finger actuator 402 is fixed on the upper end of a post 403 and has a curved pusher arm portion 404 integral therewith which is adapted to be swung about the post 403, by means to be presently described, so as to engage the portion 347 of any one of the yarn feed fingers 341 to 344 which may have been elevated to its horizontal plane for swinging the same into operative position. The post 403 is mounted for vertical sliding movement in a suitable support, such as a bracket 405, suitably secured, as by screws 406 (Figures 60 and 62), to the guide post 332. The post 403 extends downwardly substantially below the lower surface of the bracket 405 and has a collar 407 adjustably secured thereon as by a set screw 408. A compression spring 411 encircles the lower portion of the post 403 and its upper end bears against the lower surface of the bracket 405 and its lower end bears against the upper surface of the collar 407 to thus normally urge the post 403 and the corresponding yarn finger actuator 402 downwardly in Figure 60 so the lower surface of the actuator 402 will normally rest in sliding engagement with the upper surface of the bracket 405.

The yarn finger actuator 402 has a plate 412 suitably secured to the upper surface thereof, as by screws 413 (Figure 10) which, upon movement of the yarn finger actuator 402 from the position in Figure 10 to the position shown in Figure 5, moves above the portion of the corresponding yarn feed finger having the eye 345 therein to thus be elevated by the corresponding yarn feed finger as further upward movement is imparted to the yarn feed finger, in a manner to be later described when a description is given relating to the operation of the machine.

Oscillatably mounted, as at 415, in the yarn finger actuator 402, and in off-center relation to the post 403, is the front end of a link 416. The link 416 extends rearwardly and slidably penetrates a shoulder pin 417, the reduced left-hand end of which slidably penetrates one end of a control finger 420 oscillatably mounted on the shaft 380 heretofore described. The pin 417 is secured for oscillation in the control finger 420 by a nut 421 (Figure 5) suitably mounted on the reduced left-hand end of the pin 417.

The end of the control finger 420 remote from the end to which the pin 417 is connected has a follower portion 422 integral therewith which is adapted to, at times, engage the periphery of the yarn control pattern drum 390 and, at other times, to engage a plurality of irregularly shaped cams 423 to 430 inclusive, each of which has three stepped cam surfaces bearing the reference character of the corresponding cam with the respective letters *a*, *b* and *c* affixed thereto. In other words, for example, the cam 424 has cam surfaces 424*a* and 424*c* which are of the same height and between which is a lower surface 424*b*. All of the cams 423 to 430, inclusive, are substantially the same with the exception of the lengths and the distances therebetween, such variations being in accordance with a desired pattern.

In operation, one of the selected yarn feed fingers 341 to 344 is elevated to the horizontal plane of the arm 404 of the yarn finger actuator 402 and, immediately thereafter, one of the cams 423 to 430 moves into engagement with the follower portion 422 of the control finger 420 and, assuming this cam to be the cam 423, the surface 423a would cause clockwise movement of the control finger 420 so the free end of the corresponding yarn feed finger would move to substantially the position shown in Figure 13. The yarn feed finger is then elevated slightly by one of the cams shown in Figure 60 on the yarn control pattern drum 390.

Now, the latch ring 106 has an annular wall portion 433 integral therewith which is provided with a yarn feed opening 434 through which the yarn is fed from the selected yarn feed fingers 341 to 344 to the needles in the needle circle. The annular portion 433 of the latch ring 106 has an annularly extending slot 435 (Figures 11 and 12) therein which communicate with the yarn feed opening 434 and extends to the lower edge of the annular portion 433 and, upon the selected yarn feed finger being moved to the position shown in Figure 13, the yarn feed finger is moved upwardly to cause the yarn extending therefrom to pass through said slot 435 and to enter the opening 434.

Now, referring again to Figure 62, it will be observed that the follower portion 422 of the control finger 428 is then engaged by the medial portion 423*b* of the cam 423 and this permits the yarn finger actuator 402 to move slightly in a clockwise direction in Figures 5 and 10 to where the corresponding yarn feed finger will occupy the position shown in Figures 11 and 12, Figure 11 indicating the manner in which the yarn is fed to the needles with counter-clockwise movement of the needle cylinder and Figure 12 showing the manner in which the yarn is fed to the needles during clockwise movement of the needle cylinder.

After the yarn has been fed to the needles for the desired period, the portion 423*c* of the cam 423 then moves into engagement with the follower portion 422 of the control finger 420 to again move the corresponding yarn feed finger into the position shown in Figure 13 after which the yarn feed finger again moves downwardly to cause the yarn to pass through the slot 435 and below the lower edge of the latch ring 106 in Figure 62. The follower portion 422 then moves inwardly between the cams 423 and 424 to engage the peripheral surface of the yarn control pattern drum 390 thus moving the yarn finger actuator 402 from substantially the position shown in Figure 5 to the position shown in Figure 10 and permitting the corresponding tension spring 350 to move the corresponding yarn feed finger to inoperative position.

It will be observed in Figures 5 and 62 that the yarn finger actuator is normally urged to inoperative position as shown in Figures 5 and 62 by a tension spring 431 one end of which is connected to an outer member 106*a* to be presently described, of the latch ring 106 and the rear end of which is connected to one of the collars 418 which straddle the pin 417 (Figure 62). This tension spring 431 also normally urges the follower portion 422 of the control finger 420 into engagement with the periphery of the yarn control pattern drum 390 and also causes the follower portion 422 of the control finger 420 to follow the contour of the irregular surfaces of the cams 423 to 430 inclusive.

It will be observed, in Figure 62, that the latch ring 106 includes an outer annular member 106*a* and inner annular member 106*b* and the portion 433 is an integral part of the inner member 106*b*. This member 106*b* is L-shaped in cross-section so as to fit in a recess 436 in the upper inner portion of the outer member 106*a* and is secured therein by any suitable means such as screws 437 (Figures 5, 32 and 34).

The right-hand portion of the outer annular member 106*a* of the latch ring 106 is suitably secured, as by screws 440, to the upper surface of a plate 441 (Figure 5). The plate 441 extends outwardly and is suitably secured, as by a screw 442, to the upper end of a post 443 (Figures 1, 5 and 6). The post 443 extends downwardly, in Figure 6, and is threadably embedded in the circular bed plate 110. The left-hand portion of the annular member 106*a* of the latch ring 106 in Figure 5 is secured to suitable supporting means, such as a substantially Z-shaped bracket 444

(Figure 19) suitably secured, as by screws **445**, to the upper surface of the circular bed plate **110**.

The annular member **106***a* of the latch ring **106** is secured to the upper surface of the bracket **444** through the medium of a reinforcing plate **446** suitably secured, as by screws **447**, to the upper surface of the member **106***a*. and this reinforcing plate as well as the annular member **106***a* is slidably penetrated by a screw **450** for securing the reinforcing plate **446** and the outer member **106***a* of the latch ring **106** to the upper surface of the substantially Z-shaped bracket **444**. The bracket **444** also serves as a support for the clamping and cutting means to be later described.

Driving means for yarn control pattern drum

The yarn control pattern drum **390** is closed at its inner end by a head member **451** which is rotatably mounted on a yarn control pattern drum shaft **452** fixedly mounted at one end thereof in a bracket **453** (Figures 4 and 18) which extends upwardly and is suitably secured, as by screws **454**, to the lower surface of the rearwardly projecting portion **307** of the auxiliary bed plate **196**.

A suitable friction mechanism **455** (Figure 62) is suitably secured to the shaft **452** and frictionally engages the inner surface of head member **451** (Figures 55 and 62) to resist undesired rotation of the yarn control pattern drum **390**. This friction mechanism **455** is of substantially the same structure as the friction means 195 in Figure 8 which resists rotation of the top or first needle cam control pattern drum **191** and a detailed description thereof is thus deemed unnecessary. The head member **451** (Figures 8 and 56) has a ratchet wheel **456** integral therewith which is engaged by a ratchet pawl **460** pivotally connected, as at **461**, to one end of a pawl carrying arm **462** and being normally urged toward the pawl arm **462** by a tension spring **463**. The pawl arm **462** is oscillatably mounted at its front end on the shaft **452**.

A link **464** is pivotally connected, as at **465**, intermediate the ends of the pawl arm **462** and extends upwardly therefrom. The upper end of the link **464** is pivotally connected, as at **466**, to one end of a bell crank **467** (Figures 4, 8, 18 and 56). The bell crank **467** is ocillatably mounted, as at **470** (Figures 4, 8 and 18), on a vertically disposed plate **471** suitably secured, as by screws **472**, to the rear edge of the rearwardly extending portion **307** of the auxiliary bed plate **196**.

A link **473** is pivotally connected, as at **474**, to the end of the bell crank **467** remote from the end to which the link **464** is connected. This link extends outwardly, in Figure 4, and is pivotally connected, as at **475**, intermediate the ends of a yarn drum actuator **476** (Figure 4) pivotally mounted, as at **477**, on a block **480** suitably secured, as by screws **481**, to the lower surface of the transversely extending plate **308** (Figures 4 and 8). A cam follower **482** is rotatably mounted on the free end of the yarn drum actuator **476** and this cam follower **482** is adapted to, at times, engage the outer edges of a plurality of circularly arranged irregularly-shaped cam members **483**, there being four of these cams shown in Figure 47.

These cam members **483** are suitably secured to the peripheral surface of the cam drum stepping cylinder **227**, these cams **483** being spaced apart, axially, from the cams **217** so as to permit the cams **217** and **483** to move past the cam followers **214** and **482** on the respective arms **209** and **476**. The cam follower **482** is normally urged into engagement with the left-hand surfaces of the cams **483**, in Figures 4 and 8, by a tension spring **487** connected at one end thereof intermediate the ends of the link **473** and being connected at its other end to the plate **471**. The link **473** is provided with a notch **490** into which a stop finger or latch **491** (Figures 4 and 8) is normally urged by a tension spring **492**.

The tension spring **492** is connected at one end thereof intermediate the ends of the stop finger **491**, its other end being connected to the frame **305**. The stop finger **491** is pivotally mounted, as at **493**, on the rear surface of the plate **471**. Pivotally connected intermediate the ends of the stop finger **491**, as at **494**, is the lower end of a link **495** (Figures 4, 8 and 18) which extends upwardly, is turned spirally, and is pivotally connected, as at **496**, to the rear end of a stop finger control level **497** oscillatably mounted intermediate its ends, as at **500**, on an angle clip **501** (Figure 8) suitably secured, as by screws **502**, to the upper surface of the transversely extending plate **308**. The control lever **497** has a cam follower **503** in the form of a finger secured thereto as by screws **504**. The free end of this cam follower **503** normally engages the auxiliary pattern chain **205** adjacent the sprocket wheel **263** and, at times, is elevated to move the lever **497** a partial revolution in a clockwise direction, in Figure 18, by the lugs **280** on the right-hand portion of the pattern chain **265** in Figure 8, these lugs **280** being arranged according to a predetermined pattern to be knitted.

Although the cam drum stepping cylinder **227** rotates continuously during operation of the machine, it is thus seen that, upon the stop finger **491** being in engagement with the notch **490** of the link **473**, as shown in Figure 4, the cam follower **482** will be unable to move into the spaces between the cam members **483**. However, upon any one of the lugs **280** moving into engagement with the cam follower **503**, a partial revolution in a clockwise direction is imparted to the lever **497**, in Figure 18, thus moving the stop finger **491** downwardly, in Figure 4, against pull of the tension spring **492**.

Immediately upon movement of the stop finger **491** out of the notch **490**, the tension spring **487** will cause the cam follower **482** to ride against the left-hand edges of the cam members **483**. Thus, upon the cam follower moving successively into engagement with the cam members **483** and to the lower points thereof with respect to the plate **471**, a partial clockwise revolution will be imparted to the bell crank **467**, in Figure 4, to thus move the pawl **460** downwardly in Figure 56. Upon upward movement of the cam follower **482** from right to left, in Figure 4, which is caused by each of the cams **483**, a partial counterclockwise revolution will be imparted to the bell crank **467** in Figure 4, thus moving the pawl carrying arm **462** upwardly in Figure 56 to, in turn, move the pawl **460** upwardly to impart a step in rotation to the ratchet wheel and the associated yarn control pattern drum **390**.

Clamp and cutter control

In addition to the two rows of cams heretofore described on the yarn control pattern drum shown in Figures 60 and 62 for controlling the yarn feed fingers, the yarn control pattern drum has four rows of cams, to be presently described, for controlling the operation of the clamping and cutting means, also to be presently described, and one additional row of cams for controlling the sinkers in the sinker head **105** at the time of changing from knitting with one yarn to another. The clamping and cutting means is most clearly shown in Figures 19 and 20 and the first operation with respect thereto is the selecting of the particular clamping mechanism which is to be moved into operating position closely adjacent the needle circle upon changing from one yarn to another.

Referring to Figures 46 and 73, there is shown a plurality of cams **508** to **512** suitably secured to the periphery of the yarn control pattern drum and which are adapted to be succesively engaged by a follower portion **513** on one end of a control finger **514** oscillatably mounted intermediate its ends on the shaft **380**. These cams **508** to **512** are stepped for purposes to be later described as is clearly shown in Figure 73. The control finger **514** extends upwardly in Figure 73 and has a pin **515** oscillatably mounted therein and which is slidably penetrated by a link or connecting rod **516**. The connecting rod **516** has a suitable collar **517** adjustably secured thereon as by a set screw **520**.

The link **516** extends forwardly and is pivotally connected, as at **521**, to one end of a clamp carriage lifter in the form of a bell crank **522**. The bell crank **522** is oscillatably mounted, as at **523** (Figure 73), on a block **524** secured, as by screws **525**, to the vertical leg of an angle clip **526**. The angle clip **526** is suitably secured, as by screws **527** (Figure 5), to the upper surface of the thrust rod guide plate **357**.

The bell crank **522** has a forwardly extending arm **530** integral therewith which is adapted to, at times, engage a follower roller **531**, this roller **531** being shown schematically in Figure 73 and also being shown in Figures 5 and 19. The follower roller **531** is rotatably mounted on a shoulder screw **532** threadably embedded in an angle plate **533** comprising a part of a clamp carriage broadly designated at **534**, this clamp **534** being a form of supporting means for the clamping means to be presently described. The carriage **534**, to be later described in detail, is mounted for vertical sliding movement on a guide post **535** which is shown in Figure 19 as being substantially rectangular in cross-section. The guide post **535** is secured, as by screws **536**, to the upper surface of the circular bed plate **110** and also has suitably secured thereto, as by a screw **537**, an irregularly-shaped clamp positioning arm bracket **540** (Figure 6).

The clamp positioning arm bracket **540** has a stub shaft **541** oscillatably mounted therein, on the upper end of which a clamp positioning arm **542** is fixedly mounted and which extends forwardly therefrom. This clamp positioning arm **542** is adapted to engage any one of a plurality of clamp bars, there being four of these bars shown in the drawings, to coincide with the number of yarn feed fingers employed in knitting a particular pattern. These clamp bars are indicated at **543**, **544**, **545** and **546**. The clamp bars **543** to **546** are mounted for horizontal sliding movement in a block **547** of the carriage **534** and are retained in the block **547** by a suitable plate **550** suitably secured, as by screws **551** (Figure 20), against the front surface of the block **547**.

The plate **550** has a plurality of notches **552** therein (Figure 20), there being one of these notches **552** coinciding with each of the clamp bars **543** to **546** and into which coinciding stop members **553** are urged by tension spring **554**, these tension springs being connected at one end thereof to the stop pins **553** and at their other ends to suitable spring anchors **555** projecting from the plate **550**. The springs **554** also normally urge the clamp bars **543** to **546**, inclusive, from right to left in Figure 20 to inoperative position. The working end of each of the clamp bars **543** to **546**, inclusive, has a notch **556** therein to which a particular yarn from which any part of the pattern may have been knitted is directed, upon a yarn change, by a yarn guiding cam plate **557**, this yarn cam plate **557** being in the form of an angle clip secured to the upper surface of the sinker cap **107**. The yarn cam plate **557** may be secured to the upper surface of the sinker cap **107** by any suitable means such as welding, soldering and the like. All of the clamp bars **543** to **546**, inclusive, are shown in an inoperative position in Figure 19 so that the yarn guiding cam plate **557** may be more clearly shown.

Each of the clamp bars **543** to **546**, inclusive, has a pivot pin **560** slidably mounted therein on which a clamp blade **561** is oscillatably mounted (Figures 19, 20 and 21). Each of the clamp blades **561** is held in sliding engagement with the front surface of the corresponding clamp bar **543** to **546**, inclusive, by a combination compression and torsion spring **562** (Figure 21) which surrounds the screw or pivot pin **560** and is connected at one end thereof to the corresponding bar **543** to **546** and at its other end to the corresponding clamp blade **561** to normally urge the clamp blade into a closed position such as that shown in Figures 19 and 20. The torsion spring **562** is adjusted in accordance with the desired clamping pressure of the blade **561** against the corresponding clamping bar **543** to **546**, inclusive, by a knurled nut **563** threadedly mounted on the screw or pivot pin **560**. It will be noted that the free end of each of the clamping bars **543** to **546**, inclusive, and the corresponding clamping blade **561** are beveled so as to lead the yarn into the corresponding notch **556** when the yarn is directed to the particular clamping arm by the yarn guiding cam plate **557**.

The manner in which the clamp positioning arm **542** moves the particular clamping bars **543** to **546**, inclusive, which may be its path, to inoperative position will be later described. Upon each of the clamping bars **543** to **546** being independently moved into operative position, according to a desired pattern, the corresponding yarn clamping blade **561** is moved to open position, so as to expose the notch **556**, by means of a clamp and cutter actuating plunger **564**. The manner of operation and structure of the parts associated with this clamp and cutter actuating plunger **564** will be later described. However, each of the clamping bars **543** to **546**, inclusive, has a vertically extending groove **565** therein through which a portion of the clamp and cutter actuating plunger **564** is adapted to move upon the clamping bars **543** to **546** being selectively moved into operative position.

Each of the clamping blades **561** is provided with a tail portion **566** which is engaged by the actuating plunger **564** upon downward movement thereof to thus cause the corresponding blade **561** to partially rotate in a counterclockwise direction in Figure 20 to thus expose the notch **556** for reception of the yarn extending from the needle circle to the yarn feed fingers. Since each of the clamp bars **543** to **546**, inclusive, is moved into operating position resiliently, in a manner to be later described, each of the clamp bars **543** has a stop block **567** suitably secured thereon, as by screws **570**, and this stop block is adapted to engage the block **547** of the vertically movable carriage **534** upon the corresponding clamp bar being moved inwardly toward the needle cylinder to operative position.

The clamp carriage **534** also includes a vertically disposed plate **571** which is secured to the rear surface of the block **547** in Figure 19, by any suitable means such as screws **572**, these screws **572** also serving to secure the angle plate **533** to the rear surface of the vertically disposed plate **571**. When the carriage **534** is in a lowered position, as shown in Figure 19, the lower edge of plate **571** rests upon adjustment screw **573** threadably embedded in the clamp positioning arm bracket **540**.

Referring to Figure 55, it will be observed that the outer surface of the angle clip **533** has a toothed member **574** secured thereto by any suitable means such as screws **575**. The toothed member **574** is adapted to, at times, be engaged by a mating toothed member **576**, this second toothed member **576** preferably being provided with but a single tooth which is adapted to engage any one of the teeth in the first toothed member **574** upon the vertically movable carriage **534** being released, which will happen as a result of the cams **508** to **512** (Figure 73) moving out of engagement with the follower portion of the control finger **514**. The second toothed member is normally urged into engagement with the first toothed member by a tension spring **577** connected at one end to the second toothed member (Figure 55) and connected at its other end to the screws **525** in the block **524**.

This second toothed member **576** is controlled by a plurality of circularly arranged cams **577** and **578**, suitably secured on the yarn control pattern drum **390** the number of cams shown in Figure 75 being the number necessary for knitting the stocking shown in Figure 88, although it is to be understood that a greater or lesser number of cams of the type shown in Figure 75 may be provided according to a desired pattern. A follower portion **581** is adapted to, at times, engage the periphery of the yarn control pattern drum **390** and, at other times to

be engaged by the cams 577 and 578 independently of each other.

This follower portion 581 (Figure 75) is integral with the medial portion of a control finger 582 oscillatably mounted on the shaft 380 at one end thereof, and its other end has a connecting rod 583 pivotally connected thereto. This connecting rod 583 slidably penetrates a pin 584 oscillatably mounted on the lower end of the second toothed member 576 in Figures 55 and 75. A pair of collars 585 and 586 may be adjustably secured on the connecting rod 583 and are adapted to engage opposed sides of the pin 584 so that movement of the control finger 582 may be transmitted to the lower end of the second or mating toothed member 576.

Referring to Figure 55, the medial portion of the second tooth member 576 is oscillatably mounted, as at 587, on the flanged lower portion of the guide post 535 and the upper portion of the second or mating toothed member 576 is adapted to have sliding movement against the outer face of the angle plate 533.

Referring to Figures 19 and 55, it will be observed that the lower end of the stub shaft 541 has an arm 590 fixedly mounted thereon which extends inwardly and has a connecting rod 591 pivotally connected thereto. This connecting rod 591 extends rearwardly and slidably penetrates a pin 592 (Figures 5 and 55) and has a pair of collars 593 and 594 mounted thereon and normally engaging opposed sides of the pin 592. The collar 593 is fixedly mounted in adjusted position on the connecting rod 591 and the collar 594 is adapted to have longitudinal sliding movement on the connecting rod 591.

It will be observed, in Figures 5 and 55, that the connecting rod 591 extends substantially beyond the pin 592 and is surrounded by a compression spring 595, the outer end of which bears against a collar 596 adjustably secured on the connecting rod 591 and the front end of which bears against the collar 594.

The pin 592 is oscillatably mounted on the upper end of a control finger 597 (Figure 55). The control finger 597 is oscillatably mounted intermediate its ends on the shaft 380 and its lower end, in Figure 55, has a follower portion 600 integral therewith which is, at times, urged against the periphery of the yarn control pattern drum 390 and, at other times, successively urged against a plurality of cams 601 to 606, inclusive, suitably secured on the yarn control pattern drum 390.

It is thus seen that, upon any one of the cams 601 to 606, in Figure 55, moving into engagement with the follower portion 600 of the control finger 597, the control finger 597 will assume the position shown in Figure 55 and will have moved the connecting rod 591 from right to left, resiliently, due to the compression spring 595. This would cause the clamp positioning arm 542, in Figure 5, to partially rotate in a counter-clockwise direction from the dotted line position to the solid line position and would move the particular clamp arm 543 to 546, which may be in its same horizontal plane, inwardly until the stop block 567 associated therewith will have engaged the block 547 of the clamp carriage 534 and whereupon the compression spring 595 would permit the control finger 597 (Figure 55) to move slightly beyond the point at which the connecting rod 591 had stopped so as to insure that the stop block 567 of the corresponding clamp arm 543 to 546 would be held tightly against the block 547 of the clamp carriage 534.

It is evident that, upon the cams 601 to 606 moving out of engagement with the follower portion 600 of the control finger 597, the corresponding tension spring 554 (Figure 20) of the particular clamp arm 543 to 546, inclusive, which may have been moved into operative position, will cause the clamp positioning arm 542 to move outwardly to the dotted line position shown in Figure 5. This would cause the follower portion 600 of the control finger 597, in Figure 55, to move into the space between adjacent cams 601 to 606 inclusive. Since the clamp positioning arm 542 is not under spring tension while in the dotted line position, the clamp arms 543 to 546 may move outwardly past the clamp positioning arm 542 during positioning of the clamp carriage 534 through the medium of the cams shown in Figure 73. The function of the cams in Figures 55 and 73 and other cams associated with the yarn clamping apparatus will be later described when a description is given of the operation of the machine.

Yarn cutter mechanism

The yarn cutting mechanism is most clearly shown in Figures 3, 6, 10, 19 and 95, and the cams for operating the clamping and cutting mechanism are shown in Figure 74. The clamp and cutter actuating plunger 564 has heretofore been briefly described and it has been stated how the plunger 564 is adapted to move downwardly for opening the clamping blade 561 (Figures 19, 20, 21 and 95). Now, as the actuating plunger 564 moves downwardly, and simultaneously with its engaging the tail portion 566 of the particular clamping blade 561 which may be in its path, the actuating plunger 564 will engage a tail portion 610 of a movable cutter blade 611, it being preferred that a suitable resilient means be provided on a pivot 612 for holding the movable cutter blade 611 in frictional engagement with a fixed blade 613.

The fixed blade 613 has a stop pin 614 thereon which is adapted to be engaged by the movable cutter blade 611 upon the cutter blade being moved to closed position by a tension spring 615, one end of the tension spring 615 being connected to the end of the tail portion 610 of the movable blade 611 and the other end thereof being connected to a suitable spring anchor 616 which extends downwardly and is suitably secured, as by screws 617 (Figure 95) to the upper portion of the substantially Z-shaped bracket 444 heretofore described. The stationary cutter blade 613 is also suitably secured to the substantially Z-shaped bracket 444 adjacent the upper end thereof in Figure 19.

It is thus seen that, upon the actuating plunger 564 moving downwardly and engaging the tail portion 610 of the movable cutter blade 611 in Figure 95, the movable cutter blade 611 will be moved to open position for reception of the yarn directed thereto by the yarn guiding cam plate 557 in Figure 19. Then, as the actuating plunger 564 moves upwardly, the corresponding clamp arm 543 to 546, inclusive, and the stationary and movable cutter blades 611 and 613 will clamp and cut the particular yarn which may be directed thereto in a manner to be later described. The clamp and cutter actuating plunger 564 is mounted for vertical sliding movement in a guide block 620 which has an outwardly extending portion 621 integral therewith suitably secured, as by screws 622, to the upper end of the guide block 535 associated with the clamp carriage 534.

The inner face of the guide block 620 has a guide plate 625 secured thereto by any suitable means such as screws 626 (Figure 19) and a tension spring 627 is connected at one end thereof to the guide plate 625 and extends downwardly and is connected at its other end intermediate the ends of the actuating plunger 564 to thus normally urge the actuating plunger 564 upwardly against a substantially heart-shaped cam 630. The guide plate 625 extends upwardly beyond the upper end of the guide block 620. The heart-shaped cam 630 is oscillatably mounted, as at 631 (Figures 3, 6 and 19) on the upper portion of the guide plate 625 but on a horizontal axis. One end of the connecting rod 632 is pivotally connected to the heart-shaped cam 630 at a point above its pivot point 631 and extends downwardly and rearwardly at an angle and slidably penetrates a pin 633 (Figure 74) and has a collar 634 adjustably secured on the lower free end thereof.

The collar 634 is normally urged against the pin 633 (Figure 74) by a tension spring 635 (Figure 3) con-

nected at one end thereof intermediate the ends of the connecting rod **632** and its other end being connected to the guide block **620**. The pin **633** (Figure 74) is oscillatably mounted on the upper end of a control finger **636** oscillatably mounted intermediate its ends on the shaft **380** and its lower end being provided with a follower portion **637** which is urged, by the tension spring **635** (Figure 3), into engagement with the periphery of the yarn control pattern drum **390** or a plurality of circularly spaced cams **641** to **649**, inclusive, successively, suitably secured to the yarn control pattern drum **390**.

Now, assuming the follower portion **637** of the control finger **636** to be in substantially the position shown in Figure 74, upon rotation of the yarn control pattern drum **390** one of the cams **641** to **649** will move into engagement with the follower portion **637** to thus cause the control rod **632** to transmit counter-clockwise movement to the heart-shaped cam **630** in Figure 19. This causes the plunger **564** to move downwardly in the manner heretofore described for actuating the cutter blade **611** and the corresponding clamping blade **561**. It is evident that the tension springs **627** (Figure 19) and **635** (Figure 3) will urge the heart-shaped cam **630** upwardly at its rear end or in a clockwise direction in Figure 3 to thus permit the plunger **564** to return to inoperative position upon the cams **641** to **649** successively moving out of engagement with the follower portion **637** of the control finger **636** in Figure 74.

Sinker head and sinker control

Following the knitting of any particular section of fabric, such as shown in one of the diamonds in Figure 88, and following which a succeeding or second section is to be knitted of a different yarn from that employed in knitting the first-named section, the yarn employed in knitting the first-named section is clamped and cut by the clamping and cutting means heretofore described (see Figures 19, 20 and 21). However, it is well known to those familiar with the art, that the usual sinkers, one of which is shown in Figures 27 and 62, move inwardly between the needles and above the yarn being fed to the needles to cooperate with the needles in drawing stitches.

Now, upon a particular group of needles having knitted a partial course and immediately before changing from knitting with one yarn to another, the needles which do not pass through the stitch cams and which may still have the yarn fed thereto would cause the yarn to be fed past the lower edge of the sinkers as they are moved inwardly or, at least, the nibs of the sinkers **104** may catch the yarn which is fed to the needles which are not passed through the stitch cams and this would cause a considerable length of yarn to be wrapped around the needle circle between the point at which the terminal loops of the yarn knitting in the first-named section were formed and the point at which the yarn which had been employed in knitting the first-named section is severed by the clamping and cutting means heretofore described.

Therefore, pattern controlled means are provided for projecting the sinkers **104** inwardly at a point in advance of the knitting point during counter-clockwise movement of the needle cylinder, at the time that all yarn changes take place and, since the yarn currently being knitted is directed to the needles and to the sinkers at an angle and extends from a point a substantial distance above and in advance of the knitting point, the sinkers **104** are moved inwardly into operative position substantially in advance of the knitting point rather than simultaneously with approaching the knitting point, their nibs will pass beneath the yarn being fed to the needles with the result that the yarn will lay above the sinkers adjacent the terminal loops formed thereby and this will shorten the length of yarn extending between the terminal loops formed in the first section and the clamping and cutting means so as to obviate the necessity of cutting away the portions of the yarns, adjacent the terminal loops, which has not been knitted after the stocking has been knitted and removed from the knitting machine.

Now, in order to project the sinkers inwardly to operative position in advance of the actual knitting point for the purpose heretofore described, a few of the cams which are mounted in the sinker cap **107** are shown schematically in Figure 94. This particular sinker cap **107** and sinker head **105** are of types substantially as shown in my Patent No. 2,420,771 of May 20, 1947, the sinker head **105** being mounted in fixed relation to the needle cylinder substantially as shown in said Patent 1,152,850.

Referring to Figure 94, there is shown a conventional out-throw cam **653** and a conventional in-throw cam **654** past which the butts of the sinkers move the butts of the sinkers **104** traversing a pathway indicated by the arrows **655** during normal knitting operations and the butts of the sinkers **104** being projected inwardly, to traverse a pathway indicated by the arrows **656** upon ceasing to knit with a particular yarn, by means of a special in-throw cam **657**, this cam **657** constituting a part of the present invention. The cam **657** is pivotally mounted, as at **660**, on the sinker cap **107**, the sinker cap **107** being suitably slotted for slidable movement of the cam **657** therein so a part of the cam **657** may be exposed for engagement by a sinker cam actuating finger or lever **661**.

In order to insure that the sinker cam **657** will be projected inwardly to a precise predetermined position, resilient means are provided for swinging the sinker cam actuating arm **661** inwardly and the sinker cam **657** is provided with a stop pin **662** fixedly mounted therein, as by a pressed fit, and which engages the outer periphery of the sinker cap **107** upon being moved inwardly to the position shown in Figure 94.

It has already been described how the guide post **331**, on which the yarn feed fingers **341** and **344** are mounted, has vertical sliding movement in the guide block **332**. Now, this guide post **331** is confined in the guide block **332** by a plate **663** suitably secured to the front surface of the guide block **332**, as by screws **664** (Figure 15). Referring to Figures 5 and 62, there will be observed an angle clip **665** suitably secured to the front face of the plate **663**, as by any suitable means, and on which one end of the sinker cam actuating finger **661** is pivotally mounted, as at **666**. It will be noted in Figure 94 that the pivot point of the sinker cam actuating finger **661** is disposed substantially in alinement with the pivot point **660** of the cam **657** relative to the front and rear of the knitting machine.

In other words, the free ends of the cam **657** and the actuating finger **661** are disposed closely adjacent each other and the free end of the actuating finger **661** has the front end of a connecting rod **667** pivotally connected thereto as at **670** (Figures 5, 57 and 94). The connecting rod **667** extends rearwardly and loosely penetrates the upper end of a control finger **671** oscillatably mounted intermediate its ends on the shaft **380** and having a follower portion **672** integral with the lower end thereof in Figure 57. The connecting rod **667** has a collar **673** adjustably secured thereon which engages the rear surface of the control finger **671** and is normally urged there against by a tension spring **674** anchored at its front end on the spring support bracket **336** and being connected at its rear end to the connecting rod **667** adjacent the collar **673**. It is thus seen that the tension spring **674** normally urges the free end of the actuating arm **661** forwardly to substantially the position shown in Figure 94 in the event of the follower portion **672** of the control finger **671** being in an engagement with the periphery of the yarn control pattern drum **390**. The yarn control pattern drum **390** is provided with a plurality of circularly spaced cams **675** to **681**, inclusive, each of which, upon moving into engagement with the

follower portion **672** of the control finger **671**, causes the sinker actuating finger **661** to move rearwardly from the position shown in Figure 94 to substantially the position shown in Figure 5, thus permitting the sinkers to force the cam **657** outwardly so they may traverse the pathway **655** in Figure 94. This completes the description of the various elements which are controlled through cams mounted on the yarn control pattern drum **390**.

Referring to Figure 10, it will be observed that the sinker cap **107**, which is conventional in all respects with the exception of the movable cam **657** shown in Figure 94 and a cam means, to be later described, for moving the sinkers to inoperative position during the knitting of the rubber top of a stocking, this means for moving the sinkers to inoperative position during the knitting of the rubber top being substantially shown in my Patent Number 2,420,771 of May 21, 1947. The sinker cap **107** is caused to oscillate in a well known manner upon changes in direction of rotation of the needle cylinder and is provided with the usual projections or arms **685** and **686** in which adjustment screws **687** and **688** are mounted to limit the amount of oscillation of the sinker cap **107** upon engagement thereof with opposed sides of a post **691**. The post **691** is secured to the upper surface of the circular bed plate **110** by screws **692**.

Since the latch ring **106** of the present machine is peculiar to the present machine, an improved means is provided for holding the sinker cap **107** and sinker head **105** in position on the upper end of the needle cylinder **103**. It will be observed, in Figure 5, that the flange of the outer member **106***a* of the latch ring **106** is cut away at its outer edge to provide an opening **693** in which one end of a bar **694** is disposed, this bar **694** having an adjustment screw **695** threadedly penetrating the same. The adjustment screw **695** is adapted to slidably engage the upper surface of the sinker cap **107**. The bar **694** extends outwardly and is adjustably secured in the upper end of a support bracket **696** by any suitable means such as an adjustment screw **697**. The support bracket **696** extends downwardly and then inwardly and again downwardly and is suitably secured, as by screws **700** (Figure 1) to the sock horn **113**.

Feeding, clamping and cutting means for rubber yarn

It has already been stated that the rubber yarn is withdrawn from a cone or bobbin **311** mounted on one of the spindles **304** in Figure 2. The rubber yarn R then extends upwardly and passes between tension disks forming a yarn tension **701** after which the yarn R extends downwardly and forwardly at an angle and passes through a suitable thread guide **702** (Figures 1, 5 and 6) from whence it extends rearwardly and outwardly adjacent the needle cylinder and passes through the free end of a rubber yarn feed finger **703**. This rubber yarn feed finger is shown in inoperative position, in Figure 5, and is adapted to be swung inwardly adjacent the needle cylinder **103** in a counter-clockwise direction by means of a cam **704** (Figure 53) suitably secured on the main cam drum **121** which is driven at varying intervals in exactly the same manner as that shown and described in said co-pending application.

Since the main cam drum **121** is driven and controlled by the main pattern chain **163** (Figure 1), and intervening connections, in a manner identical to that shown in said copending application and also being shown in the patent to R. W. Scott No. 1,152,850 of September 7, 1915, a further description thereof is deemed unnecessary, it already having being stated that the main cam drum **121** is rotatably mounted on the shaft **122**.

The thread guide **702** is suitably secured, as by screws **705** (Figure 5) on a plate **706**, the screw **705** slidably penetrating the plate **706** and being threadably embedded in the plate **441**. A screw **707** is also provided to assist in securing the plate **706** to the upper surface of the plate **441**. The rubber yarn feed finger **703** is dependently mounted for oscillation on the lower surface of the plate **706** as at **709**.

A connecting rod **710** is pivotally connected intermediate the ends of the rubber yarn feed finger **703** at one end thereof and extends outwardly, or to the right in Figure 5, and has a pair of collars **711** adjustably secured thereon (Figures 5 and 6) which straddle one end of a lever **712** which is slidably penetrated by the connecting rod **710** and, upon movement of the lever **712**, in a manner to be presently described, like movement is imparted to the connecting rod **710** and the rubber yarn feed finger **703**, so as to move the rubber yarn feed finger **703** into and out of operative position according to the desired pattern.

The lever **712** is oscillatably mounted intermediate its ends on a post **713** and is held in position between a pair of spaced collars **714** (Figure 23) suitably secured on the post **713**. The lever **712** extends rearwardly beyond the post **713** and one end of a tension spring **716** is connected adjacent the rear end of the lever **712** and extends inwardly and is connected at its other end to the collar **351** on the reduced upper end **334** of the guide post **331**. Thus, the tension spring **716** normally urges the rear end of the lever **712** inwardly into engagement with the upper end of a bell crank **717** which extends downwardly (Figure 39) and is oscillatably mounted, as at **720**, on the front surface of a bearing bracket **721** to be later described.

The tension spring **716** (Figure 5) urges an arm **722** of the bell crank **717** downwardly against a lug **723***a* (Figure 39) which projects towards the observer in Figure 39 and is suitably secured to the upper end of a thrust rod **723** mounted for vertical sliding movement in the thrust rod guide plates **357** and **365**. The lower end of the thrust rod **723** normally rests on the upper surface of the main cam drum **121** (Figures 39 and 53) and, upon movement of the cam **704** into engagement therewith, the thrust rod **723** moves upwardly, in Figures 39 and 53, causing the bell crank **717** to move a partial revolution in a counter-clockwise direction. This will cause the lever **712** to move to the left in Figure 39 or in a clockwise direction in Figure 5 to thus move the rubber yarn feed finger **703** into operative position closely adjacent the needle cylinder.

Now, at times when the rubber yarn R is not being fed to the needles, the free end thereof is held in a clamping mechanism to be presently described (see Figure 32) and, upon the rubber yarn having been fed to the needles during the knitting of the rubber top, the rubber yarn is cut by a cutting means also to be presently described. An angle clip **725** is suitably secured, as by screws **726**, to the lower surface of the flange portion of the outer member **106***a* of the latch ring **106** and has a clamp blade **727** secured thereto by a shoulder screw **730** (Figures 32 to 34 inclusive). This clamp blade **727** is also secured in position against the angle clip **725** by a pin **731**.

The clamp blade **727** is frictionally engaged by a center or movable clamp and cutter blade **732** oscillatably mounted on the shoulder screw **730** and being provided with a notch **733** intermediate its ends and in the lower edge thereof. Upon the clamp and cutter blade **732** being moved from the position shown in Figure 34 to the position shown in Figure 32, the notch is engaged by the pin **731** to restrict downward movement thereof.

The outer surface of the movable clamp and cutter blade **732** is frictionally engaged by a stationary or fixed cutter blade **735** slidably mounted on the shoulder screw **730** and being urged inwardly against the movable cutter blade **732**, to, in turn, urge the movable clamp and cutter blade **732** inwardly against the clamping blade **727** by a compression spring **736** encircling the shoulder screw **730**.

It will be noted, in Figure 34, that the inner lower edge of the fixed clamping blade **727** is provided with a notch **737** into which the rubber yarn R is directed as the rubber yarn feed finger **703** moves outwardly relative to the

needle cylinder to inoperative position. The fixed cutter blade 735 is cut away at its inner end, as at 740 in Figure 34, and its lower edge is disposed in a slightly higher plane than that the notch 737 so that, upon upward movement of the free inner end of the movable clamp and cutter blade 732, the movable cutter blade will frictionally engage the outer or proximate surface of the clamping blade 727 to clamp the yarn therebetween and as it continues in its upward movement thereafter, the movable cutter 732 registers with the stationary cutter blade 735 to thus sever the yarn after having clamped the same.

The movable cutter blade 732 is provided with a tail portion 741 which loosely penetrates one end of a link or extension arm 742, most clearly shown in Figure 5. This link 742 extends rearwardly and beyond the vertical plane of the circular bed plate 110 and is then bent inwardly and spirally and then downwardly and is suitably secured, as by rivets 743 (Figure 39), to the upper end of a vertically disposed thrust rod 744. The thrust rod 744 is mounted for vertical sliding movement in the thrust rod guide plates 357 and 365 and its lower end is normally urged into engagement with the upper surface of the main cam drum 121 by a tension spring 745, one end of which is connected intermediate the ends of the vertically disposed rod 744 and the other end of which is connected to the thrust rod guide plate 365.

Referring to Figure 52, it will be observed that the main cam drum 121 has a cam 746 suitably secured thereto which is adapted to engage the lower end of the thrust rod 744 to urge the same upwardly in Figures 39 and 52 causing the extension arm 742 to move toward the observer in Figure 5 and upwardly in Figure 32 to substantially the position shown in Figure 34 for opening the clamping and cutting blade 732 relative to the blades 727 and 735. This will, of course, release the rubber yarn for knitting the rubber top in a stocking substantially of the type shown in Figure 88. It is evident that, upon cam 746 moving out of engagement with the lower end of the thrust rod 744 (Figure 52), the clamping and cutting blade 732 will move from the position shown in Figure 34 to the position shown in Figure 32 for clamping and cutting the rubber yarn as heretofore described.

Referring to Figure 76 the inner end of a third needle lowering cam 750 is shown in dotted lines, this third needle lowering cam normally being disposed out of the path of travel of all of the needles in the needle circle but being adapted to engage the butts of alternate needles which are directed thereto by the jack J in knitting the elastic top of a stocking. This third needle lowering cam 750 is moved into operative position simultaneously with a second movable sinker control cam 751 (Figure 10) the second movable sinker cam 751 operates upon the butts of the sinkers during the knitting of the elastic top in substantially the same manner as that shown and described in said Patent Number 2,420,771 to assist in producing the ribbed effect in the top of the stocking. This cam 751 is not an essential part of the present invention and is merely provided in order to produce the ribbed effect in the tops or welts of stockings being knitted on this machihne. This cam 751 differs from said patent only in the manner in which it is mounted and the operating means therefor.

The sinker cap 107 has a radially extending slot 752 therein (Figure 10) in which a guide bar 753 has radial sliding movement. The second movable sinker cam 751 is secured to the inner end of the guide bar 753 by any suitable means such as screws 754. The guide bar 753 is held in the slot 752 by a plate 755 suitably secured, as by screws 756, to the upper surface of the sinker cap 107 (Figures 10 and 27). The cam 751 is normally urged inwardly, to substantially the position shown in Figure 10, by a tension spring 757, one end of which is connected to the outer end of the guide bar 753 and the inner end of which is connected to the plate 755. The guide bar 753 has an eccentric 760 adjustably secured thereon which serves as a stop for the guide bar 753 and the cam 751 when the guide bar is moved inwardly to the position shown in Figure 10 and the eccentric 760 engages the outer edge of the plate 755.

The guide bar 753 has a notch 761 therein. The upper end of a sinker operating lever 762 (Figures 27 and 28) normally extends through the notch 761 in the guide bar 763 when the sinker cap 107 is in the position shown in Figure 10, it being evident that upon movement of the needle cylinder in a clockwise direction, the sinker cap 107 will move in a clockwise direction until the set screw 688 engages the post 691. This will have moved the guide bar 767 away from the upper portion of the sinker operating lever 762.

Of course, the set screw 688 only moves into engagement with the post 691 in Figure 10 during reciprocatory knitting and the cam 751 remains in substantially the same position shown in Figure 10 during all reciprocatory knitting since it is only employed during the knitting of the elastic top of a stocking.

The sinker operating lever 762 (Figures 27 and 28) is oscillatably mounted, as at 763 on a bracket 764 suitably secured, as by screws 765, to the upper surface of a cap plate 766 secured on the upper surface of a needle lowering cam block 767 in which the stem of the needle lowering cam 750 has radial sliding movement. At least one of the screws 765 serves to secure the needle lowering cam block and its cap plate together as well as securing the needle cam block to the upper surface of the circular bed plate 110. A screw 770 (Figure 27) also assists in securing the plate 766 to the cam block 767 and, in turn, assists in securing the cam block 767 to the circular bed plate 110.

The sinker operating lever 762 is normally urged in a counterclockwise direction in Figure 27 by a tension spring 771 which is connected at one end thereof to the sinker operating lever 762 and is connected at its other end to the bracket 764. Thus, the spring 771 normally urges the lower free end of the operating lever 762 into engagement with a presser member in the form of an adjustment screw 772 threadably mounted on the upper end of an L-shaped bracket 773 and being secured in an adjusted position by a lock nut 774. The bracket 773 extends downwardly and is suitably secured, as by screws 775, to the upper surface of a lever arm 776. The lever arm 776 is oscillatably mounted intermediate its ends, as at 777, on the upper end of a post 780 the lower end of which is threadably embedded in the upper surface of the auxiliary bed plate 196 (Figures 10, 15 and 28).

The rear end of the lever arm 776 engages the outer end of the stem of the tneedle lowering cam 750, the stem being urged against the lever arm 776 by a compression spring 781 mounted in a suitable cavity provided therefor in the cam block 767 (Figure 27). This compression spring 781 normally urges a plunger 782 outwardly. The plunger 782 is mounted for silding movement in the cavity in which the spring 781 is mounted and extends outwardly from the cam block 767 and engages a downwardly projecting portion 783 at the free end of the stem of the needle lowering cam 750.

Referring to Figures 6, 10 and 15, it will be observed that the front left-hand corner of the auxiliary bed plate 196 is provided with a notch 784 through which a bell crank 785 extends and the upper portion of this bell crank 785 in Figure 6 engages the outer or front end of the lever arm 776. The bell crank 785 is oscillatably mounted, as at 786, on an angle clip 787 suitably secured, as by a screw 790 (Figure 10), to the upper surface of the auxiliary bed plate 196. The bell crank 785 has the upper end of a link 791 suitably connected thereto, as at 792 and this link 791 extends downwardly in Figures 1, 6 and 72 and is pivotally connected at its lower end, as at 793, to the front free end of a control arm 794 (Figure 72) which extends rearwardly and is pivotally

mounted on a shaft **795** (Figures 3 and 4) fixedly secured at one end thereof in the standard portion **102***a* of the upper cast frame **102**.

The control arm **794** has an upwardly projecting follower portion **796** integral therewith which is adapted to normally engage the periphery of a second needle cam control pattern drum **797**. This second needle cam control pattern drum **797** may also be termed a second or lower auxiliary pattern drum. The second needle cam control pattern drum **797** has a cam **800** thereon which, upon engaging the follower portion **796** of the control arm **794**, will cause the same to move downwardly against the resistance of the compression spring **781** in the cam block **767** (Figure 27) and this will, of course, cause the third needle lowering cam **750** to move into operative position.

Now, upon the third needle lowering cam **750** being moved into operative position to where it will be engaged by the butts of the alternate needles, it will be observed that the screw **772** in Figure 27 will move from right to left and will cause partial clockwise movement to be transmitted to the sinker operating lever **762**. Inasmuch as the needle cylinder revolves in a counterclockwise direction at the time the third needle lowering cam **750** is moved into operative position, movement of the sinker operating lever **762** will cause the guide bar **753** to move outwardly with respect to the needle cylinder and to thus enter the normal path of travel of the butts of the sinkers as they move thereby with the result that the sinkers moving past the cam **751**, during the knitting of the rubber top will be moved outwardly with respect to the needles simultaneously with the alternate needles being lowered, so the elastic or rubber yarn is caught only in the hooks of the needles, which have been elevated by the jack cams, and then moved downwardly by the needle lowering cam **750**. All of the needles traveling pathway P-1 in Figure 76 are lowered, by a second lowering switch cam **887** during the knitting of the rubber top, so that alternate needles may be raised by the jacks J to catch the rubber yarn.

When the sinkers are moved inwardly to catch the elastic or rubber strand below the nibs of the sinkers while the needles are raised upwardly to their highest point thus placing the elastic strand below the latches of those needles of which it is deposited in front of and in back of the other needles and then the conventional body yarns are fed to the needles at a point immediately following the point at which the rubber yarn is admitted to the needles.

This operation with respect to the cam **751** is identical to that of my Patent No. 2,420,771 of May 20, 1947, and is more clearly described therein, it being sufficient to state that this will provide a ribbed effect in the rubber top of the stocking as heretofore stated. The cams **750** and **751** do not, necessarily, constitute a part of the present invention since they are claimed in my Patent No. 2,420,771 and are merely shown in the drawings to illustrate a manner of mounting the same for this particular type of machine since the machine shown in said last-named patent is of substantially the type shown in said Patent No. 1,152,850.

The second needle cam control pattern drum **797** has a gear **801** integral therewith which is fixedly mounted on the shaft **161** (Figure 9) heretofore described. This gear **801** and the second needle cam control pattern drum **797** are driven in the identical manner of that shown in said co-pending application to complete a revolution simultaneously at the same rate of rotation as the main pattern drum **121**. Since the main pattern drum **121** and the gear **801** (Figure 9) are both driven in a manner identical to said co-pending application, a further description thereof is deemed unnecessary. The second needle cam control pattern drum **797** is also instrumental in controlling operation of a first elevating switch cam and a right-hand widening pick feed cam shown in the right-hand portion of Figure 76, which will be later described when a description is given relating to the various needle cams.

Widening picks and widening pick feed cams

Referring to Figure 71, the second needle cam control pattern drum **797** is shown schematically and a plurality of cams **802** to **805** are shown suitably secured thereon. These cams **802** to **805**, inclusive, are adapted to successively engage a follower portion **806** integral with a control arm **807** which is also pivotally mounted on the shaft **795** at its rear end and its front end having the lower end of a connecting rod or link **810** pivotally connected thereto as at **811** in Figure 71. The link **810** is adjustable as to overall length and extends upwardly and is pivotally connected at its upper end to the free end of an arm **812** of a primary bell crank broadly designated at **813** (Figure 26).

The bell crank **813** is oscillatably mounted, as at **814** on an angle clip **815** suitably secured to and depending from the lower surface of the auxiliary bed plate **196**. The bell crank **813** also has an elongated substantially vertically upstanding arm **816** integral therewith, intermediate the ends of which a secondary or auxiliary bell crank **817** is oscillatably mounted as at **820**. The auxiliary bell crank **817** has a substantially horizontally disposed arm **821** integral therewith to which the upper end of a tension spring **822** is connected. This tension spring **822** extends downwardly and is connected to a suitable anchor **823** suitably secured to and depending from the arm **812** of the primary bell crank **813**. The tension spring **822** normally urges a second arm **824** of the bell crank **817** into engagement with the outer edge of the stem of a right-hand widening pick feed cam **825** mounted for radial sliding movement relative to the needle cylinder in a right-hand widening pick feed cam block **826** suitably secured, as by screws **827**, to the upper surface of the circular bed plate **110**.

The tension spring **822** (Figure 26) also normally urges the arm **821** of the bell crank **817** into engagement with a stop pin **830** projecting from the arm **816** of the primary bell crank **813**. The right-hand widening pick feed cam **825** is held in sliding engagement with the block **826** by a cap or cover plate **831** secured to the upper surface of the block **826** by any suitable means such as screws **832**. The plate **831** has a slot **833** therethrough which is slidably penetrated by a stop pin **834** projecting upwardly from the upper surface of the right-hand widening pick feed cam **825**.

Opposed walls of the slot **833** in the plate **832** restrict inward and outward movement of the right-hand widening pick feed cam **825** as they are engaged by the pin **834**. The right-hand widening pick feed cam **825** is normally urged outwardly by a spring loaded plunger **835** mounted for sliding movement in the block **826** and being normally urged outwardly by a compression spring **836** mounted in a suitable cavity provided therefor in the block **826**. The outer end of the spring loaded plunger **835** engages a projection **837** depending from the lower surface of the stem of the right-hand widening pick feed cam **825** at its outer end. The right-hand widening pick feed cam **825** has an angle clip **840** suitably secured thereto and extending upwardly therefrom and this angle clip **840** is adapted to be resiliently engaged by one of a pair of L-shaped dogs **841** and **842** (Figure 5) oscillatably mounted on opposed ends of a substantially V-shaped feed cam actuating arm **843**.

The inner ends of the L-shaped dogs **841** and **842** are normally urged inwardly by tension springs **844** and **845**, respectively (Figure 5), the inner ends of the springs being connected to a plate **846** fixedly mounted on the upper surface of the feed cam actuating arm **843** as by screws **847**. These screws **847** slidably penetrate a plate **846** and the actuating arm **843** and are threadably embedded in a block **850** fixedly mounted on the upper end of a post **851**. The manner in which the post is mounted and also

the manner in which oscillation is imparted thereto will be later described.

A first elevating switch cam 852 is also mounted for radial sliding movement relative to the needle cylinder 103 in the cam block 826 (Figures 24 and 25) and is held in engagement with the block 826 by a suitable plate 853 secured on the block 826 by any suitable means such as screws 854. The outer end of the stem of the first elevating switch cam 852 has a bunter 855 suitably secured thereto and depending therefrom which is engaged by an adjustment screw 856 and the upper end of an arm 858 of a bell crank broadly designated at 860. The screw 856 is mounted in a crank arm 857, to be later described, which is controlled by the first needle cam control pattern drum 191 (Figures 5 and 5–A).

The bell crank 860 is oscillatably mounted, as at 861 on a bracket 862 suitably secured, as by screws 863, to the lower surface of the circular bed plate 110. The bell crank 860 has an arm 864 integral therewith to which the upper end of a substantially vertically disposed link 865 is pivotally connected (Figure 25). The link 865 (Figure 1) extends downwardly and is adjustable as to length in the manner of the link 810. The lower end of the link 865 is pivotally connected to the free end of a control arm 866 (Figure 63) which extends rearwardly and is also pivotally mounted on the shaft 795 (Figure 4). The control arm 866 has a reading projection or follower portion 867 integral therewith, and extending upwardly therefrom, which is normally urged toward the periphery of the second needle cam control pattern drum 797 (Figure 63) by a compression spring 870 mounted in a suitable cavity provided therefor in the cam block 826 (Figure 25). This compression spring 870 urges a spring pressed plunger 871 outwardly into engagement with the bunter 855 at the outer end of the stem of the first elevating switch cam 852.

In Figure 63 it will be observed that the second needle cam control pattern drum 797 has a pair of spaced cams 872 and 873 suitably secured thereon which are adapted to successively move into engagement with the follower portion 867 integral with the control arm 866 so as to transmit counter-clockwise movement to the bell crank 860, in Figure 25, to thus move the first elevating switch cam 852 into operative position. The adjustment screw 856 in Figure 25 is associated with means responsive to cams on the first needle cam control pattern drum and is adapted to move the first elevating switch cam 852 into operative position at times when there are no cams on the second needle cam control pattern drum disposed in engagement with the follower portion 867 of the control arm 866 in Figure 63 and the intervening connections betwen the adjustment screw 856 in Figure 25 and the first needle cam control pattern drum 191 will be later described.

Referring to Figure 5, is will be observed that the outer end of the L-shaped dog 842 is adapted to intermittently engage an angle clip 874 suitably secured adjacent the outer end of the stem of a left-hand widening pick feed cam 875 (Figures 35, 36 and 76). The left-hand widening pick feed cam 875 is mounted for radial sliding movement in a left-hand feed cam block 876 suitably secured, as by screws 877, to the upper surface of the circular bed plate 110. The upper surface of the cam block 876, which is cut at an angle, has a plate 880 suitably secured thereto, as by screws 881 (Figure 36) and this plate 880 confines the stem of the left-hand widening pick feed cam 875 in the block 876. The plate 880 has a slot 882 therein in which a stop pin 883 projecting upwardly from the upper surface of the stem of the left-hand widening pick 875 has sliding movement.

The inner and outer walls of the slot 882 relative to the needle cylinder restrict radial movement of the left-hand widening pick feed cam 875 in opposite directions. The outer end of the stem of the left-hand widening pick feed cam 875 has a suitable projection or bunter 884 (Figure 35) suitably secured thereto and depending therefrom, the inner surface of which is engaged by a spring loaded plunger 885 which is normally urged outwardly with respect to the block 876 by a compression spring 886 mounted in a suitable cavity provided therefor in the cam block 876.

A second lowering switch cam 887 is also mounted for radial sliding movement in the cam block 876 and is normally urged inwardly to operative position by a tension spring 890 which loosely penetrates the cam block 876 (Figure 36) and is connected, as at 891, to the cam block 876 at one end thereof, its outer end being connected to a bunter block 892 suitably secured to and depending from the lower surface of the stem of the second lowering switch cam 887 adjacent the outer end of the stem thereof. This bunter block 892 associated with the second lowering switch cam 887 is clearly shown in the central left-hand portion of Figure 6 and inward and outward movement of the second lowering switch cam 887 is alternately controlled, at times, by suitable cams on the first needle cam control pattern drum and is controlled at other times by suitable cams on the main cam drum and intervening connections. The cams and intervening connections for controlling the second lowering switch cam 887 will be later described.

Widening picks per se

It will be observed in Figure 76 that at times when the right-hand widening pick feed cam 825 is in operative position and during counter-clockwise movement of the needle cylinder, this will direct the butts of certain of the needles downwardly to a pair of first and second right-hand widening picks 893 and 894 respectively. Upon the left-hand widening pick feed cam 875 being moved to operative position and during clockwise movement of the needle cylinder, this cam 875 will direct the butts of certain needles downwardly to engage a pair of first and second left-hand widening picks 895 and 896 respectively.

It might be stated that the said co-pending application includes but a single right-hand widening and a single left-hand widening pick each of which is adapted to engage the butts of and direct two needles downwardly. In the present instance, each of the right-hand widening picks 893 and 894 direct two of the needles downwardly during the knitting of each course of the needle cylinder as the needles move from right to left in Figure 76 and, similarly, the first and second left-hand widening pick 895 and 896 also each direct two of the needles downwardly upon the butts thereof being directed thereto. This will be more fully described when a description is given as to the operation of the machine.

Figures 86 and 87 clearly show the manner in which the set of right-hand widening picks 893 and 894 are mounted for oscillation on vertical axes as well as being mounted for up and down movement relative to the needle cylinder and, since both the right-hand and left-hand set of widening picks 893 and 894 and 895 and 896, respectively, are mounted in an identical manner, except being opposite hand, only a detailed description will be given as to the manner in which the set of right-hand widening picks 893 and 894 are mounted and the same reference characters shall apply to like parts associated with both sets of widening picks 893 to 896, inclusive.

The first and second right-hand widening picks 893 and 894 are universally mounted on a block 897 (Figures 15, 86 and 87) suitably secured, as by screws 900 (Figure 15) to the circular bed plate 110, the circular bed plate 110 being omitted in Figure 86 for purposes of clarity.

The universal mounting for each of the widening picks 893 and 894 includes a vertically disposed shaft (Figure 87) 901 mounted for vertical sliding movement in an outwardly projecting ear 902 of the block 897. The upper end of this shaft 901 has an enlarged portion 903 integral therewith which is suitably slotted for slidable reception

of a medial portion of the respective widening picks 893 and 894 and each of the respective widening picks is oscillatably mounted, as at 904, in the slot provided therefor in the respective enlarged portion 903 of the shaft 901.

The lower end of the shaft 901 also has vertical sliding movement in an ear 905 integral with the block 897, there being a space provided between the ears 902 and 905 for a suitable spring anchor, such as a cotter pin 906, to which the lower end of a tension spring 907 is connected. The upper end of the spring 907 is connected intermediate the ends of the corresponding widening picks 893 and 894 at a point between the outer ends thereof and the universal mounting therefor. It will be observed in Figures 15 and 86 that each of the widening picks 893 to 896 is provided with an outwardly projecting tail portion 910, the tail portions 910 of the widening picks 895 and 896 being directed outwardly in an opposite direction to that of the tail portions associated with the widening picks 893 and 894. The tension springs 907 normally urge the outer portions of the respective widening picks 893 to 896 against the upper edges of cam plates 911, there being one of the cam plates 911 associated with each pair of widening picks so as to cause the working ends of the pair of widening picks 893 to 896 to move downwardly as they are directed outwardly by virtue of the needle butts directed thereto by the respective widening pick feed cams 825 and 875.

Now, the widening picks 893 and 895 operate in co-acting relation to each other as do the widening picks 894 and 896, this co-acting relationship between the widening picks 893 and 895 and 894 and 896 being substantially the same as that of said co-pending application.

In Figures 5, 6 and 29, there is shown first and second widening pick swing arms 912 and 913, respectively, which are oscillatably mounted on a centrally located and vertically disposed post 914 which threadably penetrates an angle clip 915 and is secured therein by a lock nut 916 threadably mounted on the lower end thereof. The angle clip 915 is suitably secured, as by screws 917, to the front surface of the post 691. Spacer or bearing plates 920 to 921 are provided (Figure 29) the plate 920 being disposed between the first and second swing arms 912 and 913 and the first swing arm 912 having rotational sliding movement against the upper surface of the plate 921.

The plates 920 and 921 are slidably penetrated by the post 914 and the swing arms 912 and 913 are oscillatably mounted on the post 914.

The swing arms 912 and 913 and the plates 920 and 921 are resiliently urged into engagement with one another and with the upper surface of the angle clip 915 by a compression spring 922 encircling a reduced portion 923 of a collar 924 against which bears the upper end of the compression spring 922. The collar is fixedly mounted on the post 914.

The purpose of the compression spring 922 is to prevent movement of the swing arms 912 and 913 unintentionally. The outer ends of the first and second widening pick swing arms 912 and 913 are bent downwardly, as is clearly shown in Figure 6, and the downwardly bent ends of the first widening pick swing arm 912 engage the proximate surfaces of the tails of the first right-hand and left-hand widening picks 893 and 895 respectively (Figure 15). The down-turned portions of the second or upper widening pick swing arm 913 engage the proximate surfaces of the tails of the second right-hand and the left-hand widening picks 894 and 896 and it is thus seen that, upon movement of the needle cylinder 103 in a counter-clockwise direction in Figures 5 and 15, the first and second right-hand widening picks 893 and 894 would swing outwardly to substantially the position shown in Figure 15.

This results in the swing arms 912 and 913 swinging in a clockwise direction in Figure 5 against the tail portions of the corresponding widening picks 895 and 896 which would thus cause them to be moved into operative position so that upon movement of the needle cylinder 103 in a clockwise direction, the widening picks 895 and 896 would be in operative position and would, upon being engaged by the butts of the needles, cause the right-hand widening picks 893 and 894 to be moved into operating position and so on throughout reciprocatory knitting.

Control means for widening pick feed cams during reciprocatory knitting

It has already been stated how the feed cam actuating arm 843 is fixed on the block 850 which is, in turn, fixedly mounted on the upper of the post 851 (Figures 5, 15 and 29). The post 851 is mounted for oscillation in a bearing member 925 suitably secured, as by screws 926 (Figure 15), to the front edge of the circular bed plate 110. Suitable collars 927 and 928 are adjustably secured on the upper and lower portions of the shaft or post 851 so as to prevent endwise movement of the post 851 in the bearing member 925.

It will be observed, in Figures 1, 6 and 29, that the shaft or post 851 extends downwardly beyond the bearing member 925 and has one end of a link 931 fixedly secured thereto. This link 931 extends rearwardly and is pivotally connected, as at 932, to the left-hand end of a link 933 (Figure 6). The link 933 extends outwardly toward the auxiliary bed plate 196 and is pivotally connected, as at 934, to a vertically disposed switch arm or switch bar 935 through the medium of an angle clip 936, the angle clip 936 being suitably secured, as by screws 937 (Figure 17), to the front surface of the switch arm 935. The lower end of the switch arm 935 is universally connected, as at 940 to a bar 941 suitably secured to the standard 102*a* of the upper cast frame 102.

The lower end of the switch bar 935 is universally mounted so the upper end thereof may move in a forward and rearward direction as well as inwardly and outwardly with respect to the knitting machine frame. The switch arm 935 has a follower portion 942 integral therewith (Figure 17), the upper and lower ends of which are beveled or cut at an angle so as to lead the follower key portion 942 of the switch arm 935 to opposed sides of a substantially annular cam member 943 projecting from a widening pick cam ring 944 which is fixedly secured on and surrounds the periphery of a shogging disk.

The shogging disk 945, the cam ring 944 and other associated parts shown in Figure 17 are substantially the same as those shown in said co-pending application. The shogging disk will be later described in detail. The cam portion 943 (Figure 17) integral with the widening pick cam ring 944 is cut away, as at 946, to thus provide a space between the opposed ends of the cam portion 943, which is substantially larger than the vertical length of the follower key portion 942 on the switch bar 935 (Figure 17). The opening 946 between the opposed ends of the cam portion 943 of the cam ring 944 is shown in Figure 42 in alinement with the follower key portion 942 and it will be observed that the follower key portion 942 is disposed in central alinement with the cam portion 943 and opposed ends of the cam portion 943 are beveled in accordance with the oppositely beveled upper and lower ends of the follower key portion 942.

Now, owing to the fact that the compression springs 836 and 886 (Figures 25 and 35) normally urge the respective widening pick feed cams 825 and 875 outwardly, the follower key portion 942 on the bar 935 is alternately urged in opposite directions and is thus caused to alternately bear against opposed surfaces of the cam member 943 on the cam ring 944, since the angle clips 840 and 874 on the respective cams 825 and 875 alternately bear against the dogs 841 and 842. It is thus seen that the follower key 942 is urged to a point centrally of the opening 946, as shown in Figure 42, and the beveled ends

of the key 942 will lead the key to opposite sides of the cam member 943 as it reciprocates past the key 942.

The key portion 942 of the switch arm 935 is held out of engagement with the cam ring 944 by pattern controlled means to be presently described during shogging of the needle cylinder and during rotary knitting, that is, during continuous rotation of the shaft 153. During reciprocatory knitting, the follower key 942 on the bar 935 is held against the periphery of the cam ring 944 by a tension spring 947 which is clearly shown in Figure 3.

It is thus seen that as long as the key portion 942 of the switch bar 935 remains in engagement with the cam ring 944 and during reciprocatory motion of the shaft 153, oscillation will be transmitted through the links 933 and 931 (Figure 6) to the shaft 851 which will, in turn, cause oscillatory motion to be transmitted to the substantially V-shaped feed cam actuating arm 843 in Figure 5.

The dogs 841 and 842 are provided as a safety feature, the tension in the springs 844 and 845 being substantially greater than the pressure of the springs 836 and 886, respectively (Figures 5, 26 and 35) so the outer ends of the L-shaped dogs 841 and 842 will cause the respective cams 825 and 875 to be moved into the path of the butts of certain needles in the needle cylinder in alternate relation to each other. The purpose of the L-shaped dogs 841 and 842 is to permit either of the cams 825 and 875 to move outwardly independently of each other in the event that some of the butts of the needles may not be properly positioned or in the event that some type of foreign matter may become lodged between the inner ends of the cams 825 and 875 and the outer surface of the needle cylinder 103.

Although the cam ring 944 (Figures 16 and 17) is mounted in the identical manner of said co-pending application and causes alternate movement of the widening pick feed cams 825 and 875 into and out of operating position in substantially the same manner as that shown in said co-pending application, the number of times that the widening pick feed cams 825 and 875 are thrown into operation during the knitting of a stocking is greater in the present application than in said co-pending application and, therefore, the operation as to movement of the switch arm 935 to cause its key portion 942 to move into and out of engagement with the cam ring 944 is controlled by an individual pattern means to be presently described (Figures 3, 7 and 9).

The present control means for moving the widening pick feed cams 825 and 875 into alternate operation includes a third auxiliary pattern drum 950 which may also be referred to as a widening pick feed cam pattern drum or wheel. Referring to Figure 3, it will be observed that the pattern wheel 950 has a plurality of closely spaced circularly arranged cams 951 suitably secured to the periphery thereof and all of which are identical. These cams 951 are provided for alternately moving the follower key 942 (Figure 17) into and out of engagement with the periphery of the cam ring 944. This pattern wheel 950 is driven intermittently in a step-by-step manner according to the desired pattern and is controlled as to its intermittent movement by the lugs 165 heretofore described as being provided on the conventional pattern chain 163 (Figures 7 and 16) and through intervening connections.

The intervening connections between the pattern wheel 950 and the lugs 165 on the pattern chain 163 include a ratchet wheel 952 (Figure 7) which is integral with the pattern wheel 950. The pattern wheel 950, along with the ratchet wheel 952, is rotatably mounted on the left-hand end of the shaft 161 in Figure 7. There are two teeth in the ratchet wheel 952 for each of the cams 951 on the cam wheel 950 for purposes to be later described. In order to prevent free rotation of the pattern wheel 950 and the ratchet wheel 952 on the shaft 161, there is provided a suitable friction means in the form of a leaf spring member 953 suitably secured, as by screws 954, to the left-hand edge of the base 100 of the machine. This leaf spring member 953 extends upwardly, in Figure 7, and has a friction member 955 adhesively secured thereto which is urged against the outer surface of the pattern wheel 950 by the leaf spring member 953.

A ratchet pawl 956, pivotally mounted adjacent the upper end of a pawl carrying arm 957, is normally urged into engagement with the sprocket wheel 952 by a tension spring 960 (Figure 7). The upper end of the tension spring 960 is connected intermediate the ends of the pawl 956 and the lower end thereof is connected intermediate the ends of the pawl carrying arm 957.

Referring to Figure 9, it will be observed that the upper end of the pawl carrying arm 957 has a hook portion 961 integral therewith which normally engages a latch 962. The latch 962 is in the form of a bell crank and has an upwardly extending arm 963 integral therewith, the latch 962 being oscillatably mounted, as at 964 (Figures 7 and 9), on an angle clip 965 suitably secured, as by screws 966, to the front face of the bar 941. The arm 963 of the latch 962 has detent lever 967 oscillatably mounted thereon, as at 970.

The detent lever 967 is normally urged into engagement with a stop pin 971, projecting from the arm 963, by a tension spring 972 conneted at its upper end to the upper end of the detent lever 967 and being connected at its lower end to the arm 963. The detent lever has a rounded lower end and is provided with a notch 973 at its outer edge adjacent the lower rounded end thereof. The purpose of the notch and the rounded lower end of the detent lever 967 will be later described.

The latch arm 962 is normally urged into engagement with the hook portion 961 of the pawl carrying arm 957 by a tension spring 974 (Figures 7 and 9) which is connected at its upper end to the outer end of the latch 962 and is connected at its lower end intermediate the ends of the pawl carrying arm 957. The lower end of the pawl carrying arm 957 is fixedly mounted on one end of a shaft 975 oscillatably mounted in a bearing bracket 976 which extends downwardly and is suitably secured, as by screws 977, to the front face of the base frame 100. It will be observed that the pattern wheel 950 is disposed closely adjacent the second needle cam control pattern drum 797 and the bearing bracket 976 also serves as a guide member for the actuating arms or levers 794, 807 and 866, these arms being shown in cross-section in Figure 7.

One end of a bar 980 (Figure 9) is fixedly mounted on the end of the shaft 975 adjacent the pattern chain 163 and has a bunter 981 suitably secured thereto, as by screws 981*a*, and the free end of this bunter 981 is disposed in the same vertical plane as the quadrant 184. The bunter is normally urged upwardly at its right-hand end in Figure 9 by a tension spring 982, the lower end of which is connected to one of the screws 981*a* and the upper end of which is connected to a follower stud 983 (Figure 7) which suitably penetrates a follower stud arm 984 and is secured therein by a nut 985. This follower stud 983 is disposed in the same vertical plane as the lugs 165 on the pattern chain 163 and is urged into engagement therewith by the tension spring 982.

It is thus seen that the tension spring 982 normally urges the follower stud 983 and the bunter 981 toward each other. The tension spring 982, in urging the bunter 981 upwardly, also urges the hook portion 961 of the pawl carrying 957 outwardly in the event of the latch arm 962 being moved upwardly at its free end and out of engagement with the hook portion 961 at the pawl carrying arm 957. Movement of the pawl carrying arm 957 and the bunter 981 in a counter-clockwise direction in Figure 9 is limited by the medial portion of the bunter 981 engaging a fixed spacing collar 166 on which the pattern chain 163 is mounted.

The follower stud arm 984 extends to the left and then inwardly, as shown in Figures 7 and 16, and is welded or otherwise secured to a hub member 986 to which the rear end of a latch lifting arm 987 is also suit-

ably secured as by welding. The latch lifting arm 987 extends forwardly and is then bent outwardly and again forwardly and has a pin 990 fixedly mounted therein, as by a pressed fit, which engages the rounded lower end of the detent lever 967.

Now, in operation, upon one of the lugs 165 on the pattern chain 163 moving into engagement with the follower stud 983, to thus move the follower stud arm 984 in a clockwise direction in Figure 9, the latch lifting arm 987 is also moved in a partial revolution in a clockwise direction then, in so doing, the pin 990 causes the detent lever 967 along with the latch 962 to move upwardly.

Now, as the detent lever 967 moves upwardly it also moves to the right in Figure 9 permitting the pin 990 to move past the notch 973 in its upward movement and simultaneously releasing the latch 962 to permit the same to move downwardly against the upper end of the pawl carrying arm 957. However the pawl carrying arm 957 will have moved outwardly substantially beyond the position shown in Figure 9 relative to the machine frame due to the tension spring 982. This will have caused the bunter 981 to move upwardly, assuming the quadrant 184 to be elevated substantially above the position shown in Figure 9. Upon the quadrant 184 moving in a counter-clockwise direction in Figure 9, the quadrant will cause the bunter 981 and the pawl carrying arm 957 to move in a clockwise direction to thus cause the ratchet pawl 956 to engage one of the teeth in the ratchet wheel 952 (Figure 7) to thus rack the same one tooth.

Upon the ratchet pawl 956 having racked the ratchet wheel 952 one tooth, the latch 962 will again engage the hook 961 to prevent the ratchet pawl 956 from again moving in a counter-clockwise direction until another of the lugs 165 moves into engagement with the follower stud 983 to repeat the operation as heretofore described.

Now, as the particular lug which had been in engagement with the follower stud 983 moves out of engagement with the same, the pin 990 may again move downwardly due to the tension spring 982, and will partially rotate the detent lever 967 in a counter-clockwise direction in Figure 9 as it moves past the same to again assume the position shown in Figure 9. The purpose of the detent lever 967 is to permit sudden release of the latch 962, following the lifting of the latch 962 out of engagement with the hook portion 961 of the pawl carrying arm 957, to insure that the latch 962 will again be in a position for engaging the hook 961 upon movement of the ratchet pawl racking the ratchet wheel 952 the equivalent of one tooth.

It might be stated that there are two teeth in the ratchet wheel for each of the cams 951 so that upon racking the ratchet wheel 952 the pattern wheel 950 will rotate the equivalent of half the length of one of its cams 951 and, assuming a follower portion 991 of a control finger 992 to have been disposed between the proximate edges of two adjacent cams 951, the succeeding cam 951 will then remain in engagement with the follower portion 991 of the control finger 992 until a succeeding step is imparted to the ratchet wheel 952 and the pattern wheel 950, in the manner heretofore described, at which time the follower portion 991 will again move into position between the preceding and succeeding cams 951 on the pattern wheel 950.

When any one of the cams 951 is in engagement with the control finger 992, the control finger assumes the position shown in Figure 3 and the control finger 992, which is in the form of a bell crank and is oscillatably mounted, as at 993 on the outer end of the bar 941, will have moved in a clockwise direction in Figure 3. Now, the control finger 992 has an inwardly projecting gear 994 integral therewith (Figure 7) which, upon clockwise movement of the control finger 992 in Figure 3, will move toward the observer in Figure 7 to thus move the switch bar 935 forwardly and move the key portion 942 of the switch bar 935 out of engagement with the cam ring 944 (Figure 17).

It is evident that, upon the follower portion 991 (Figure 3) moving into position between adjacent cams 951 on the cam wheel 950, the control finger 992 will move in a counter-clockwise direction in Figure 3 to thus permit the follower portion 942 of the switch bar 935 to again move into engagement with the cam ring 944 for alternately moving the right-hand and left-hand widening pick feed cams 825 and 875, respectively, into and out of operative position.

Arrangement of the needle butts and means for shogging the needle cylinder

Of particular importance to the present invention is the means for shogging the needle cylinder to cause a certain group representing a portion of the needles in the needle circle to move equidistant past the knitting station in knitting a first portion of a stocking during reciprocatory knitting and then shogging the needle cylinder so as to cause either the opposite group of needles in the needle circle to move equidistant past the knitting station during reciprocatory knitting or to cause another group of needles, including some of the needles in the first group along with additional needles from the second group, to move equidistant past the knitting station in order to produce triangular or rectilinear areas in knitted fabric wherein the juncture of adjacent areas, which shall be hereinafter referred to as the suture, may extend at an angle relative to the wales and courses being knitted.

The term "knitting station" is used herein to designate a point substantially midway between the stitch cams 1056 and 1057 (Figures 76 to 84, inclusive) to be later described. The lowermost edge of each stitch cam 1056 and 1057 defines a knitting point.

The shogging means of the present invention is identical to that of said co-pending application. However, the butts of the needles in the needle circle are arranged differently from those of said co-pending application, as will be presently described, and the cooperating relationship between the particular arrangement of the needles in the present invention and the shogging means includes a particular important feature of the present invention.

Therefore, a description of the arrangement of the needle butts will now be given following which a description of the shogging means for the cylinder will be given, the description of the shogging means being deemed necessary although the shogging means is identical to that of said co-pending application.

Referring to Figure 76, a typical one of the needles is shown in elevation and the upper ends of a plurality of the needles are shown adjacent the developed inner surface of the latch ring 106. The needles shall be generally designated at N and, referring to Figures 44 and 45, there is shown the arrangement of the butts of the needles, the needles in the needle circle being generally arranged into four groups, namely, A, B, C, D. Each of the groups of needles includes a pair of long butt needles and substantially half of the remaining needles in each group are medium butt needles as to length and the remaining substantial half of the needles in each group have butts shorter than the medium butt needles and shall be hereinafter referred to as short butt needles.

For purposes of clarity, the needles having the different lengths of butts in the various groups shall be identified separately. In other words, the two long butt needles in group A shall be indicated at ANL, the long butt needles in group B being designated at BNL, the long butt needles in group C being indicated at CNL and the long butt needles in group D being indicated at DNL. The medium butt needles in group A are indicated at ANM, the medium butt needles in group B being indicated at BNM, the medium butt needles in group C being indicated at CNM, and the medium butt needles in group D being

indicated at DNM. The short butt needles in group A are indicated at ANS, the short butt needles in group B being indicated at BNS, the short butt needles in group C being indicated at CNS, and the short butt needles in group D being indicated at DNS.

This machine is shown as having 108 needles, it being understood that any number of needles could be employed and, in practice it has been found that in order to properly aline the points of adjacent triangularly-shaped areas which are disposed one above the other, it is preferably that there be 14 short butt needles in each of the groups B and D and 16 short butt needles in each of the groups A and C. It is also preferable that there be 10 medium butt needles in each of the groups A, B, C and D as shown in Figures 44 and 45. The purpose of the various lengths of butts on the needles and the particular manner of arrangement thereof as shown in Figures 44 and 45 will be later described.

It has already been stated how the beveled gear **187** in Figures 7 and 16 is engaged by a beveled gear **188** associated with the needle cylinder **103** for transmitting rotation thereto from the shaft **153**. However, since the beveled gear is rotatably mounted on the shaft **153**, shogging clutch means, of which the shogging disk **945** is a part, is provided for locking the beveled gear **187** with respect to the shaft **153** and varying radial positions to, at times, produce a shogging effect in the needle cylinder **103** during the forming of a suture between two adjacent areas knitted of a different yarn in a stocking.

For example, after a triangular portion or gusset G–1, such as shown in Figure 89 has been knitted at one side of a stocking of the type shown in Figures 88 and 89, the next step is to knit the triangular portion G–2. Obviously, it is knitted on the opposite half of the needles from which the gusset at the opposite side of the stocking will have been knitted.

The clutch mechanism, to be presently described, becomes operative between the knitting of the gusset G–1 and the knitting of the gusset G–2 in Figure 88 to rotate the needle cylinder approximately one and a half revolutions to cause the cylinder to be so disposed that knitting can then be commenced at the opposite side of the needle cylinder from that which the previous knitting had occurred.

Referring to Figures 7, 16 and 17, there is shown a locking disk **1000**, which is also a part of the shogging mechanism, against which the shogging disk **945** is adapted to, at times, have sliding rotational movement. At other times, the shogging disk **945** is locked in fixed relation to the locking disk **1000** in a manner to be presently described.

The locking disk **1000** is suitably secured, as by screws **1000***a*, to the left-hand or outer face of the beveled gear **187** (Figures 7 and 16). The diameter of this disk **1000** is substantially less than the diameter of the beveled gear **187**.

The locking disk **1000** is provided with spaced notches **1001** to **1004**, inclusive, about its periphery, the notches **1001** and **1002** being disposed diametrically opposite from each other and the notches **1003** and **1004** also being disposed diametrically opposite each other but transversely of the notches **1001** and **1002** for purposes to be later described. The locking disk **1000** is provided with lead-in slots **1006**, there being one of these slots associated with each of the notches **1001** to **1004** inclusive.

Referring to Figure 16, it will be observed that the shogging disk **945** is of substantially the same diameter as the locking disk **1000** and is fixedly mounted on the left-hand end of the shaft **153** by any suitable means such as a screw **1007** and a key **1008**. The shogging disk **945** has a notch **1011** cut in its periphery in which a portion of a locking finger or latch **1012** has radial sliding movement. This locking finger **1012** is oscillatably mounted, as at **1013**, in the slot **1011** of the shogging disk **945** and has a tail portion **1015** integral therewith which projects inwardly and the inner free end of which is engaged by a spring-pressed pin **1016** slidably mounted in a cavity **1017** in the end of the shaft **153**.

In order to produce a shogging effect between the shogging disk **945** and the locking disk **1000** of the shogging clutch, which will, in turn, be transmitted to the needle cylinder **103**, automatic pattern controlled means are provided, to be presently described, for disengaging the locking finger **1012** from engagement with any one of the notches **1001** to **1004**, inclusive, and for causing the locking finger **1012** to be moved into engagement with another of the notches **1001** to **1004**, inclusive.

An adjustment screw **1021** is held against the outer surface of the tail **1015** of the locking finger **1012** by means of cams, to be presently described, on the needle cam control pattern drum **191** and through intervening connections to be presently described. The adjustment screw **1021** is threadably embedded in the free end of a shogging crank arm **1022** (Figure 16). It will be observed, in Figures 7 and 16, that the sock horn **113** has an opening **1023** therein into which the free end of the crank arm **1022** projects and, in order to prevent the free end of the arm **1022** from interfering with the sock being knitted and extending within the sock horn **113**, a suitable shield plate **1024** is suitably secured to the inner wall of the sock horn **113**.

The crank arm **1022** extends rearwardly and is then bent to the right in order to miss the thrust rods projecting through the thrust rod guide bar **365**, as is clearly shown in Figure 16, and the rearmost end of the crank arm **1022** is fixedly mounted on the lower end of a vertically disposed shaft **1025** which is oscillatably mounted in the tubular bearing bracket **721** (Figures 4, 16 and 39) which has an inwardly projecting portion **1027** integral therewith and disposed intermediate the upper and lower ends thereof, this portion **1027** being suitably secured, as by screws **1028** (Figures 5 and 5–A), to the upper surface of the auxiliary bed plate **196**.

Fixedly mounted on the upper end of the vertically disposed shaft **1025**, and in sliding rotational engagement with the upper end of the tubular bracket **721**, is one end of a shogging clutch control finger **1030** (Figures 4, 5–A and 70) the reading end of which is urged against the periphery of the first needle cam control pattern drum **191** by the spring-pressed pin **1016** in Figure 16. The control finger **1030**, at times, engages the periphery of the needle cam control pattern drum **191** adjacent the lower edge thereof, as is clearly shown in Figure 4, and this pattern drum **191** has a plurality of spaced cams **1031** to **1041** suitably secured thereon which are adapted to engage the reading end of the control finger **1030**, successively, so as to produce a shogging effect in the needle cylinder at predetermined periods during the knitting of a stocking.

It is evident that when the shogging clutch control finger **1030** (Figure 70) is out of engagement with the cams **1031** to **1041**, inclusive, the finger **1012** will remain in locked position, that is, the finger **1012** will remain in engagement with any one of the notches **1001** to **1004** (Figure 17) in the locking disk **1000**. Now, upon any one of the cams **1031** to **1041**, inclusive, moving into engagement with the reading end of the shogging clutch control finger **1030** (Figure 70), the control finger **1030** will, of course, move in a counter-clockwise direction causing the shaft **1025** (Figure 16) to move in a like manner.

This will move the tail portion **1015** of the locking finger **1012** inwardly along with the spring-pressed pin **1016**, and will move the locking finger **1012** out of engagement with the notch in the locking disk **1000**. The notches **1001** to **1004** in the locking disk **1000** (Figure 17) always remain in the same position relative to the needles in the needle circle (Figure 44) and, for purposes of clarity, it is to be assumed that the locking finger **1012**

is in engagement with the notch **1001** in the disk **1000** at the time the needles in groups A and B in Figure 44 move equidistant past the knitting station and when the locking finger **1012** is in engagement with the notch **1002** in the locking disk **1000**, the needles in groups C and D move equidistant past the knitting station. When the locking finger **1012** is in engagement with the notch **1003** in the locking disk **1000**, the needles in groups A and D move equidistant past the knitting station and when the locking finger **1012** is in engagement with the notch **1004**, as shown in Figure 17, the needles in groups B and C move equidistant past the knitting station.

As an example of the operation of the shogging clutch, assuming the free end of the control finger **1012** to have been in engagement with the notch **1004**, as shown in Figure 17, upon the finger **1012** being moved out of the notch **1004**, the shaft **153** with the shogging disk **945** will then move one revolution in a counter-clockwise direction in Figure 17. Now, although all of the cams **1031** to **1041** on the needle cam control pattern drum **191** (Figure 48) may be of susbtantially the same length, movement of the auxiliary pattern chain **265** (Figure 2) and the relative position of certain of the lugs **279** thereon (Figure 8), are such as to vary the periods at which a step in rotation is imparted to the needle cam control pattern drum **191** and to vary the period during which the locking finger **1012** is in a raised or inoperative position and during which the locking finger **1012** will move in a path of slightly greater radius than the radius of the locking disk **1000** according to a desired pattern so as to clear the notches **1001** to **1004**.

In order to produce a shogging effect in the needle cylinder **103**, the locking finger **1012** is moved out of engagement with the corresponding notch **1001**, **1002**, **1003** or **1004** immediately following the end of a clockwise revolution of the shaft **153**, the shogging disk **945** and the locking disk **1000** in Figure 17. The shaft **153**, with the shogging disk **945**, then moves in a counter-clockwise direction in Figure 17 for a complete revolution while the locking finger **1012** remains disposed so as to move in a path of greater radius than the disk **1000** and then, upon the shaft **153** with the shogging disk **945** again moving in a clockwise direction, the locking finger **1012** is released so as to bear, under pressure of the spring loaded pin **1016** (Figure 16), against the periphery of the locking disk **1000**. According to the desired pattern, the locking finger **1012** may be caused to bear against the periphery of the locking disk **1000** between any one of the four notches **1001** to **1004**, inclusive, and will then be led into the next succeeding notch by means of the corresponding lead-in slot or notch **1006**.

Now, assuming the locking finger **1012** to have been released so as to engage the periphery of the locking disk **1000** at a point between the notches **1002** and **1004**, by virtue of the pattern chain **265**, during clockwise movement of the shaft **153** and the shogging disk **945**, the locking finger **1012** will move into engagement with the notch **1004** to thus transmit a half revolution to the locking disk **1000**, which will, of course, impart a half revolution to the needle cylinder **103**.

Assuming that the machine had been knitting on the needles in groups A and D, since these groups A and D correspond to the notch **1003** in the locking disk **1000** (Figures 17, 44 and 45), this means that the needles in groups A and D had been moving equal distances from the knitting station upon movement of the needle cylinder **103** in opposite directions during reciprocatory knitting. When the locking finger **1012** has moved into engagement with the notch **1004** in the manner previously described, this will shog the needle cylinder in such a manner to cause the needles in groups B and C to assume the arc of action previously travelled by the needles in groups A and D and the needles in groups A and D will assume the previous position and arc of movement of the needles in groups B and C.

It is thus seen that, with the shogging of the needle cylinder a half revolution in the manner described, the needles in groups B and C will then move equal distances past the knitting station upon movement of the needle cylinder during reciprocatory knitting. The function of the shogging mechanism, with respect to the needles in Figures 17, 44 and 45, will be more fully described during the description of the manner of operation of this machine. It might be stated, however, that in knitting a stocking of the type shown in Figure 88, it is to be assumed that all rotary knitting, that is, continuous rotation of the needle cylinder **103**, takes place when the locking finger **1012** is in engagement with the notch **1001** (Figure 17) in the disk **1000**.

During the shogging of the needle cylinder, that is, during the time that the locking finger **1012** is moving around the disk **1000**, and is not in engagement with any one of the notches **1001** to **1004**, inclusive, the beveled gear **187** is prevented from rotating due to the friction of the beveled gear **188** at the lower end of the needle cylinder **103** against the auxiliary bed plate **196**. It is evident that a suitable friction mechanism may be provided on the crank arm **1022** in Figure 16 to engage the outer face of the gear **187** as the arm is moved inwardly to release the locking finger **1012** from the corresponding notches **1001** to **1004**, inclusive, to further assist in preventing movement of the locking disk **1000** during the shogging operation, if desired. A suitable friction device is illustrated at **1018** having a resilient member **1019** held against the beveled gear **187** by a spring pressed bolt **120**, the friction device being mounted on the shogging crank arm **1022**.

Conventional needle and jack cams

A description will now be given relating to the various conventional needle cams which control the actuation of the needles and other mechanisms associated therewith. Referring to Figures 76 to 84, inclusive, there are shown various diagrammatic views of the needle cams, and in these views there is shown a number of conventional cams, some of which are identical to and others of which are similar to the conventional cams shown in said Patent 1,152,850. The widening pick feed cams have already been described except as to a specific control means for the widening picks which will be later described. A brief description of the conventional cams associated with the cams which are peculiar to the present invention will be given in order that their relation with the cams of the present invention may be clearly understood.

The needle cylinder **103** is surrounded adjacent its lower end by a conventional cam cylinder or ring **1042** (Figure 76) which is spaced apart from the needle cylinder **103** so that the stationary needle cams, to be presently described, may be secured to the inner surface thereof with the proximate surfaces of said cams being disposed in closely spaced relation to the needle cylinder **103** so as to be engaged by the butts of the needle jacks J (Figure 76).

Suitably secured to the inner face of the cam cylinder or ring **1042** is a jack guiding ring **1043** the lower edge of which is disposed a substantial distance upwardly of the lower edge of the cam ring **1042** so as to provide a slot through which the butts of the needle jacks J may pass. The jack guide ring **1043** is cut away at one side thereon and has a conventional jack lowering cam and a needle guide cam **1044** and **1045**, respectively, mounted in the space defined by the cut-away portion of the jack guide ring **1043**. The jack ring, as well as the cams **1044** and **1045**, serves to maintain a vertical attitude of the jacks J and prevents the jacks J from being thrown out of the conventional slots, provided therefor in the needle cylinder, due to centrifugal force caused by rotation of the needle cylinder **103**.

The lower proximate portions of the cams **1044** and

1045 are cut away as to form an inverted V-shaped opening. An advancing jack cam 1046 is disposed in the V-shaped opening defined by the cams 1044 and 1045 for raising the needle jacks J, alternate needles having a conventional jack disposed in the same vertical plane for raising them so the needles therebetween may take the elastic yarn R during the knitting of the elastic top of a stocking.

A segmental needle support race 1047 is mounted atop the jack guide ring 1043 and terminates at one end thereof in engagement with the cam 1045. The upper surfaces of the cam 1045 and the segmental support race 1047 are disposed at the same level.

Conventional hardened cams 1050 and 1051 are disposed at a point at the rear of the knitting machine, which, together, form a V-shaped opening from which sloping respective surfaces 1052 and 1053 of the hardened cams 1050 and 1051 lead in opposite directions to return the butts of any needles which may be passed into said opening during the knitting operation, to a horizontal plane. Mounted on the cam plate 110 in a conventional manner and disposed centrally of the opening defined by the surfaces 1052 and 1053 on the hardened cams 1050 and 1051 is a conventional bottom center cam 1054 and a conventional top center cam 1055 which are spaced apart from each other in a vertical plane to permit the butts of the needles to pass therebetween during the knitting operations. A conventional left-hand stitch cam 1056 and a conventional right-hand stitch cam 1057 are disposed adjacent opposed sides of the top and bottom center cams 1055 and 1054, respectively. The cams 1054 to 1057, inclusive, collectively define the knitting station.

Special narrowing picks

Due to the fact that each of the four widening picks 893 to 896, inclusive, usually engages the butts of two needles, depending upon the direction of rotation of the needle cylinder thereby, improved narrowing picks are provided which are peculiar to the present invention. The left-hand narrowing pick is indicated broadly at 1060 and the right-hand narrowing pick is indicated broadly at 1061. These narrowing picks 1060 and 1061 differ from those of other knitting machines in that each of the narrowing picks 1060 and 1061 is adapted to receive the butts of two needles during reciprocatory knitting in the knitting of the leg or pattern portion of the stocking.

However, due to the fact that the number of needles increased in widening a the knitting of the heel and toe, during each movement of the needle cylinder in either direction, is but a single needle, it is necessary that the capacity of the narrowing picks 1060 and 1061 be decreased during the knitting of the heel and toe portions of a stocking and that one of the left-hand widening picks and one of right-hand widening picks also be rendered inoperable during the knitting of the heel and toe of a stocking. The manner in which the widening picks 893 and 895 are rendered inoperable will be later described and a description will now be given relating to the structure and manner of operation of the narrowing picks 1060 and 1061.

Inasmuch as both the narrowing picks 1060 and 1061 are identical, except being opposite hand, only the left-hand narrowing pick will be described in detail and like parts associated with the right-hand narrowing pick 1061 will bear the same reference characters as those parts associated with the left-hand narrowing pick 1060. The left-hand narrowing pick 1060 is shown in detail in Figures 40 and 41 and the connection between the left-hand and the right-hand narrowing picks 1060 and 1061, respectively, is shown in detail in Figures 15 and 43.

Referring to Figures 40 and 41, the left-hand narrowing pick 1060 includes a base member 1062 which is suitably secured, as by a screw 1063, to the upper surface of the circular bed plate 110 at the rear of the machine. This base member 1062 extends upwardly and has a stem portion 1064 (Figure 41) oscillatably mounted therein, the upper end of which has a longitudinally slotted block 1065 integral therewith which is adapted to move in sliding rotational engagement with the upper end of the base member 1062. The longitudinally slotted block 1065 serves as a support for a narrowing pick arm 1066 which is provided with a notch 1067 in the upper free or working end thereof, this notch being open at the outer edge of the narrowing pick arm 1066. The width of this notch 1067 is such as to engage two needle butts in the needle cylinder simultaneously and to then swing upwardly with movement of the needle cylinder 103 by virtue of a lifting cam engaging the lower surface of the narrowing pick arm 1066 adjacent the working end thereof, this narrowing pick lifting cam being indicated at 1070 in Figure 41. The narrowing pick arm 1066 is oscillatably mounted in the longitudinally slotted block 1065 as at 1066*a* (Figure 41). The narrowing pick lifting cam 1070 is suitably secured to the outer face of an angle clip 1071 which is, in turn, suitably secured to the upper surface of the circular bed plate 110.

A latch support block 1073 is suitably secured, as by a screw 1074, to the outer surface of the narrowing pick arm 1066 and the narrowing pick arm 1066 is provided with a longitudinally extending groove coinciding with the bottom of the notch 1067 and in which a pick restrictor 1075 is mounted for longitudinal sliding movement. The latch support block 1073 also closes one side of the groove in which the pick restrictor 1075 is shown in its outermost position in Figures 40 and 41 and means are provided for moving the pick restricting member inwardly so as to restrict the size of the notch 1067 at the working end of the narrowing pick arm 1066 during the knitting of the heel and toe pockets of a stocking so that but a single needle butt may be engaged by the narrowing pick 1060 during clockwise movement of the needle cylinder thereby or, in the event of the needle cylinder moving in a counter-clockwise direction, the right-hand narrowing pick 1061 will function in a manner identical to that of the left-hand narrowing pick 1060. The position of the pick restrictor 1075 relative to the notch 1067 at the working end of the narrowing pick arm 1066 is controlled by suitable cams, to be presently described, on the main cam drum 121 and through intervening connections.

Referring to Figure 40, there is shown a pin 1076 which extends inwardly relative to the needle cylinder between the lower edge of the latch support block 1073 and the upper edge of the narrowing pick arm 1066. One end of a tension spring 1077 is connected to the pin 1076 and extends outwardly with respect to the needle cylinder and is connected at its outer end to a similar pin 1080 which is secured, as by a pressed fit, to the narrowing pick arm 1066 so that the pick restrictor 1075 is normally urged outwardly relative to the notch 1067 of the narrowing pick arm 1066.

The enlarged upper end 1081 of a bell crank 1082 is normally urged into engagement with the outer end of the pick restricting member 1075 by a tension spring 1083. The lower end of the tension spring 1083 is connected to the outer end of the bell crank 1082 and its upper end is connected to the upper portion of a bell crank support 1084 in the form of an L-shaped bracket. The L-shaped bracket 1084 is suitably secured, as by screws 1085, to the upper surface of the circular bed plate 110. The bell crank 1082 is oscillatably mounted, as at 1086 on the lower portion of the L-shaped bracket 1084.

Means are provided, to be presently described, for restricting inward movement of the enlarged portion 1081 of the bell crank 1082 so the pick restricting member 1075 normally assumes the position shown in Figures

40 and 41. However, upon the means which normally restrict the movement of the bell crank 1082 being actuated in a manner to be presently described, the spring 1083, which is of substantially greater tension than the spring 1077, will cause the bell crank 1082 to move in a clockwise direction in Figure 41 to thus move the pick restricting member 1075 from left to right in Figure 41 to restrict the size of the notch 1067.

The pick restricting member 1075 has a projection 1087 on the upper surface thereof which, upon movement of the pick restricting member 1075 from left to right in Figure 41, is engaged by a latch member 1090 pivotally mounted at its inner end, as at 1091 in the latch support block 1073. A tension spring 1092, connected at its upper end, as at 1093 (Figure 40), to the latch 1090 and connected at its lower end to the pin 1030, normally urges the latch into engagement with the upper edge of the pick restricting member 1075 which is being moved into operative position to restrict the size of the notch 1067. The projection 1087 on the pick restricting member 1075 is engaged by the latch 1090, by virtue of the tension spring 1092, to thus prevent the pick restricting member 1075 from again being moved outwardly until the latch 1090 is released in a manner to be presently described.

The latch 1090 has a tail 1094, the lower surface of which is adapted to be engaged, at times, by a laterally extending portion 1095 of a latch lifting lever 1096. The control lever 1096 is oscillatably mounted intermediate its ends adjacent the upper end of the L-shaped bracket 1084 as at 1097. The laterally extending portion 1095 of the latch lifting lever 1096 in Figure 41 is normally urged downwardly and into engagement with an eccentric stop member 1100, suitably secured to the bracket 1084, by a tension spring 1101, the upper end of the tension spring being connected to the front portion of the control lever 1096 and the lower end thereof being connected to the bracket 1084.

The eccentric stop 1100 restricts downward movement of the laterally extending portion 1095 of the control lever 1096 although the bell crank 1082 may continue in its clockwise movement, in Figure 41, after the control lever 1096 has engaged the eccentric stop 1100. The upper edge of the substantially horizontally extending arm of each of the bell cranks 1082 associated with the corresponding narrowing picks 1060 and 1061 is engaged by a pick restrictor control lever 1102, each of these control levers extending inwardly toward each other and each being oscillatably mounted intermediate their ends on an angle clip 1103 suitably secured to the upper surface of the circular bed plate 110 (Figure 15).

The proximate ends of the pick restrictor control levers 1102 in Figure 15 are engaged by a forwardly projecting portion or ear 1105 (Figure 51) of an L-shaped member 1106 suitably secured, as by rivets 1107, to the upper ends of respective thrust rods 1110 and 1111, the thrust rod 1110 being provided for controlling the left-hand narrowing pick 1060 and the thrust rod 1111 (Figures 51 and 54, respectively), being provided for controlling the right-hand narrowing pick 1061. It will be observed in Figures 51 and 54 that the thrust rods 1110 and 1111 are mounted for vertical sliding movement in the thrust rod guide bars 357 and 365 and the lower ends thereof are adapted, at times, to engage the periphery of the main cam drum 121 and at, other times, the lower end of the thrust rod 1110 is successively engaged by circularly arranged cams 1112, 1113 and 1114, the opposed ends of the cams 1112 and 1114 being spaced apart from each other and the cam 1113 being of slightly greater height than the cams 1112 and 1114 for purposes to be later described.

The lower end of the thrust rod 1111 (Figure 54) is adapted to engage circularly arranged cams 1115, 1116 and 1117 at times when it is not in engagement with the periphery of the pattern drum 121, these cams 1115, 1116 and 1117, being identical to the corresponding cams 1112, 1113 and 1114 and all of the cams 1112 to 1117 being suitably secured to the main cam drum 121.

The cams 1112 to 1114 are arranged in the same manner as the cams 1115 and 1117 so the pick restricting member 1075 associated with each of the narrowing picks 1060 and 1061 will be moved into operation simultaneously, this being necessary during the knitting of the heel and toe pockets of a stocking. When either of the thrust rods 1110 or 1111 (Figures 51 and 54) is resting on the first of the respective cams 1112 and 1115, the pick restrictor control lever 1102 is moved towards the observer at its inner end in Figure 15 causing the outer portion thereof to move downwardly. Now, referring to Figures 40 and 41, it will be observed that downward movement of the pick restrictor control lever 1102 will cause the bell crank 1082 to assume substantially the position shown, assuming the lower ends of the respective thrust rods to have been resting upon the main cam drum 121 before having engaged the respective cams 1112 and 1115.

In this event, each of the corresponding pick restricting members would be in operative position thus restricting the size of the notch 1067 and upon the thrust rods 1110 and 1111 being elevated by the respective cams 1113 and 1116 (Figures 51 and 54), the bell crank 1082 associated with each narrowing pick 1060 and 1061 would then be partially rotated in a counter-clockwise direction, beyond the position in which it is shown in Figure 41, with the result that the latch lifting lever 1096 would be moved in a counter-clockwise direction beyond the position in which it is shown in Figure 41 in a manner to be presently described. The bell crank 1082 has the lower end of a connecting rod 1120 pivotally connected thereto, as at 1121, and extending upwardly therefrom. This connecting rod 1120 slidably penetrates a lip portion 1122 of an angle clip 1123 suitably secured, as by a screw 1124, to the outer end portion of the control lever 1096 (Figures 40 and 41).

A collar 1125 is adjustably secured on the upper end of the connecting rod 1120 in Figures 40 and 41 and, upon counter-clockwise movement of the bell crank 1082 in Figure 41 beyond the position shown, the collar 1125 will engage the upper surface of the lip portion 1122 of the angle clip 1123 thus causing the latch lifting lever 1096 to move in a counter-clockwise direction beyond the position shown in Figure 41, with the result that its laterally extending portion 1095 will engage the tail 1094 of the latch 1090 and will lift the latch 1090 out of engagement with the projection 1087 of the pick restricting member 1075.

The tension spring 1077 (Figure 40) will then urge the pick restricting member 1075 outwardly to substantially the position shown in Figure 41, inasmuch as the enlarged portion 1081 of the bell crank 1082 will have previously moved to substantially the position shown in Figures 40 and 41. Upon the thrust rods 1110 and 1111 moving into engagement with the respective cams 1114 and 1117 following their engagement with the respective cams 1113 and 1116, the bell crank 1082 will again reverse its direction of movement and will move a partial revolution in a counter-clockwise direction to again assume the position shown in Figures 40 and 41. This will permit the latch lifting lever 1096 to again assume the position shown in Figure 41 against the eccentric stop 1100 and will thus permit the latch 1090 to slidably engage the upper edge of the pick restricting member 1075 preparatory to the pick restricting member 1075 again being moved inwardly as the lower ends of the respective thrust rods 1110 and 1111 move into the space between the respective cams 1112 and 1114 and 1115 and 1117 to engage the periphery of the main cam drum 121. In other words, from the time the thrust rods 1110 and 1111 fall into engagement with the cam drum 121 between the respective cams

1112 and 1114 and 1115 and 1117 until the thrust rods 1110 and 1111 are engaged and elevated by the respective cams 1113 and 1116, the respective narrowing picks 1060 and 1061 will raise but a single needle with each reciprocation of the needle cylinder. During the remaining part of a revolution of the cam drum 21, the narrowing picks will raise two needles to pass above the stitch cams with each reciprocation of the needle cylinder 103.

Referring to Figures 15, 43 and 57, there is shown a composite or extensible link 1130 which is pivotally connected at opposed ends thereof to the left-hand and right-hand narrowing picks 1060 and 1061. The composite link 1130 includes end link members 1131 and 1132 each of which is provided with a longitudinally extending slot 1133 closed at opposed ends thereof and these end members 1131 and 1132 are connected to an intermediate link member 1134 (Figure 43). The intermediate member 1134 is adjustably secured to the right-hand end member 1132 by a screw 1135 and the intermediate member 1134 is provided with a pair of longitudinally extending closed-ended slots 1136 which are slidably penetrated by corresponding shoulder screws 1137 threadably embedded in the left-hand end member 1131 of the composite link 1130. The intermediate member 1134 and the left-hand member 1131 are provided with coinciding openings 1140 and 1141 of the same size for purposes to be presently described.

Means are provided for varying the distance between the remote walls of the slots 1133 according to the number of needles which are moved out of operation by the narrowing picks 1060 and 1061 with each reciprocation of the needle cylinder 103. The remote walls of the two slots 1133 are normally engaged by shouldered pins 1142, there being one of these shouldered pins 1142 associated with each of the narrowing picks 1160 and 1161. As is clearly shown in Figure 40, the shouldered pin 1142 associated with each of the narrowing picks 1160 and 1161 is integral with and projects upwardly from the upper surface of the longitudinally slotted block 1065 adjacent the outer end thereof and when the members 1131, 1132 and 1134 of the composite link 1130 are held in fixed relation to each other, by means to be presently described, regardless of any variation in overall length of the composite link 1130, upon movement of one of either of the narrowing picks 1060 or 1061 inwardly and upwardly toward the other of the picks, the other of the picks is moved outwardly and downwardly relative to the first of the picks to engage the upper surface of the corresponding stitch cam 1056 or 1057 as the case may be (Figure 76).

It has already been described how the narrowing picks 1060 and 1061 will, at times, raise two needles, such as during the reciprocatory knitting of the ornamental pattern of a stocking and, at other times, raise but a single needle during each movement of the needle cylinder in either a clockwise or a counter-clockwise direction, such as during the knitting of the heel and toe pocket of a stocking.

It is evident that when each of the narrowing picks 1060 and 1061 is conditioned for receiving the butts of two needles, they are swung by the needle butts during each movement of the needle cylinder in each direction a predetermined distance until the butts pass thereby and when the narrowing picks 1060 and 1061 are conditioned for receiving the butt of but a single needle, it is obvious that the narrowing pick 1060 or 1061, as the case may be, would move toward the other of the narrowing picks a greater distance when elevated by the butt of a single needle than would be the case when they are engaged by the butts of two needles. Therefore, in order to lower the pick 1060 or 1061, which is being moved, into operative position as the other of the narrowing picks is being raised to inoperative position so that the narrowing pick that is being moved into operative position may be properly seated in the notch therefor in the stitch cam 1056 or 1057, it is necessary that the length of the composite link 1130 be varied.

This variation of the composite link 1130 is determined by means to be presently described. In other words, the length of the link 1130 is relatively greater when narrowing one needle with each movement of the needle cylinder in each direction than it is when narrowing two needles with each movement of the needle cylinder in each direction.

The means for controlling the position of the members 1131, 1132 and 1134 of the composite link 1130 relative to each other includes a pilot pin 1143 (Figures 43 and 57) having a reduced lower end portion 1144. The pin 1143 is normally urged into engagement with the coinciding openings 1140 and 1141 of the respective members 1134 and 1131 of the composite link 1130 by a tension spring 1145 secured at its lower end, in Figure 57, to one side of the guide block 332 heretofore described and being secured at its upper end to a pivoted arm 1146 pivotally mounted, as at 1147 (Figure 57) on the guide block 332. The arm 1146 has a pilot arm 1148 suitably secured thereto and extending forwardly therefrom to the lower surface of which the pilot pin 1143 is suitably secured and which depends therefrom (Figures 43 and 57).

Referring to Figures 39 and 57, it will be observed that the spring 1145 also normally urges the pivoted arm 1146 into engagement with a laterally extending hooked portion 1150 of a substantially L-shaped thrust rod cap 1151 suitably secured, as by rivets 1152 (Figure 57), to the upper portion of a vertical disposed composite link control thrust rod 1153. The thrust rod 1153 is mounted for vertical sliding movement in the thrust rod guide bars 357 and 365 and is adapted, at times, to rest against the upper surface of the main cam drum 121 and, at other times, it is engaged by a cam 1154 which extends through an arc of approximately 260 degrees and is suitably secured to the periphery of the cam drum 121.

During normal action of the narrowing picks 1060 and 1061 (Figure 15), that is, during narrowing of a single needle per each clockwise and each counter-clockwise movement of the needle cylinder, the lower end of the thrust rod 1153 in Figure 57 engages the cam 1154 on the main cam drum 121. This permits the pilot 1143 to assume the position shown in Figure 43. It is seen that the reduced portion 1144 then engages the openings 1140 and 1141 to relatively increase the length of the composite link 1130.

However, when the lower end of the thrust rod 1153 engages the cam drum 121, this causes the laterally extending hooked portion 1150 of the L-shaped cap 1151 on the upper end of the thrust rod 1153 to move downwardly in engagement with the pivoted arm 1146. This will cause the pivoted arm to move in a clockwise direction in Figure 57 and will move the enlarged portion of the pilot 1143 into the coinciding openings 1140 and 1141 in the members 1134 and 1131, respectively (Figure 43), of the composite link 1130 so as to relatively shorten the composite link 1130, since it is evident that relative movement between the members 1131 and 1134 is permitted by virtue of the shoulder screw 1137 working in the slots 1136 of the intermediate member 1134.

The left-hand and right-hand narrowing picks 1060 and 1061 of the present invention operate in substantially the same manner as conventional narrowing picks in that the stitch cams 1056 and 1057 in Figure 76 are provided with the usual notch in the upper surface thereof into which the leading edges of the corresponding narrowing picks 1060 and 1061 alternately move for picking up the leading one or two needles, as the case may be, depending upon the direction of rotation of the needle cylinder. However, there are particular instances throughout the knitting of an ornamental pattern portion of a stocking such as that shown in Figure 88 when it is necessary that the right-hand narrowing pick 1061 be elevated

to inoperative position although it may not have been moved to inoperative position by any of the butts of the needles moving from right to left in Figure 76 having engaged the same.

For example, during the shogging operations of the needle cylinder all of the needles in the needle circle assume an elevated position to where the butts thereof will pass above the stitch cams and, upon going into the knitting of a rectilinear area following the shogging operation, two needles are moved downwardly to pass through the stitch cams as the needle cylinder moves in a counter-clockwise direction moving the needles from right to left in Figure 76. It is evident that upon these two needles being moved downwardly, if the right hand narrowing pick **1061** is in operative position, that is, in engagement with the upper surface of the right-hand stitch cam **1057**, these two needles would engage the right-hand narrowing pick **1061** to be elevated thereby to inoperative position.

It is essential that these two first needles remain in a lowered position and pass through the stitch cams and, therefore, the right-hand narrowing pick is elevated to inoperative position, by pattern controlled means to be presently described, to where the butts of these two needles will pass beneath the same as they pass above the right-hand stitch cam **1057**.

The pattern controlled means for controlling the position of the right-hand narrowing pick **1061** in order that these two needles may pass through the stitch cams is most clearly shown in Figures 5–A, 15, 23 and 69. As heretofore described, parts of the right-hand and left-hand narrowing picks **1060** and **1061**, are identical except being opposite hand. However, the right-hand narrowing pick also includes an angle clip **1160**. An angle clip, such as the angle clip **1160**, associated with the narrowing pick **1061** is not required in association with the narrowing pick **1060**.

Referring to Figure 15, it will be observed that the angle clip **1160** extends rearwardly and outwardly so that its outwardly extending portion is disposed rearwardly of the pivot point of the right-hand narrowing pick **1061**, this angle clip **1160** being suitably secured to the block **1065** of the narrowing pick **1061**. The rearwardly and outwardly extending portion of the angle clip **1160** is slidably penetrated by a headed connecting rod **1161** which also extends outwardly and rearwardly at an angle and is pivotally connected, as at **1162** in Figure 15, to one end of a narrowing pick control finger **1163**.

The connecting rod **1161** is pivotally connected to the narrowing pick control finger **1162** in the same manner that the link **416** (Figure 5) is connected to the control finger **420**. The control finger **1163** is oscillatably mounted intermediate its ends on the post **713** heretofore described. The control finger **1163** is supported for oscillation by a collar **1164** adjustably secured on the post **713**. It has already been stated how the post **713** extends downwardly and is threadably embedded in the auxiliary bed plate **196**.

The upper surface of the control finger **1163** is slidably and oscillatably engaged by a plate to be later described which is instrumental in the controlling of a first lowering switch cam also to be later described and this plate is held in sliding engagement with the control finger **1163** by a collar **1165** (Figure 23) also adjustably secured on the post **713**.

It will be observed in Figures 5–A and 69 that the narrowing pick control finger **1163** has an outwardly projecting follower portion **1166** integral therewith which normally engages the periphery of the first auxiliary or first needle cam control pattern drum **191** and is also adapted to be successively engaged by a plurality of circularly spaced cams **1171** to **1178**, inclusive, suitably secured to the periphery of the first needle cam control pattern drum **191**.

It will be noted in Figure 15 that the right-hand narrowing pick **1061** is an inoperative position which may have been caused as a result of the right-hand narrowing pick **1061** having been engaged by the butt of one or more needles during a counterclockwise revolution of the needle cylinder, this also serving to move the left-hand narrowing pick **1060** to operative position for a succeeding clockwise revolution of the needle cylinder. The headed connecting rod **1161** is provided to permit just such movement of the narrowing pick **1061** independently of the connecting rod **1161**.

However, it has already been described that it is necessary that the right-hand narrowing pick, at times, be moved in inoperative position by the butts of some of the needles and, in such instances, the follower portion **1166** of the narrowing pick control finger **1163** (Figure 69) is engaged by any one of the cams **1171** to **1178** on the first needle cam control pattern drum **191** to cause the same to move a partial revolution in a clockwise direction.

This will cause the connecting rod **1161**, in Figure 15, to move from left to right and its headed left-hand end then engages the angle clip **1160** to impart movement to the right-hand narrowing pick assembly **1061** in a clockwise direction causing the same to assume the position shown in Figure 15. This will, of course, cause the left-hand narrowing pick **1060** to move into operative position by virtue of the composite link **1130** extending between the left-hand and right-hand narrowing picks **1060** and **1061**.

It is thus seen that the first two needles heretofore described, which may be directed downwardly by one of the cams to be presently described disposed to the right of the right-hand stitch cam **1057**, would then pass through the stitch cams and beneath the left-hand stitch cam **1056** and upon the next succeeding movement of the needles from left to right in Figure 76 the left-hand narrowing pick **1060** would then be in position to elevate the two needles which previously passed through the stitch cams as they moved from right to left as other needles are lowered to pass through the stitch cams by means of the widening picks as will be clearly described in the Method of Operation.

Widening pick control during knitting of heel and toe

It has already been described that the right-hand widening picks **893** and **894** cooperate to lower four needles and two needles are raised by the right-hand narrowing pick **1061** as they move from right to left in Figure 76, upon each counter-clockwise revolution of the needle cylinder **103**, during the knitting of the ornamental pattern portion of a stocking.

The left-hand widening picks **895** and **896** function in a manner identical to the right-hand widening picks upon each clockwise revolution of the needle cylinder during the knitting of an ornamental pattern portion of a stocking. However, during the widening at the heel and toe pockets, it is necessary that only a single additional needle be put into operation with each rotary movement of the needle cylinder in each direction and it is, therefore, necessary that one of the widening picks **893** or **894** be inoperative during counter-clockwise rotation of the needle cylinder and it is necessary that one of the left-hand widening picks **895** or **896** be inoperative during each clockwise rotation of the needle cylinder.

Therefore, means are provided which render the first left-hand widening pick **895** inoperative during the knitting of the heel and toe, this taking place during a clockwise revolution of the needle cylinder and since the first right-hand widening pick **893** will have been moved to an inoperative position during the preceding counter-clockwise revolution of the needle cylinder, upon failure of the first left-hand widening pick **895** to be engaged by the butts of any of the needles with a clockwise revolution of the needle cylinder, both of the first widening picks **893** and **895** would remain inoperative during

the knitting of the heel and toe pockets of the stocking.

The means for rendering the first left-hand widening pick **895** inoperative during the knitting of the heel and toe pockets of a stocking includes a widening pick knock-off lever **1181** (Figures 3, 5, 8 and 15) which is oscillatably mounted intermediate its ends, as at **1182**, on an angle clip **1183** suitably secured to the upper surface of the circular bed plate **110**. The widening pick knock-off lever **1181** has a downwardly projecting tail portion **1184** integral therewith which is off-set intermediate its ends (Figure 15) so as to extend downwardly past the circular bed plate **110** and to the lower end of which one end of a connecting rod **1185** is pivotally connected (Figures 3 and 15).

It will be observed in Figure 3 that the connecting rod extends downwardly and rearwardly at an angle, from the tail portion **1184** of the widening pick knock-off lever **1181**, and then extends rearwardly in a horizontal plane and has a collar **1186** (Figures 3 and 55) adjustably secured thereon to which one end of a tension spring **1187** is suitably connected, the other end of this tension spring **1187** being suitably connected to the circular bed plate **110** to, thus, normally urge the connecting rod **1185** from left to right in Figure 3 and normally urging the lever **1181** in a counter-clockwise direction in Figure 3. Means, to be presently described, are provided for restricting movement of the lever **1181** in a counter-clockwise direction and, when this means is released, the right-hand portion of the widening pick knock-off lever **1181** in Figure 3, is permitted to move in a counter-clockwise direction against the lower surface of the tail portion **910** of the first left-hand widening pick **895** (Figure 15).

This will elevate the tail portion or outer end of the first left-hand widening pick **895** and will cause the inner or working end thereof to be lowered below the plane of the needle butts as they move from right to left in Figure 76 thus permitting any needles which normally would have been lowered by the first left-hand widening pick **895** to continue in a horizontal plane until lowered by the second left-hand widening pick **896**. One of the needles traversing the pathway P–1 in Figure 76 will be elevated by the left-hand narrowing pick **1060** to pass above the stitch cams.

The means for restricting counter-clockwise movement of the widening pick knock-off lever **1181** in Figure 3 include a bell crank **1190** which is slidably penetrated at its lower end, in Figure 55, by the rear end portion of the connecting rod **1185**, the connecting rod **1185** having a suitable collar **1191** adjustably secured thereon and normally being urged against the rear surface of the bell crank **1190** by the tension spring **1187** heretofore described. The bell crank **1190** is oscillatably mounted, as at **1192**, on the angle clip **526** (Figures 55 and 73) and the lower surface of the horizontal leg of the bell crank **1190** is engaged by a substantially L-shaped extension arm **1193** (Figure 5) suitably secured to the upper end of a thrust rod **1194** (Figures 39 and 50). The extension arm **1193** extends through a suitable opening **1195** (Figure 73) in the angle clip **526**.

The thrust rod **1194** (Figures 39 and 50) is mounted for vertical sliding movement in the thrust rod guide bars **357** and **365** and its lower end normally rests on the peripheral surface of the main cam drum **121**. The main cam drum **121** has a cam **1196** suitably secured thereto which extends through an arc of approximately 100 degrees and which is adapted to engage the lower end of the thrust rod **1194** during the knitting of the ornamental pattern portion of a stocking. Now, when the cam **1196** engages the lower end of the thrust rod **1194**, the thrust rod **1194** moves upwardly causing like movement to be imparted to the thrust rod extension arm **1193** in Figures 55 and 73. This will cause the bell crank **1190** to rotate a partial revolution in a clockwise direction (Figures 3 and 55) causing the connecting rod **1185** to move from right to left in Figures 3 and 55 to, in turn, transmit movement to the widening pick knock-off lever **1181** in a clockwise direction in Figure 3. This will, of course, cause the widening pick knock-off lever **1181** to assume the position shown in Figure 3.

Now, upon the cam **1196** moving out of engagement with the lower end of the thrust rod **1194** in Figure 50, the thrust rod **1194** will move downwardly thus permitting the tension spring **1187** to pull the connecting rod **1185** from left to right, in Figures 3 and 55, with the result that the widening pick knock-off lever **1181** will rotate a partial revolution in a counterclockwise direction, in Figure 3, to thus move the first left-hand widening pick **895** to inoperative position, in the manner heretofore described, which will take place during the knitting of the heel and toe pockets of a stocking.

Needle cams controlled by needle cam control pattern drum

Referring to Figure 48 there is shown a schematic developed lay out of the arrangement of the cams on the needle cam control pattern drum **191** and there is shown above the upper edge of the needle cam control pattern drum in Figure 48 a plurality of numerals, namely, **1** to **36**, inclusive, these numerals being equally spaced from each other. It is preferred that these numerals appear on the upper edge of the needle cam control pattern drum in Figure 1 arranged in the same manner shown in Figure 48 so they may be used as a guide to the operator in setting up the machine. In this instance the pointer **201** in Figure 5–A serves as a means of determining position of the needle cam control pattern drum relative to the machine frame.

There are shown in Figure 48 seven horizontal rows of cams, the bottom row including the cams **1031** to **1041** for controlling the shogging clutch mechanism shown in Figures 16 and 17. The second row of cams from the bottom in Figure 48 includes the cams **1171** to **1178** which are instrumental in moving the right-hand narrowing pick **1061** to inoperative position during the knitting of the uppermost point in each of the diamond-shaped areas of a stocking such as that shown in Figure 88 as heretofore described. The remaining five rows of cams in Figure 48 are employed in controlling the needle cams (Figure 76) to be presently described in detail.

Reading from right to left in Figure 76, there are first shown an upper and a lower stationary needle leveling cam **1200** and **1201**, respectively, which are provided to insure that the needles will be directed to the widening pick feed cams **825** and **875** at the proper elevation. The first elevating switch cam **852** has been described and is shown adjacent the lower leveling cam **1201**. To the left of the right-hand widening pick feed cam **825** there is shown the first and second right-hand widening picks **893** and **894**, respectively, the needle lowering cam **750** being shown below the second right-hand widening pick **894**.

A second elevating switch cam **1202** is disposed to the left at the second right-hand widening pick and above which a portion of a first lowering switch cam **1203** is disposed. The conventional stitch cams, including cams **1054**, **1055**, **1056** and **1057**, are disposed to the left of the first lowering switch cam **1203** in Figure 76. Disposed to the left and above the stitch cam **1056** is an auxiliary needle leveling cam **1204**, this cam being a stationary cam. The left-hand widening picks **895** and **896** are shown disposed to the left of the auxiliary needle leveling cam **1204** and the left-hand widening pick feed cam **895** and the second lowering switch cam **887** are shown disposed to the left of the left-hand widening picks **895** and **896** in Figure 76 to complete the brief description of the needle cams shown in Figure 76.

Referring to Figures 29, 30 and 31, it will be observed that the upper and lower leveling cams **1200** and **1201** are provided with respective outwardly extending tail por-

tions 1205 and 1206 which engage opposed sides of the post 691 and are secured thereto by any suitable means such as screws 1207. The first elevating switch cam 852 and the right-hand widening pick feed cam 825 have been described as to structure and one of the control means for the first elevating switch cam 852, responsive to second needle cam control pattern drum 797 (Figure 7) has been described. The first elevating switch cam 852 is also controlled by the first needle cam control pattern drum 191, this pattern drum 191 being provided with a pair of circularly spaced cams 1210 and 1211 (Figures 48 and 64) which are adapted to be successively engaged by a follower member 1212 suitably secured, as by screws 1213 (Figure 5–A), to a control arm 1214.

The control arm 1214 has a tubular portion 1215 integral therewith (Figure 6) which projects downwardly therefrom and is oscillatably mounted on a post 1216 supported on the auxiliary bed plate 196 and being secured thereon by a screw 1217. It will be observed, in Figure 6, that the control arm 857 heretofore described is an integral part of the tubular portion 1215 associated with the control arm 1214 and projects from a medial portion of the tubular portion 1215.

The cam follower 1212 is normally urged into engagement with the periphery of the first needle cam control pattern drum 191 by the spring loaded plunger 871, in Figure 25, this spring loaded plunger 871 also serving, in this instance, to hold the first elevating switch cam 852 in an inoperative position. However, upon either one of the cams 1210 or 1211 moving into engagement with the follower member 1212 on the arm 1214, movement is imparted to the arm 1214 and its tubular portion 1215 in a clockwise direction in Figure 5–A. This will cause the arm 857 to move in the same direction with the result that the adjustment screw 856, on the free end thereof, will move the first elevating switch cam 852 into operative position for elevating certain of the needles in accordance with a desired pattern.

The structure of the right-hand widening pick feed cam 825 and the manner in which it is controlled by the second needle cam control pattern drum 797 (Figure 7) and the main pattern chain 163 during reciprocatory knitting has been described. The manner in which the widening pick feed cam 825 is controlled by the first needle cam control pattern drum 191 will now be given.

Referring to Figures 5 and 26 there will be observed a bunter plate 1220 which is suitably secured, as by a screw 1221, to the upper surface of a control arm 1222 and against which the leg 816 of the primary bell crank 813 (Figure 26) is normally urged by the spring loaded plunger 835 associated with the right-hand widening pick feed cam 825. This control arm 1222 is integral with a vertically disposed tubular member 1223 which also has an arm 1224 integral therewith and projecting outwardly from the upper end thereof.

The control arm 1224 has a suitable cam follower member 1225 secured thereto by any suitable means such as screws 1226. The spring loaded plunger 835 in Figure 26 normally urges the reading end of the follower member 1225 against the periphery of the first needle cam control pattern drum 191. This follower member 1225 is also adapted to be engaged by a cam 1227 suitably secured to the periphery of the first needle cam control pattern drum 191 (Figures 48 and 65).

It is thus seen that, upon the cam 1227 moving into engagement with the follower member 1225, clockwise movement will be imparted to the arms 1224 and 1222 in Figure 5–A for a partial revolution. This will cause the arm 1222 to move inwardly, in Figures 5 and 26, and will, in turn, cause the bunter 1220 to move the vertical leg 816 of the primary bell crank 813 inwardly towards the needle cylinder. This will cause the secondary bell crank 817 to move inwardly to thus move the right-hand widening pick feed cam 825 into operative position. In the event of any of the needle butts being disposed in the path of the right-hand widening pick feed cam 825 as it is being moved into operative position, the tension springs 822, in Figure 26, will permit the bell crank 813 to rotate in a clockwise direction for a partial revolution and, upon the butts moving past the cam 825, the cam 825 will snap into position by virtue of the tension spring 822.

The structure and control means relating to the right-hand widening picks 893 and 894 and the rubber stitch cam 750 having been described, a description of the structure of the second elevating switch cam 1202 and the control means therefor will now be given and also a description of the structure and control means relating to the first lowering switch cam 1203 will be given.

The stems of the second elevating switch cam 1202 and the first lowering switch cam 1203 are mounted for radial sliding movement in a second switch cam block 1230 (Figure 15, 22, and 23). The second switch cam block 1230 is irregular in shape, as may be clearly observed in Figures 22 and 23, and the stem of the second elevating switch cam 1202 is held in the block 1230 by a plate 1231 suitably secured, as by screws 1232, to the second switch cam block 1230. The switch cam block 1230 is suitably secured to the circular bed plate 110 as by screws 1233.

The stem of the first lowering switch cam 1203 slidably penetrates an angular plate 1229 suitably secured to the block 1230 and rests on the block 1230 adjacent its upper end and the upper surface of the plate 1229 is slotted as at 1234. A stop pin 1235 extends through the slot 1234 and is embedded in the stem of the first lowering switch cam 1203. This stop pin 1235 is normally urged against the outermost wall of the slot 1234, relative to the needle cylinder by a tension spring 1236 connected at its outer end to a pin 1237 projecting upwardly from the upper surface of the plate 1229.

Referring to Figure 22, it will be observed that the outer end of the stem of the second elevating switch cam 1202 has a bunter 1240 suitably secured thereto and depending therefrom, the inner surface of which is engaged by a spring loaded plunger 1241 slidably mounted in the block 1230 for normally urging the second elevating switch cam 1202 to an inoperative position. This spring loaded plunger 1241 also urges the stem of the cam 1202 against a vertically disposed lip 1242 on an angle clip 1243 (Figure 68) suitably secured to a control finger 1244. The control finger 1244 is oscillatably mounted on the reduced upper end of a standard 1245 which extends downwardly, in Figure 23, and is suitably secured, as by screws 1246, to the upper surface of the auxiliary bed plate 196.

The spring loaded plunger 1241 also normally urges the reading end of the control finger 1244 into engagement with the periphery of the first needle cam control pattern drum 191. Referring to Figure 68, it will be observed that the first needle cam control pattern drum 191 has a pair of circularly spaced cams 1247 and 1248 suitably secured thereto which are stepped at their leading ends so as to ease the second elevating switch cam 1202 into operating position, either of the cams 1247 or 1248, upon engaging the reading end of the control finger 1244, causing movement to be imparted to the control finger 1244 in a counter-clockwise direction, in Figures 5–A and 68, with the result that the lip portion 1242 of the angle clip 1243 will move the second elevating switch cam 1202 into operative position.

At times when neither of the cams 1247 or 1248 are in engagement with the reading end of the control finger 1244, the second elevating switch cam 1202 is moved into operative position by means of a pair of circularly spaced cams 1251 and 1252 (Figure 62) on the main cam drum 121 and through intervening connections to be presently described.

It will be observed, in Figure 62, that the lower end of a vertically disposed thrust rod 1253 normally rests

against the upper surface of the main cam drum 121 and is adapted to be successively engaged by the cams 1251 and 1252. This thrust rod 1253 is mounted for vertical sliding movement in the thrust rod guide bars 357 and 365 heretofore described.

The thrust rod 1253 has a forwardly projecting extension arm 1254 suitably secured thereto (Figures 15 and 62), the inner free end of which engages a substantially horizontal leg of a bell crank 1255. The bell crank 1255 is oscillatably mounted, as at 1256, on an angle clip 1257 suitably secured to the upper surface of the circular bed plate 110.

The substantially vertical leg of the bell crank 1255 engages one end of a control lever 1260 which extends forwardly and is oscillatably mounted intermediate its ends on the post 713 (Figures 22 and 23) and has sliding oscillatory movement between a pair of closely spaced collars 1261. The control lever 1260 extends forwardly, beyond the post 713, and has a suitable bunter 1262 suitably secured thereto and extending inwardly therefrom and engaging the bunter 1240 at the outer end of the stem of the second elevating switch cam 1202. It is thus seen that the spring loaded plunger 1241 also normally urges the bunter 1240 on the stem of the second elevating switch cam 1202 against the bunter 1262 on the control lever 1260 to, in turn, urge the control lever 1260 in a counter-clockwise direction, in Figure 15, against the substantially vertical leg of the bell crank 1255. This will normally urge the extension arm 1254 and the associated thrust rod 1253 downwardly in Figure 62.

It is thus seen that, upon either of the cams 1251 or 1252 moving into engagement with the lower end of the thrust rod 1253, in Figure 62, the thrust rod 1253 will move upwardly causing the bell crank 1255 to impart movement to the control lever 1260 in a clockwise direction in Figure 15. This will cause the free end of the control lever 1260 to move inwardly to where the bunter 1262 will move the second elevating switch cam 1202 into operative position. This completes the description of the second elevating switch cam 1202 and the control means therefor.

Referring to Figures 15 and 22, it will be observed that the outer end of the stem of the first lowering switch cam 1203 has an upwardly projecting bunter 1263 suitably secured thereto. This bunter 1263 is adapted to, at times, be engaged by the free end of a spring pressed lever 1264 oscillatably mounted intermediate its ends, as at 1265, on a horizontally disposed plate 1266. The lever 1264 is normally urged towards the bunter 1263 on the stem of the first lowering switch cam 1203, and against a stop pin 1267 projecting from the plate 1266, by a tension spring 1270. The tension spring 1270 is connected at one of its ends to the outer end of the lever 1264 and its other end is suitably connected to the plate 1266 (Figure 15).

Referring to Figure 23, it will be observed that the plate 1266 is oscillatably mounted on the post 713 in sliding engagement with the upper surface of the control lever 1163 and is confined thereon by the collar 1165 heretofore described. Referring to Figure 15, it will be observed that the lower right-hand corner of the plate 1266 is cut away and a follower pin 1271 engages the outer edge of the plate 1266 at the point at which the plate 1266 is cut away. This follower pin 1271 depends from a control finger 1272 (Figures 22 and 23) which extends forwardly and is pivotally mounted on the reduced upper end of the standard 1245 heretofore described. A suitable collar 1274 is provided on the reduced upper end of the standard 1245 to retain the control fingers 1272 and 1244 thereon.

Referring to Figures 5–A and 67, it will be observed that the reading end of the control finger 1272 is normally urged into engagement with the periphery of the first needle cam control pattern drum 191 by the tension spring 1236 (Figures 15 and 22) which urges the first lowering switch cam 1203 to inoperative position. The reading end of the control finger 1272 is adapted to be successively engaged by a plurality of circularly spaced cams 1281 to 1288, inclusive, suitably secured to the first needle cam control pattern drum (Figures 48 and 67). This completes the description of the structure of the first lowering switch cam 1203 and the pattern controlled means therefor.

Referring to Figures 15, 37 and 38, it will be observed that the auxiliary needle leveling cam 1204 has a stem 1290 integral therewith which is suitably secured, as by screws 1291, to the upper end of a cam support in the form of an L-shaped bracket 1292 suitably secured, as by screws 1293, to the upper surface of the circular bed plate 110.

It has already been described how the left-hand widening picks 895 and 896 are constructed and the structure relating to the left-hand widening pick feed cam 875 and the second lowering switch cam 887 has also been described. The manner in which the left-hand widening pick feed cam 875 is intermittently moved into operative position during the various widening operations has been described and a description will now be given as to the means for controlling the second lowering switch cam 887.

Referring to Figure 35, it will be observed that the stem of the second lowering switch cam 887 is held in the block 876 by a closure plate 1294 suitably secured to the block 876 as by screws 1295. The bunter 892, on the outer end of the stem of the second lowering switch cam 887, is urged inwardly by the tension spring 890 (Figure 36) against an arm 1296 (Figures 6, 15, 35 and 36). This arm 1296 extends outwardly and is fixed on the upper portion of a shaft 1297. The shaft 1297 is oscillatably mounted in a bearing block 1300 suitably secured, as by screws 1301, to the front edge of the circular bed plate 110. Also fixedly mounted on the upper portion of the shaft 1297, in Figures 6, 35 and 36, is a forwardly extending arm 1302 which has one end of a link 1303 pivotally connected thereto as at 1304.

Referring to Figure 6, it will be observed that this link extends horizontally past the front of the machine and is pivotally connected, as at 1305 (Figure 5–A), to the front end of a rearwardly extending arm 1306 integral with a vertically disposed tubular member 1307.

The tubular member 1307 is mounted for oscillation on a post 1310 resting on the upper surface of the auxiliary bed plate 196. The post 1310 is held in position on the circular bed plate 196 by a screw 1311. Referring to Figure 6 it will also be observed that the arm 1306 extends from a medial portion of the post 1310 and the post 1310 also has a control arm 1312 integral with the upper end thereof and extending outwardly therefrom. Referring to Figures 5–A and 66, it will be observed that the control arm 1312 has a follower member 1313 suitably secured thereto, as by screws 1314, which is normally urged into engagement with the periphery of the first needle cam control pattern drum 191 by a tension spring 890 in Figure 36.

The first needle cam control pattern drum 191 has first and second spaced cams 1315 and 1316 suitably secured thereto. Upon either of the cams 1315 or 1316 moving into engagement with the follower member 1313, movement is imparted to the arms 1312 and 1306 in a clockwise direction in Figures 5–A and 66. This will cause the link 1303 to move from right to left in Figures 5, 5–A, 6 and 15 with the result that the arms 1302 and 1296 will also move in a clockwise direction. The arm 1296 will then move the second lowering switch cam 887 outwardly to inoperative position.

During all knitting, other than knitting of an ornamental pattern portion of a stocking such as that shown in Figure 88, the second lowering switch cam 887 (Figure 76) is controlled by suitable cams, to be presently described, on the main cam drum 121 (Figure 55). Re-

ferring to Figure 6, it will be observed that there is an arm **1320** fixedly mounted on the lower end of the shaft **1297** which slidably and oscillatably engages the lower end of the bearing **1300**. This arm **1320** extends inwardly and has one end of a connecting rod **1321** connected to the lower surface thereof and extending rearwardly therefrom. This connecting rod is pivotally connected at its rear end, in Figures 3 and 55, to a substantially vertical leg of an L-shaped bell crank **1322** which is oscillatably mounted on an angle clip **1323** (Figure 55) suitably secured to and depending from the upper thrust rod guide bar **357** as is clearly shown in Figure 55. The substantially horizontal leg of the bell crank **1322** slidably engages the upper surface of a pin **1324** projecting outwardly or laterally from a vertically disposed thrust rod **1325**.

The thrust rod **1325** is mounted for vertical sliding movement in the upper and lower thrust rod guide bars **357** and **365**, respectively, and its lower end normally rests on the upper surface of the main cam drum **121**. The main cam drum **121** has a plurality of circularly spaced cams **1326** to **1329**, inclusive, suitably secured therto which are adapted to successively engage the lower end of the thrust rod **1325**.

It is thus seen that, upon any one of the cams **1326** to **1329**, inclusive, engaging the lower end of the thrust rod **1325**, the thrust rod **1325** will be projected upwardly to impart movement in a counter-clockwise direction to the bell crank **1322** in Figure 55. This will impart movement to the connecting rod **1321** causing the same to move from left to right, in Figures 3 and 55, or toward the observer in Figure 6, with the result that the arm **1296** in Figure 15, which is also fixed on the shaft **1297**, will move outwardly at its free end to thus move the second lowering switch cam **887** outwardly with respect to the needle cylinder to inoperative position.

It is evident that, upon the cams **1326** to **1329** successively moving out of engagement with the lower end of the thrust rod **1325**, the thrust rod **1325** will move downwardly by virtue of the tension spring **890**, in Figure 36, which will, of course, move the second lowering switch cam **887** into operative position.

Method of operation and fabric structure

Referring to Figures 88 to 91, inclusive, there are shown a few of the variegated ornamental pattern portions which may be knitted into a tubular fabric, such as the leg portion of a stocking, on the present machine. Since the various cams and other pattern controlled elements on the knitting machine heretofore described are particularly arranged for knitting a stocking of the type shown in Figures 88 and 89, the method of operation will be given with particular reference to this stocking and to the fabric structure shown in Figure 92. All of the stockings shown in Figures 88 to 91, inclusive, have the same characteristic parts typical of a half-hose comprising a ribbed or elastic top or welt **1350**, a ring top or courses **1351**, a leg or ornamental pattern portion **1352**, a ring heel or courses **1353**, a heel pocket **1354**, a foot **1355** and a toe pocket **1356**.

The top **1350**, the ring courses **1351** and **1353** and the foot **1355** of the stockings shown in Figures 88 to 91, inclusive, are all knitted with continuous rotation of the needle cylinder **103**. The leg or ornamental pattern portion **1352** and the heel and toe pockets **1354** and **1356**, respectively, are knitted with reciprocatory movement of the needle cylinder **103**. Referring to Figure 93, there is shown a developed view of the leg or ornamental pattern portion **1352** of the stocking shown in Figures 88 and 89, Figure 89 being a view of the opposite side of the stocking shown in Figure 88.

After knitting the top **1350** and the ring courses **1351**, a detailed description of which will follow later in this specification, the machine then goes into reciprocatory knitting during which a substantially triangularly-shaped upper gusset G–1 is knitted starting with approximately half of the needles and narrowing down to a point at which time all of the needles will be in a raised or inoperative position. The needle cylinder **103** then shogs a half revolution during which time the terminal loops of the gusset G–1 are retained on the needles. Then, a second upper gusset G–2 similar to the gusset G–1 is knitted at the opposite side of the stocking starting with the other half of the needles and narrowing down to a point, resulting in all of the needles again being raised and after which another shogging operation takes place. The gussets G–1 and G–2 are shown, for purposes of description, as being knitted of a gray yarn.

The needle cylinder **103** is then shogged a quarter revolution, following which two needles are lowered to initiate the knitting of diamond R–3 by widening up to a point including substantially half of the needles in the needle circle and then again narrowing down to a point to again elevate all of the needles in the needle circle. In the knitting of the diamond R–3, a suture is formed at the juncture between the upper edges of the diamond R–3 and the proximate lower edges of the gussets G–1 and G–2. For purposes of description, it is to be assumed that the diamond R–3 is knitted of a red yarn.

After the red diamond R–3 is knitted, the needle cylinder is again shogged a half revolution to knit a diamond Y–4 identical to the diamond R–3 and which, for purposes of description, is shown as being knitted of a yellow yarn. After knitting the diamond Y–4 to include substantially half of the needles, and during which time a suture is formed at the juncture between the gussets G–1 and G–2 and the upper edges of the diamond Y–4, a diamond B–5 is knitted, this diamond B–5 shown as being knitted of a blue yarn for purposes of description. The diamond B–5 is knittted of substantially half of the needles and includes half of the needles which are knitted in each of the diamonds R–3 and Y–4.

Following the knitting of the diamond B–5, all of the needles are raised and the needle cylinder is shogged a half revolution following which a diamond B–6 is knitted at the opposite side of the stocking from which the diamond B–5 is knitted. This diamond B–6 is also shown as being knitted of a blue yarn for purposes of description. Diamonds R–7 and Y–8 are then successively knitted with intervening shogging operations following which gussets G–9 and G–10 are knittted also with intervening shogging operations. For purposes of description, the diamond R–7 is knitted of a red yarn, the diamond Y–8 being knitted of a yellow yarn and the gussets G–9 and G–10 being knitted of a gray yarn. The remaining parts of the stocking are also knitted of a gray yarn in the present instance.

Referring to Figure 93, it will be observed that the various rectilinear or triangularly-shaped areas are defined by lines which are to be hereinafter referred to as suture lines, although the loops formed at the suture between two adjacent areas of different colored yarns are substantially the same as the loops formed throughout the stocking in the knitting of any single area. The loop structure at the suture between adjacent areas is shown in detail in Figure 92.

It might be stated that, in the present instance, the needles rarely knit along the suture lines during the shogging operations as is the case in said co-pending application. The only instance in which the needles traverse and knit along the suture line during the shogging operation, with respect to the stocking shown in Figures 88, 89 and 93, is following the knitting of the gusset G–9 after which the needles knit along the suture line defining the lower edge of the diamond Y–8 and the upper edge of the gusset G–10 and following which the gusset G–10 is knitted.

Rib or elastic top

Referring to Figures 46, 48, 49 and 85, the relative positions of the reading ends of the various control fingers with respect to the associated cams on the respective cam drums are shown as circular dots representing the posi-

tion that these control fingers will assume upon "cutting out" a stocking prior to going into the knitting of a new stocking and the machine then goes into the knitting of the elastic top of a stocking.

In knitting the stocking shown in Figures 88 and 89, the latter part of a preceding stocking, that is, the loopers rounds, were knitted of the same yarn, which in this instance is a gray yarn, as that of the top or welt of the next succeeding stocking to be knitted.

Therefore, the clamp arm **543** (Figures 5, 19 and 20) will have assumed an operative position during the knitting of the latter part of one stocking and will remain in this position until the welt **1350**, the ring courses **1351** and the gussets G–1 and G–2 (Figures 88 and 89) have been knitted. In this instance, the clamp arm **543** (Figure 19) will have been moved into operative position by the cam **601** (Figure 55) on the yarn control pattern drum **390**.

Referring to Figure 74, it will be observed that the follower portion **637** on the control finger **636** will have moved into engagement with the periphery of the yarn control pattern drum **390** as the cam **649** moved out of engagement therewith upon "cutting out" a previously knitted stocking and this operated the clamp and cutter mechanism of Figure 19 so the grey yarn is held by the clamp blade **561** (Figures 20 and 21) on the operating end of the clamp arm **543**.

The first movable sinker cam **657** (Figure 94) remains in an outward position during the knitting of the top of the stocking so that the butts of the sinkers may traverse the pathway **655**. This is caused by the cam **675** on the yarn control pattern drum (Figure 57) having moved into engagement with the follower portion **672** of the control finger **671** which, in turn, causes the connecting rod **667** to move rearwardly, moving the sinker cam actuating arm **661** rearwardly from the position shown in Figure 94. This movement of the sinker actuating arm **661** outwardly with respect to the needle cylinder occurred during the knitting of the preceding stocking.

Following the knitting of a preceding stocking, the butts of the needles pass through the stitch cams and, in so doing, release the stitches carried thereby to complete the knitting of the preceding stocking. At this time, the butts of the needles are disposed in the elevation of the pathway P–1 in Figure 76 to the left of the cams **1050** and **1056** and, therefore, in order to insure that the needles will be disposed at the proper elevation for starting the knitting of the stocking, the second lowering switch cam **887** is moved into operative position by means of the cam **1329** on the main pattern drum **121** moving out of engagement with the thrust rod **1325** in Figure 55. Thus, the butts of the needles will move along immediately above the upper edge of the cam **1045** from right to left in Figure 76 and the third needle lowering cam **750** is then moved into operative position in a manner to be presently described.

The rubber or elastic yarn R is then fed to the needles. In so doing, the rubber or elastic yarn feed finger **703** is swung into operative position by means of the cam **704** (Figure 53) on the main cam drum **121** moving into engagement with the lower end of the thrust rod **723**, causing the same to move upwardly in Figures 39 and 53, thus causing the lug **723***a* to engage the arm **722** of the bell crank **717** to impart movement in a counter-clockwise direction thereto in Figure 39. This will cause the lever **712** to move in a clockwise direction in Figure 5 to swing the elastic yarn feed finger **703** inwardly and downwardly away from the observer in Figure 5 and in a counter-clockwise direction to operative position.

Referring to Figures 46, 52 and 53, it will be observed that, immediately after the cam **704** has moved into engagement with the thrust rod **723**, the cam **746** moves into engagement with the corresponding thrust rod **744**. This will elevate the thrust rod **744**, in Figures 39 and 52, and, since the extension arm **742** is secured to the upper end of the thrust rod **744**, the extension arm **742** will also move upwardly or toward the observer in Figure 5. As the extension arm **742** moves upwardly, it will be observed in Figures 32, 33 and 34 that, the movable clamp and cutter blade **732** will move from the position shown in Figure 32 to the position shown in Figure 34 to thus release elastic yarn R immediately after it has been introduced to the needle circle.

Just before the elastic yarn feed finger **703** is moved into operative position, the third needle lowering cam **750** is moved into operative position because a step in rotation is imparted to the second needle cam control pattern drum **797** in a counterclockwise direction in Figure 72, in the manner heretofore described, to thus move the cam **800** on the needle cam control pattern drum **797** into engagement with the follower portion **796** on the control arm **794**. This will cause the control arm **794** to move downwardly and will move the link **791** in a like manner (Figures 6 and 72) to impart movement to the bell crank **785** in a clockwise direction in Figure 6. This will cause the upper end of the bell crank **785** to move from left to right, in Figures 6 and 10, to impart movement to the lever **776** in a counter-clockwise direction in Figure 10.

Now, referring to Figure 27, it will be observed that this will move the third needle lowering cam **750** into operating position to be engaged by the butts of needles directed thereto by virtue of the jacks J riding up the cam **1046**, there being one of these jacks J beneath each of alternate needles as is clearly shown in Figure 76.

It is thus seen that alternate needles will be elevated to take the elastic yarn and the butts of the needles will then pass beneath the cam **750**, as is clearly indicated by the lower path of arrows in Figure 76, to thus take the rubber yarn as the hooks of the needles pass beneath the lower edge of the latch ring **106** indicated by the lowermost needle in the vertical plane of the cam **750** in Figure 76. It is evident that the butts of the needles following the pathway indicated by both the upper and lower rows of arrows will then pass through the stitch cams to follow the pathway P–1.

Referring to Figures 27 and 28, it is evident that upon the elastic yarn stitch cam **750** being moved into operative position, the presser screw **772** will impart clockwise movement to the sinker operating lever **762** causing the upper end thereof to move outwardly in Figure 10 to thus move the cam **751** into the path of the butts of the sinkers **104**. The elastic yarn is fed to the needles at a point immediately above the second movable sinker cam **751** and, therefore, movement of the sinker cam **751** into the path of travel of the butts of the sinkers conditions the sinkers for receiving the elastic yarn R in the nibs thereof, this operation taking place in the identical manner of that shown and described in said Patent No. 2,420,771 for creating a ribbed effect in the top of a stocking.

Subsequent to the introduction of the elastic yarn R to the needle circle, the first operation in the knitting of a sock is to swing the uppermost of the yarn feed fingers, which is the yarn feed finger **341** (Figures 60 and 61), inwardly to the position shown in Figure 13 and this will aline the yarn from the inner end of the clamp arm **543** with the slot **435** in the latch ring **106** (Figure 13). Inasmuch as the yarn feed finger **341** is the uppermost of the yarn feed fingers in Figures 60 and 61, it is not necessary that the yarn feed fingers or the carriage therefor be elevated prior to the yarn feed finger **341** being swung inwardly to the position shown in Figure 13 as is the case with respect to the remaining yarn feed fingers **342** and **344** inclusive. The yarn feed finger **341** is swung inwardly, from the position shown in Figure 10 to the position shown in Figure 5 due to a step being imparted to the yarn control pattern drum **390** in the manner heretofore described. This moves the step **423***a* of the cam **423** into engagement with the follower portion **422** of the control finger **420** (Figures 46 and 62). This will, of course, cause the control finger **420** to move

in a clockwise direction, in Figure 62, thus moving the link **416** rearwardly in Figures 5, 10 and 62 which will, in turn, impart movement in a counter-clockwise direction to the yarn finger actuator **402** in Figures 5 and 10.

This moves the free end of the yarn feed finger **341** to substantially the position shown in Figure 13 and another step is then imparted to the yarn control pattern drum **390**. During the course of this step of the pattern drum **390**, the step **423***a* then moves out of engagement with the follower portion **422**, in Figure 62, permitting the follower portion **422** to move into engagement with the surface **423***b* to move the free end of the yarn feed finger **341** to the position shown in Figures 11 and 12.

However, while the surface **423***a* of the cam **423** is in engagement with the follower portion **422** of the control finger **420** in Figure 62, the yarn feed finger **341** is elevated slightly by means of a cam **391** (Figure 60) which moves into engagement with the follower portion **377** of the control finger **376**. Thus, the control finger **376** will cause the bell crank **362** to move in a clockwise direction in Figure 60 to elevate the guide post **331** and the associated yarn feed fingers **341** to **344**, inclusive.

This moves the yarn feed finger **341** upwardly from substantially the position shown in Figure 58 to the position shown in Figures 60 and 62, during which the yarn is moved upwardly through the slot **435** to enter the yarn feed opening **434**. The yarn feed finger **341** is then moved from the position shown in Figure 13 to the position shown in Figures 11 and 12 in the manner heretofore described.

As the yarn moves upwardly through the slot **435** in the latch ring **106** (Figures 11, 12, 13 and 14), the yarn is moved upwardly between the hooks and latches of the needles in the needle circle and is then fed to the needles as the needle cylinder **103** rotates in a counter-clockwise direction as is shown in Figure 13 and, thus, the yarn is fed to the needles as shown in Figure 11 during counter-clockwise rotation of the needle cylinder.

The desired number of courses are then knitted in forming the top of the stocking and then the cams **704** and **746** (Figures 52 and 53), on the main pattern drum **121**, successively move out of engagement with the respective thrust rods **723** and **744**, permitting the thrust rods to successively move downwardly to move the elastic yarn feed finger **703** to inoperative position as shown in Figure 5 and, immediately thereafter to move the extension arm **742** downwardly from the position shown in Figure 34 to the position shown in Figure 32 for successively operating the clamping and cutting mechanism for the elastic yarn R in the manner heretofore described.

The cam **800** on the second needle cam control pattern drum **797** (Figure 72) then moves out of engagement with the follower portion **796** of the control arm **794** to permit the tension spring **757** (Figure 10) to again move the second movable sinker cam **751** inwardly to operative position. This, of course, also moves the third needle lowering cam **750** outwardly to permit the needle butts to continue movement in the plane of the pathway **P–1** as they pass through the stitch cams in knitting the ring top **1351** (Figures 88 and 89).

Knitting gusset G–1

During the knitting of the final course in the ring top **1351** of the stocking, the needle cylinder **103** rotates in a counter-clockwise direction and the needle cams **852** and **887** are successively moved into the path of the needles for elevating substantially half of the needles to pass above the stitch cams and for causing the remaining half of the needles to remain in a lowered position so as to pass through the stitch cams.

In this instance, the needles in groups D and A (Figures 44 and 45) are successively raised to inoperative position and the needles in groups B and C remain in a lowered or operating position. The cam **852** is moved into operative position due to the first needle cam control pattern drum **191** having been moved a first step, in the manner heretofore described, during which the follower member **1212** (Figures 5–A and 64) is engaged by the step **1210***a* on the cam **1210** and is then engaged by the high point of the cam **1210** to move the cam **852** inwardly in a step-by-step manner so that the cam **852** will engage the two long butt needles DNL, as the needle cylinder rotates in a counter-clockwise direction in Figure 44, and will then be moved inwardly to its full operating position as it engages the medium butt needles BNM to thus be disposed so as to elevate the short butt needles DNS and the needles in group A. Now, in order that another step in rotation may not be required of the first needle cam control pattern drum **191**, the second lowering switch cam **887** is controlled at this point by the main pattern drum **121** (Figure 3).

As the short butt needles ANS in group A (Figure 44) move in a counter-clockwise direction past the cam **887** and immediately before being elevated by the needle cam **852** (Figure 77), the second lowering switch cam moves inwardly because the cam **1326** (Figure 55) on the main pattern drum **121** moves out of engagement with the lower end of the thrust rod **1325** thus permitting the same to move downwardly to, in turn, permit the connecting rod **1321** to move from right to left in Figures 3 and 55. As the connecting rod **1321** moves from right to left in Figures 3 and 55, the right-hand portion of the arm **1320** (Figure 6) moves away from the observer and this causes the arm **1296** to move in a like manner with the result that the tension spring **890**, in Figure 36, moves the second lowering switch cam **887** inwardly to where its working end will resiliently engage the outer surfaces of the short butt needles ANS and, as the two long butt needles BNL of group B move into engagement with the second lowering switch cam **887**, they will be lowered by this cam and will permit the cam **887** to move all the way into operative position.

It is thus seen that the needles in groups D and A will be successively elevated to traverse a pathway **P–2**, in Figure 77, and also, the leading few of the needles in group B will be lowered slightly by the cam **887** so as to follow pathway **P–3** in Figure 77 below the cam **852**. The reason only a few of the leading needles in group B will be lowered by the cam **887** is that both of the cams **887** and **852** are moved to inoperative position after all of the needles in groups A and D will have been raised by the first elevating switch cam **852**.

It is thus seen that the needle cam **887** (Figure 77) is moved into operative position after the needle cam **852** has elevated substantially all of the needles in groups D and A so as to insure that none of the needles in groups B and C will be elevated by the needle cam **852**, the two long butt needles BNL serving to separate the needles in groups B and C from those in groups D and A. It is evident that upon the needle cam **852** moving to inoperative position, it is no longer necessary that the needle cam **887** remain in an operating position.

Although the second lowering switch cam **887** was permitted to move into operative position by the cam **1326** on the main cam drum **121** having moved out of engagement with the thrust rod **1325**, the second lowering switch cam **887** is moved out of operative position by the cam **1315** (Figure 66) on the first needle control pattern drum **191** as this cam **1315** moves into engagement with the follower member **1313** to impart movement to the arms **1312** and **1306** in a clockwise direction in Figures 5–A and 66. It is evident that this will cause the arm **1296** to move in a clockwise direction, in Figure 5, by virtue of the link **1303** and the arm **1302**. Clockwise movement of the arm **1296**, in Figure 5, will cause the same to move outwardly at its free end to move the needle cam **887** outwardly as is clearly shown in Figure 36.

At substantially the same time that the second lowering switch cam **887** is moved outwardly to inoperative

position the cam **1210** (Figure 64) moves out of engagement with the follower member **1212** on the arm **1214** to permit the arm **857** to be moved outwardly with first elevating switch cam **852** by the spring loaded plunger **871** (Figure 25) thus moving the first elevating switch cam **852** to inoperative position.

The inward and outward movement of the needle cams **887** and **852** in the manner just described takes place during a partial revolution, in a counter-clockwise direction, of the needle cylinder in knitting the ring top **1351**. The needle cylinder comes to rest momentarily at the end of this final counter-clockwise revolution and the shogging clutch mechanism, shown in Figures 7, 16 and 17, is conditioned to cause the needles at the juncture of groups B and C to move equidistant past the knitting station.

The shogging of the needle cylinder **103** actually takes place at the time the needle cams **887** and **852** (Figure 77) are in an operative position for elevating the needles in groups D and A to inoperative position. As the needle cylinder moves its final revolution in the knitting of the ring top **1351**, the conventional clutch mechanism for changing from rotary to reciprocatory knitting is operated in a well-known manner by one of the lugs **164** on the main pattern chain **163** (Figure 7) having caused the cam **157** to rotate to where it will change the position of the shifter **156** (Figures 7 and 16) and to where the shaft **153** will oscillate in fixed relation to the pinion **155** by virtue of the oscillating quadrant **184**.

Simultaneously with the needle cylinder approaching the end of its final revolution in the knitting of the ring top **1351**, the locking finger **1012** is moved in a clockwise direction in Figure 16 to move the same out of engagement with the notch **1001** in the locking disk **1000** (Figure 17). This locking finger **1012** is moved out of the notch **1001**, in Figure 17, because of the cam **1031** on the first needle cam control pattern drum **191** (Figure 70) moving into engagement with the reading end of the control finger **1030** to thus cause the control finger **1030**, along with the shogging crank arm **1022** (Figure 16), to move in a counter-clockwise direction.

The operation of the machine is so timed that the locking finger **1012** moves out of engagement with the notch **1001** at precisely the time that the needle cylinder is conditioned to move in its first clockwise revolution following the final counter-clockwise revolution thereof in knitting the ring top **1351**. Therefore, the shaft **153** (Figure 17) will then move in a counter-clockwise direction and, thus the locking finger **1012** will move around the locking disk **1000** in a counter-clockwise direction in Figure 17, along with the shogging disk **945**, and the locking finger **1012** will again come to rest immediately in alinement with the notch **1001** but will not move into the same.

Now, upon the next clockwise revolution of the shaft **153** the locking finger **1012** will move in a clockwise direction, in Figure 17, at which time the cam **1031** (Figure 70) will move out of engagement with the reading end of the control finger **1030** to permit the locking finger **1012** to resiliently engage the outer periphery of the locking disk **1000** to thus lead into the notch **1004**. This will cause the locking disk **1000** to rotate one quarter of a revolution with the shogging disk **945** to impart one quarter of a revolution to the needle cylinder **103** in a counter-clockwise direction, this one quarter of a revolution of the needle cylinder taking place while the needle cams **887** and **852** are in an operative posiiton and also while they are being moved to an inoperative position and causing the needles in groups B and C to pass through the stitch cams to knit the first course in the gusset G–1.

In order that the narrowing picks **1060** and **1061** may be properly conditioned for elevating two needles upon each reciprocation of the needle cylinder, the pick restrictor **1075** (Figures 40 and 41) is permitted to move outwardly, to the inoperative position shown, by the tension spring **1077** at substantially the time of knitting the ring top **1351**. This pick restrictor **1075** previously was held in an operative position in each of the narrowing picks **1060** and **1061** by the corresponding latch **1090**, and then the corresponding cams **1113** and **1116** on the main pattern drum **121** moved into engagement with the lower ends of the respective thrust rods **1110** and **1111** (Figures 51 and 54) causing the thrust rods to move upwardly to, in turn, cause the outer ends of the corresponding levers **1102** to move downwardly to elevate the laterally extending portions **1095** of the corresponding control levers **1096**. This raised the latches **1090** out of engagement with the corresponding pick restrictors **1075** associated with the corresponding narrowing picks **1060** and **1061**.

Thus, upon each reciprocation of the needle cylinder **103**, following the shogging operation last described, the narrowing picks **1060 and 1061** will alternately be engaged by the two leading needles in the groups B and C, depending upon the direction of rotation of the needle cylinder, to elevate these two needles to inoperative position until all of the needles in groups B and C in addition to all the needles in groups A and D shall have been elevated.

Gusset G–2

In knitting the final partial course in the gusset **G–1**, the two needles CNL at the juncture of groups B and C (Figures 44 and 45) pass through the stitch cams in a counter-clockwise direction, in the course of which a second shogging operation occurs, and on the succeeding clockwise revolution of the needle cylinder these two needles CNL are elevated by the left-hand narrowing pick **1060**.

As the needle cylinder **103** approaches the end of this clockwise revolution, in Figure 44, the right-hand widening pick feed cam **825** is moved into operative position, as shown in Figure 78, so as to lower half of the needles in the needle circle, including the needles in groups A and D to operative position for knitting the first course in the gusset G–2.

Referring to Figure 71, the second needle cam control pattern drum **797** will have moved during previous knitting to where another step will be imparted thereto during the latter part of a clockwise revolution of the needle cylinder **103** following the knitting of the gusset G–1 and at which step the cam **803** moves into engagement with the follower portion **806** on the control arm **807** causing the link **810** to move downwardly, in Figures 6 and 71, to impart counter-clockwise movement to the primary and secondary bell cranks **813** and **817** in Figure 6. This will cause the bell cranks **813** and **817** to move in a clockwise direction, in Figure 26, thus moving the right-hand widening pick feed cam **825** into operative position.

As above stated, the second shogging operation occurs as the final course is knit in gusset G–1 and with counter-clockwise movement of the needle cylinder in Figure 44. Now, upon completion of this counter-clockwise movement of the needle cylinder, during which the locking disk **1000** moves in a clockwise direction in Figure 17, the locking finger **1012** (Figures 16 and 17) is again moved out of engagement with the notch **1004** in the locking disk **1000**, by means of the cam **1032**, in Figure 70, moving into engagement with the control finger **1030**. It is evident that the needle cylinder **103** will cease to rotate in the course of its latter counter-clockwise revolution and the locking finger **1012** then moves out of engagement with the notch **1004**. The locking finger **1012** then moves about the locking disk **1000** a complete revolution in a counter-clockwise direction in Figure 17, during which time the needle cylinder is stationary. The locking finger **1012** then reverses its movement, moving in a clockwise direction, during which the cam **1032** (Figure 70) moves out of engagement with control finger **1030** so the locking finger **1012** will resiliently engage the locking disk **1000** between the notches **1001** and **1003** and to impart further clockwise movement to locking disk

1000 in Figure 17 and further counter-clockwise movement to the needle cylinder **103** in Figure 44.

This will condition the needle cylinder so that needles at the juncture of groups A and D will move equidistant past the knitting station during reciprocation thereof. As the needle cylinder **103** continues this counter-clockwise movement, during which it rotates a total of one and one-half revolutions, the needles remaining in groups A and D are lowered to operative position, the needle cam 825 having been moved into operating position against the outer surfaces of the butts of the short butt needles CNS in group C and then into full operating position beneath the needles DNL and DNM as these last-named needles are lowered along with the rest of the needles in groups D and A.

The needle cam **825** was, at this point, moved into engagement with the outer surfaces of the butts of the needles CNS in group C to engage and lower the long butt needles DNL, as it moved into position above the needles BNM while lowering the same, and then lowering all of the needles in groups D and A successively. In so doing, the butts of the needles in groups D and A traverse a pathway P–4 in Figure 78.

Now, as the needles ANS in group A move adjacent the second elevating switch cam **1202** this cam **1202** is moved inwardly against the outer surfaces of the butts of these short butt needles ANS so as to be disposed in the path of the succeeding long butt needles BNL to move these long butt needles upwardly to where they will pass above the stitch cams, since these long butt needles, along with a few of the medium butt needles BNM will have been directed downwardly by the needle cam **825** before this right-hand widening pick feed cam **825** will have moved out of the path of the needles as they are directed thereto from between the upper and lower leveling cams **1200** and **1201**. In this instance, the second elevating switch cam **1202** (Figure 78) will have been moved into operative position by means of the cam **1247** (Figure 68), on the first needle cam control pattern drum **191**, moving into engagement with the reading end of the control finger **1244** causing the same to move in a counter-clockwise direction in Figures 5–A and **68**.

This will cause the vertically disposed lip **1242** to move inwardly, from right to left in Figure 22, to, in turn, move the second elevating switch cam **1202** inwardly in a step-by-step manner since the leading end of the cam **1247** is stepped for this purpose and so that the cam **1202** may be disposed in the path of the butts of the long butt needles BNL and then moved inwardly beneath the long butt needles BNL and the butts of the medium butt needles BNM where it will remain to elevate any of the needles in groups B and C which may have been lowered by the right-hand widening pick feed cam **825**.

The cam **803** (Figure 71) moves out of engagement with the follower portion **806** to move the needle cam **825** to inoperative position after having lowered the needles for knitting the gusset G–2 so the cam **825** will be out of the way during the knitting of this gusset G–2.

During this counter-clockwise movement of the needle cylinder **103**, in Figure 44, which occurred during the second shogging operation, the right-hand narrowing pick **1061** had to be moved to inoperative position, so as to move the left-hand widening pick **1060** to operative position, since none of the butts of the needles engage the right-hand narrowing pick **1061** during this counter-clockwise movement of the needle cylinder **103**. Therefore, the cam **1171** (Figure 69) moved into engagement with the follower portion **1166** of the control finger **1163** to cause the control finger **1163** to move in a clockwise direction in Figures 69 and 5–A to, in turn, move the connecting rod **1161** from left to right in Figures 15 and 69 to move the right-hand narrowing pick **1061** to inoperative position and, in so doing, to move the left-hand narrowing pick **1060** into operative position so as to be engaged by the leading needles in group A upon the next clockwise revolution of the needle cylinder.

Another reason the right-hand narrowing pick **1061** is moved to inoperative position as the needle cylinder moves in a counter-clockwise direction is to insure that all of the needles in groups B and A may pass through the stitch cams in knitting the first course in the gusset G–2 rather than permitting the two long butt needles DNL in group D to be elevated to inoperative position before they have had a chance to pass through the stitch cams. The narrowing then continues from course to course in the same manner as in knitting the gusset G–1, that is, two needles being elevated to inoperative position with each rotary movement of the needle cylinder in each direction by the narrowing picks **1060** and **1061** until all of the needles in groups D and A are again elevated to inoperative position along with the needles in groups B and C.

Diamond R–3

The final course in the gusset G–2 is knitted by the two needles ANL at the juncture of groups A and D as the needle cylinder **102** moves in a counter-clockwise direction. The needle cylinder then moves a complete revolution in a clockwise direction, in Figure 44, during which the left-hand narrowing pick **1060** elevates the remaining two needles ANL and, thus, moves the right-hand narrowing pick **1061** into an operative position. Following this last-named clockwise revolution of the needle cylinder **103**, in Figure 44, a third shogging operation takes place during which a change is made in the yarn feed fingers requiring that the first sinker cam **657** (Figure 94) be moved inwardly to interrupt the normal path of travel of the butts of the sinkers **104** and the clamping and cutting mechanism for the gray yarn also operates (Figure 19, 20 and 21). The yarn feed finger **341** moves out of operating position, after having withdrawn the yarn from the yarn feed opening **434**, through the slot **435** in Figures 11, 12 and 13, and the yarn feed finger **342**, immediately below the yarn feed finger **341**, is elevated and moved into operative position in a manner similar to that in which the yarn feed finger **341** had previously been moved into operative position. The first lowering switch cam **1203** is also moved into operative position (Figure 76) and the right-hand narrowing pick **1061** is moved into inoperative position for purposes to be presently described.

In knitting the final course in the gusset G–2, during which the two needles ANL, in Figure 44, pass through the stitch cams with movement of the needle cylinder in a counter-clockwise direction, it is necessary that the sinkers **104** be moved inwardly at the knitting station by means of the first movable sinker cam **657**, in Figure 94, to cause the butts of the sinkers **104** to traverse the pathway **656** and, at substantially the same time, it is necessary that the yarn feed finger **341** be moved so as to aline the gray yarn with the slot **435** in the latch ring **106** (Figure 11) and then move downwardly to remove the yarn from the opening **434**. Then, the yarn feed finger **341** swings outwardly from the position shown in Figure 5 to the position shown in Figure 10 and, in so doing it directs the yarn to the clamping and cutting means where the grey yarn is clamped and cut.

Referring to Figure 57, the yarn control pattern drum **390** will have rotated to where the follower portion **672** of the control finger **671** will move into the space between the cams **675** and **676** and, in so doing, the tension spring **674** will move the connecting rod **667** forwardly to move the sinker cam actuating arm **661**, along with the cam **657**, in a counterclockwise direction in Figure 94. At this time, the portion **423c** of the cam **423**, on the yarn control pattern drum **390** (Figure 62), moves into engagement with the follower portion **422** on the control finger **420**.

This will cause the control finger **420** to move in a clockwise direction, in Figure 62, to again move the yarn

feed finger 341 from the position shown in Figure 11 to the position shown in Figure 13, after which the yarn feed fingers 341 to 344, inclusive, are permitted to move downwardly, simultaneously because of the cams 391, in Figure 60, moving out of engagement with the follower portion 377 (Figure 60), permitting the guide post 331 to move to its lowermost position. It has already been described how a plate 412 (Figure 10) on the yarn feed finger actuator 402 causes the yarn finger actuator 402 to move vertically with the particular yarn feed finger that is in either of the positions shown in Figures 11 and 13. Therefore, upon the post 331 moving downwardly to its normal position the portion 423c of the cam 423 in Figure 62 moves out of engagement with the follower portion 422 of the control finger 420, thus permitting the follower portion to move into engagement with the periphery of the yarn control pattern drum 390 and permitting the yarn feed finger 341 and the yarn finger actuator 402 to assume the position shown in Figure 10.

However, the yarn from the yarn feed finger 341 will then extend from the yarn feed finger 341 in the position in which it is shown in Figure 10 to the last two needles which pass through the stitch cams, which in this instance, is the two needles ANL in Figure 44, and, with further movement of the needle cylinder in a counter-clockwise direction in Figure 10, the needles will cooperate with yarn feed finger 341 to direct the yarn to the cam plate 557, in Figure 19, which will, in turn, direct the yarn to the inner end of the clamp arm 543 and between the cutter blades 611 and 613 in Figure 95 having been opened at the time the gray yarn was first passed through the needles in knitting the top of the stocking because the cam 642 in Figure 74 will move out of engagement with the follower portion 637 upon the gray yarn being directed to the clamp arm 543 and to the cutter blades 611 and 613 in the manner heretofore described.

Referring to Figures 5 and 55, it will be observed that the cam 601 on the yarn control pattern drum 390 moves out of engagement with the follower portion 600 of the control finger 697, which takes place immediately following the clamping and cutting operation just described. This permits the tension spring 554 associated with the clamp arm 543 (Figure 20) to move the clamp arm 543 outwardly causing the clamp positioning arm 542 to move in a clockwise direction, in Figure 19 to, in turn, move the follower portion 600 of the control finger 597 against the yarn control pattern drum 390 between the cams 601 and 602.

The needle cylinder 103 then makes its clockwise revolution in Figure 44 to permit the left-hand narrowing pick 1060 to elevate the two needles ANL at the juncture of groups A and D.

The needle cylinder 103 then moves in a counter-clockwise direction in a step-by-step manner for one and a quarter revolutions during which the third shogging operation takes place so as to position the locking finger 1012 in engagement with the notch 1002 and to cause the needles DNL at the juncture of groups C and D to move equidistant past the knitting station. The locking finger 1012 is caused to move out of engagement with the notch 1003 and into engagement with the notch 1002 in the locking disk 1000 (Figure 17) by successive movement of the cam 1033 (Figure 70) into and out of engagement with the control finger 1030.

As the needle cylinder 103 is moved in a counter-clockwise direction, during which the third shogging operation takes place, the high point of the cam 508 (Figure 73) moves into engagement with the control finger 513 causing the same to move in a counterclockwise direction to, in turn, cause the bell crank 522 to move in the same direction in Figure 73. The arm 530 of the bell crank 522 will then engage the roller 531 to raise the clamp carriage 534 to a predetermined level. Now, since the teeth in the mating toothed members 574 and 576 (Figure 55) are ratchet teeth, the tension spring 577 will urge the toothed member 576 into engagement with adjacent teeth in the toothed member 574 and the follower portion 513 of the control finger 514, in Figure 73, will then be engaged by the low point of cam 508 on the yarn control pattern drum 390 to permit the clamp carriage 534 to move downwardly, by gravity, until the tooth in the member 576 is in full engagement with one of the teeth in the toothed member 574 on the angle plate 533 of the clamp carriage 534.

This will position the clamp arm 544 (Figures 19 and 20) in the same horizontal plane as the positioning arm 543, following which the cam 602, in Figure 55, will engage the follower portion 600 of the control finger 497 to again move the connecting rod 591 forwardly to impart movement to the positioning arm 542 in a counter-clockwise direction in Figure 19 to thus move the clamp 544 into operative position.

Also, during the counter-clockwise revolution of the needle cylinder 103, in Figure 44, in which the third shogging operation takes place, the second yarn feed finger 342 is positioned at the required elevation and is moved into operative position by means of the portion 392a of the cam 392 (Figure 60) moving into engagement with the follower portion 377 of the control finger 380 to again elevate the guide post 331, along with all of the yarn feed fingers 341 to 344, to where the yarn feed finger 342 will be disposed in the path of the yarn finger actuator 402. The yarn finger actuator 402 will then be moved from the position shown in Figure 10 to substantially the position shown in Figure 5, in a step-by-step manner, as the portion 424a of the cam 424 engages the follower portion 422 of the control finger 420. This moves the second yarn feed finger 342 to the position in which the yarn feed finger 341 is shown, in Figure 13, at which point the red yarn will extend from the working end of the clamp arm 544 to the free end of the yarn feed finger 342.

The yarn feed finger 342 is then moved upwardly and then outwardly in a manner identical to that heretofore described for the yarn feed finger 341, the successive cams being employed for this purpose, that is, the cam 392b in Figure 60 serving to elevate the yarn feed finger to move the red yarn into the yarn feed opening 434 in the latch ring 106 and the cam surface 424b permitting the yarn feed finger to move from the position shown in Figure 13 to the positions shown in Figures 11 and 12.

Also, during this counter-clockwise revolution of the needle cylinder, in which the third shogging operation takes place, the narrowing pick 1061 is moved into inoperative position and the first lowering switch cam 1203 is moved into an operative position by means to be presently described. For instance, the right-hand narrowing pick 1061 (Figure 15) is moved to inoperative position by the cam 1172 on the first needle cam control pattern drum 191 and through the intervening connections heretofore described. At substantially the same time that the needle cam 1203 is moved into operative position, the right-hand widening pick feed cam 825 is also moved into operative position by means of the cam 804 in Figure 17 and intervening connections.

The needle cam 1203 is moved into operative position, at this time, by the cam 1281 on the first needle cam control pattern drum 191 in Figure 67. This cam 1281 engages the control finger 1272 moving the same in a counter-clockwise direction in Figures 5–A, 15 and 67. It will be observed, in Figure 15, that counter-clockwise movement of the control finger 1272 will cause clockwise movement of the plate 1266 along with the spring loaded lever 1264. The lever 1264 will then resiliently engage the bunter 1263 (Figures 22 and 23) and will move the stem of the first lowering switch cam 1203 inwardly until the bunter 1263 engages the outer surface of the angle plate 1229 to thus restrict inward movement of the cam 1203 to where this cam 1203 will be in the path of the butts of long butt needles only.

The purpose of the spring loaded lever **1264** (Figure 15) is to permit the lever **1264** to urge the bunter **1263** against the outer surface of the plate **1229** although the plate **1266** may move beyond the point at which the lever **1264** is permitted to move, through its engagement with the bunter **1263**, and through engagement of the bunter **1263** with the outer surface of the angle plate **1229**.

Now, during a part of the counter-clockwise revolution of the needle cylinder in which the third shogging operation takes place, it is necessary that the two needles DNL at the juncture of groups C and D (Figures 44 and 45) be lowered to operative position so as to pass through stitch cams. Therefore, the right-hand widening pick feed cam **825** is moved into operative position by the cam **804** on the second needle control cam pattern drum **797** (Figure 71) so as to resiliently engage the outer surfaces of the butts of the short butt needles CNS and as the long butt needles DNL move into engagement with the cam **825**, they are projected downwardly along with the succeeding needles in groups D and A, the needles DNL permitting the cam **825** to move all the way into operative position.

However, as the needles DNL and the succeeding needles in groups D and A are moved downwardly by the cam **825**, they are caused to engage the first elevating switch cam **1202** to be projected upwardly to the level of the first lowering switch cam **1203** (Figure 79). However, since the switch cam **1203** is sufficiently close to the needle cylinder **103** so as to engage only the long butt needles, the two long butt needles DNL will engage the lower surface of the first lowering switch cam **1203** to be moved downwardly to traverse a pathway P–**6** as they pass through the stitch cams and the remaining needles which have been elevated by the second elevating switch cam **1202** will continue along a pathway P–**7** to pass above the stitch cams (Figure 79). It is thus seen that the two needles DNL will pass through the stitch cams to draw the first stitches in knitting the first course at the point of the diamond R–**3** (Figures 88 and 89).

As the stitches are formed by the two long butt needles DNL in knitting the first course in the diamond R–**3**, the cam **643** (Figure 74) will move into engagement with the follower portion **637** of the control finger **636** to again cause the heart-shaped cam **630** in (Figure 19) to move the plunger **564** downwardly for releasing the red yarn from the clamp arm **544**. Also, the cam **804** (Figure 71) moves out of engagement with the projection **806** on the control arm **807** to permit the right-hand widening pick feed cam **825** to return to inoperative position. The cam **676** (Figure 57) also moves into engagement with the follower portion **672** on the control finger **671** to again move the sinker actuating arm **661** outwardly to where the butts of the sinkers **104** may again traverse the pathway **655** in Figure 94. The first course in the red diamond R–**3** is knitted by the two needles DNL as the needle cylinder rotates in a counter-clockwise direction in Figure 44.

Now, at the end of this revolution of the needle cylinder **103** in a counter-clockwise direction the widening operation is initiated as one of the cams **951** on the cam wheel **950** (Figure 3) moves out of engagement with the follower portion **991** of the bell crank **992** to permit the follower key portion **942** (Figure 17), on the switch bar **935**, to move into engagement with cam ring **944** on the shogging disk **945** and into the notch **946** between opposed ends of the annular cam **943** as shown in Figure 42. With reciprocation of the shaft **153** and the shogging disk **945**, the follower key **942** will be caused to alternately engage opposed sides of the cam **943** to impart oscillatory motion to the feed cam actuating arm **843**, in Figure 5, for alternately moving the respective left-hand and right-hand widening pick feed cams **875** and **825** into operating position in accordance with the direction of rotation of the needle cylinder **103** and, in so doing, the left-hand widening pick feed cam **875** will be the first cam to be moved into operative position, since the first revolution of the needle cylinder in which a widening operation is effected is in a clockwise direction in Figures 5 and 44.

During the knitting of the preceding stocking, on this machine, the right-hand widening picks **893** and **894** were moved downwardly and outwardly relative to the needle cylinder to inoperative position thus conditioning the left-hand widening picks **895** and **896** for receiving and each lowering two needles into operative position upon movement of the left-hand widening pick feed cam **875** into operative position and with clockwise rotation of the needle cylinder.

It might be stated that the cam **1196**, in Figure 50, is in engagement with the lower end of the thrust rod **1194** at the time that the left-hand widening pick feed cam **875** is moved into operative position and this causes the widening pick knock-off lever **1181** to occupy substantially the position shown in Figure 3 so as to permit the first left-hand widening pick **895** to assume an operative position.

Since the two needles DNL passed through the stitch cams with counter-clockwise movement of the needle cylinder in knitting the first course in the diamond R–**3**, upon clockwise movement of the needle cylinder **103**, or movement of the butts of the needles from left to right, in Figures 76 and 84, the left-hand widening pick feed cam **875** will engage the outer surfaces of the butts of the medium butt needles DNM in group D under resilient pressure of the L-shaped dog **842** (Figure 5) and as the two long butt needles DNL move adjacent the same, the left-hand widening pick feed cam **875** will snap into full operative position so as to engage and lower the butts of the needles in group C. This will cause all of the needles in group C to traverse a pathway P–**10** from left to right in Figure 84 and the first four short butt needles CNS adjacent the long butt needles DNL will engage the left-hand widening picks **895** and **896**, each of these widening picks **895** and **896** engaging two of the short butt needles CNS (Figures 44 and 84), to move the same downwardly to traverse a pathway P–**11** from left to right in Figure 84.

However, since the left-hand narrowing pick **1060** is in an operative position adjacent the left-hand stitch cam **1056**, the left-hand narrowing pick **1060** will engage the two leading needles of those needles which have been lowered which, in this instance, will be the two long butt needles DNL, and will elevate these needles DNL along a pathway P–**12**, in Figure 84, causing the needles DNL to pass above the stitch cams as the four leading short butt needles CNS of group C continue on through the stitch cams to knit the second coure in the diamond R–3.

It is evident that, upon movement of the left-hand widening picks **895** and **896** downwardly in lowering the first four needles in group C, in Figure 44, the tails **910** of these left-hand widening picks **895** and **896** will engage the left-hand downturned portions of the respective first and second widening pick swing arms **912** and **913** (Figure 6) causing them to move in a counter-clockwise direction in Figure 5 and their right-hand down turned portions will engage the tails of the respective right-hand widening picks **893** and **894** to move these widening picks **893** and **894** into operative position so as to be engaged by the leading four needles in group D during the knitting of the third course of the diamond R–**3**, which occurs during a counter-clockwise revolution of the needle cylinder. This will include the two long butt needles DNL and the first two adjacent short butt needles DNM in group D.

The second two short butt needles in group C will then be elevated by the right-hand narrowing pick which will have been moved to operative position during the preceding clockwise revolution of the needle cylinder and thus the first two short butt needles in group C, the two long butt needles DNL and the first two medium butt needles DNM in group D will knit the third course.

Referring to Figure 80, it will observed that, upon movement of the needle cylinder **103** in a counter-clockwise

direction or upon movement of the needle butts from right to left in Figure 80, the elevated needles will traverse a pathway P–13 as they are engaged by the right-hand widening pick feed cam **825** and are directed downwardly to the right-hand widening picks **893** and **894** and the leading four needles will be lowered to operate position by the widening picks **893** and **894** to where their butts will traverse a pathway P–14. The remaining subsequent needles which have been lowered by the right-hand widening pick feed cam **825** will then continue in a straight line from the lower edge of the cam **825** and will be elevated by the second elevating switch cam **1202** to traverse a path P–15 and the leading two needles, in which instance was the second two short butt needles CNS from the long butt needles DNL in Figure 44, will be elevated by the right-hand narrowing pick **1061** to traverse a pathway P–16 to thus pass above the stitch cams along with those needle butts which traversed the pathway P–15.

It will be observed in Figure 84, that those needles which were not lowered by the left-hand widening picks **895** and **896**, after having been lowered by the left-hand widening pick feed cam **875**, continue in a straight line from the lower edge of the widening pick feed cam **875** and are then elevated by the auxiliary needle leveling cam **1204** traversing a pathway P–17 as the needle butts move from left to right in knitting the second course in the red diamond R–3. The widening operations then continue in substantially the manner heretofore described until all of the needles in groups C and D have been lowered to pass through the stitch cams in knitting the centermost course in the diamond R–3.

One of the cams **951** on the cam ring **950** (Figure 3) then moves into engagement with the follower portion **991** on the control finger **992** causing the same to move in a clockwise direction to move the follower key portion **942** (Figure 17) out of engagement with the cam ring **944** and to thus permit the widening pick feed cams **825** and **875** to cease their alternate movement into and out of operation and also rendering the widening picks **893** to **896**, inclusive, inoperative. The final course during which the widening operation takes place in knitting the diamond R–3 occurs upon movement of the needle cylinder in a counter-clockwise direction or from right to left, in Figures 76 and 80, and, since the two long butt needles CNL (Figure 44) were lowered during the last preceding clockwise revolution of the needle cylinder, the last four short butt needles DNS in group D are lowered by the right-hand widening picks **893** and **894** to traverse the pathway P–14 (Figure 80) and the two long butt needles CNL are elevated by the right-hand narrowing pick **1061** to traverse the pathway P–16 as the remaining needles in groups C and D pass through the stitch cams. Thus, the right-hand narrowing picks **893** and **894** assume an inoperative position upon this final revolution of the needle cylinder, during which a widening operation takes place and the right-hand widening pick feed cam **825** remains in an operative position while the left-hand widening pick feed cam **875** remains in an inoperative position.

The machine then goes into the narrowing operations in the same manner as that described for the gussets G–1 and G–2 with the exception that the right-hand widening pick feed cam **825** will lower any of the needles which had previously been raised and they will again be raised by the cam **1202** to pass above the stitch cams and the leading needles, that have been lowered in knitting the upper half of the diamond R–3, will be elevated to inoperative position by the narrowing picks **1060** and **1061**, depending upon the direction of rotation of the needle cylinder, to thus narrow two needles upon each rotary movement of the needle cylinder in each direction until all of the needles in groups C and D will have again been elevated to inoperative position, the needles in groups A and B remaining in an elevated position throughout the knitting of the diamond R–3.

Since the remaining diamonds Y–4, B–5, B–6, R–7 and Y–8 and the gusset G–9 are knitted in substantially the same manner as the gussets G–1 and G–2 and the diamond R–3, a detailed description of the operation of the various knitting instrumentalities is deemed unnecessary, there being suitable cams on the various pattern and cam drums for effecting operation of the particular clamping and cutting devices and yarn changing operations as well as shogging the needle cylinder following the knitting of each area. It is evident that the needle cylinder is shogged a half revolution after knitting the diamond R–3 so as to knit the diamond Y–4 and is then shogged a quarter revolution for knitting the diamond B–5 following which the needle cylinder is again shogged a half revolution for knitting the diamond B–6 and so on.

It might be stated that, since the yarn feed finger **341** for the gray yarn will not move to inoperative position following the knitting of the gusset G–1 and before knitting the gusset G–2, the gray yarn merely extends from the lowermost point of the gusset G–1 to the uppermost course in the gusset G–2 and is laid along the suture between the gusset G–1 and the diamond R–3. However, the cams in the present drawings are arranged so that, although both of the diamonds B–5 and B–6 are knitted of the same yarn, the yarn feed finger **344**, which, in this instance, is the yarn feed finger employed in knitting the blue diamonds B–5 and B–6, moves outwardly following the knitting of a diamond B–5 to introduce the blue yarn to the clamping and cutting mechanism following which the yarn feed finger **344** for the blue yarn is again moved into operative position, in the manner heretofore described for the yarn feed finger **341**, so the blue yarn may be directed to the needles for knitting the diamond B–6 without the necessity of extending the blue yarn from the bottom point of the diamond B–5 to the top or uppermost point of the diamond B–6. This obviates the necessity of cutting away the blue yarn extending between the lowermost and uppermost points of the respective diamonds B–5 and B–6.

The manner of operation of the means for positioning the clamp carriage **534** has heretofore been described with respect to elevating the clamp carriage **534**. However, following the knitting of the diamond B–6, which is knitted of a blue yarn and this blue yarn being clamped by the lowermost clamp arm **546** in Figures 19 and 20 when the blue yarn is not being fed to the needles, the red yarn is fed to the needles during the knitting of the diamond R–7 and, since the clamp arm **544** corresponds to the yarn feed finger **342** for clamping and feeding the red yarn to the needles, it is evident that the clamp arm **544** must be lowered so as to be disposed in the plane of the clamp arm positioner **542** in Figure 19. This is substantially the case in changing the color of the yarn, that is, following the knitting of the yellow diamond Y–8 preparatory to knitting the gray gusset G–9.

Now, referring to Figures 73 and 75, it will be observed that the cam **577**, in Figure 75, coincides with the cam **511** in Figure 73 relative to the respective control fingers **582** and **514**. When the follower portion **513** of the control finger **514** (Figure 73) is engaged by the cam **511**, the arm **530** of the bellcrank **532** is caused to move upwardly. However, at this time, the roller **531** is disposed in a higher plane than the plane to which the arm **530** will be elevated by the cam **511**. Immediately after the cam **511** has moved into engagement with the follower portion **513** of the control finger **514**, the cam **577** (Figure 75) moves into engagement with the follower portion **581** of the control finger **582** to thus cause the toothed member **576** to move in a counter-clockwise direction in Figures 55 and 75.

This will permit the clamp carriage **534** to move downwardly, by gravity, until the roller **531** engages the arm **530** of the bell crank **522** (Figure 73) and this will aline

the clamp arm 544 with the clamp positioning arm 542 which will operate upon the arm 544 in the manner heretofore described with respect to the arm 543. Immediately after the roller 531 on the clamp carriage has engaged the arm 530 of the bell crank 532 (Figure 73), the cam 577 moves out of engagement with the follower portion 581 of the control finger 582 to permit the toothed member 576 to again move into engagement with the mating toothed member 574 on the clamp carriage 534. The cam 511 then moves out of engagement with the follower portion 513 of the control finger 514 and the clamp carriage 534 is then supported by the toothed member 576 in the manner heretofore described.

Now, inasmuch as the gray yarn is clamped by the uppermost of the clamp arms in Figure 20, when the gray yarn is to be fed to the needles following a period in which one of the clamp arms below the clamp arm 543 had been in an operative position, such as following the knitting of the diamond Y–8 preparatory to the knitting of the gusset G–9, it is not necessary that there be a cam provided on the yarn control pattern drum for engaging the follower portion 513 of the control finger 514 since the carriage 534 may then move to its lowermost position to engage the screw 573 in Figure 19. In this instance, the cam 578 (Figure 75) moves into engagement with the follower portion 581 of the control finger 582 to move the toothed member 576 out of engagement with the mating toothed member 574 on the clamp carriage 534 thus permitting the clamp carriage 534 to move downwardly, by gravity, against the screw 573. The clamp arm 543 is then in position to be engaged by the clamp positioning arm 542 for moving the same into operative position in the manner heretofore described.

Gusset G–10

In the instance of knitting the particular stocking shown in Figure 88 and in accordance with the manner in which the various knitting instrumentalities are arranged in the present drawings, the yarn feed finger 341 for the gray yarn does not move outwardly to inoperative position between the knitting of the guessets G–9 and G–10. Instead, the needles in group D are lowered to pass through the stitch cams during the shogging operation between the knitting of the guessets G–9 and G–10 in addition to the needles in groups B and C, which had been lowered in the usual widening operations as heretofore described for knitting the lowermost course in the guesset G–9. Since the needles in group D are lowered in addition to the needles in groups B and C during the shogging operation between the knitting of the gussets G-9 and G–10, the needles in group D pass through the stitch cams to form stitches along the suture at the lower edge of the diamond Y–8 and the upper edge of the gusset G–10 rather than laying the gray yarn along this suture line without knitting the same.

In order to lower the needles in group D for knitting along the suture between the lower edge of the diamond Y–8 and the gusset G–10, the cam 1227 on the first needle cam control pattern drum 191 (Figure 65) engages the follower member 1225 to move the right-hand widening pick feed cam 825 into operative position, through intervening connections heretofore described, and cam 1248 (Figure 68) engages the control finger 1244 to move the second elevating switch cam 1202 (Figure 76) inwardly in a step-by-step manner and the cam 1288 (Figure 67) engages the control finger 1272 to move the first lowering switch cam 1203 (Figure 76) into operative position for engaging only the long butt needles through the intervening connections as heretofore described.

It is thus seen that all of the needles in group D, which will have been in a raised position following the knitting of the final course in the gusset G–9, and the needles in groups B and C, will be lowered by the right-hand widening pick feed cam 825 and since the right-hand widening picks 893 and 894 at this time have assumed a lowered or inoperative position, the needles in group D along with a few of the needles in group A will traverse a pathway P–20 in Figure 83 and the second elevating switch cam 1202 will move inwardly as the short butt needles DNS in group D (Figure 44) move past the same and, due to the stepped leading end of cam 1248, in Figure 68, this second elevating switch cam 1202 will move inwardly far enough to engage only the long butt needles ANL and those few of the medium butt needles ANM which may have been lowered by the right-hand widening pick feed cam 825 and, in so doing, these last named needles ANL and ANM will traverse a pathway P–21.

Since the first lowering switch cam 1203 will have moved into operation for engaging the long butt needles ANL, these two long butt needles ANL will be moved downwardly along a pathway P–22 in Figure 83 and the remaining needles ANM in group A, which may have been lowered by the right-hand widening pick feed cam 825, will continue in the plane of the upper edge of the second elevating switch cam 1202 to traverse a pathway P–24, in Figure 83, to thus pass above the stitch cams. It is thus seen that, during this final shogging operation and during which the needle cylinder 103 moves in a counter-clockwise direction in Figure 44, a course is knitted with all of the needles in groups B, C and D, the course knitted by the needles in group D forming the suture at the juncture of the diamond Y–8 and the gusset G–10 and the two needles ANL are also passed through the stitch cams following the shogging operation to knit the first course in the gusset G–10.

The shogging operation which takes place during the knitting of the last course in the gusset G–9, and during the knitting along the suture between the diamond Y–8 and the gusset G–10, positions the locking finger 1012 (Figures 16 and 17) in engagement with the notch 1003 in the locking disk 1000 and this causes the two long butt needles ANL to move equidistant past the knitting station. After all of the needles in groups B, C and D and the two long butt needles ANL have passed through the stitch cams, with movement of the needle cylinder in a counter-clockwise direction in Figure 44, and during the shogging operation, all of the needles in groups B, C and D, with the exception of the two needles ANL, are elevated to pass above the stitch cams before knitting the second course in the gusset G–10. Therefore, with movement of the needle butts from right to left in Figure 76, before the two long butt needles ANL (Figure 44) have moved to the radial plane of the second lowering switch cam 887, the cam 1315 permits the second lowering switch cam 887 to be moved into operative position by the tension spring 890 (Figure 36). When this second lowering switch cam 887 is moved inwardly by the tension spring 890, it will engage the outer edges of the short butt needles DNS in group D and will thus be in position to engage the butts of the long butt needles ANL to cause the same to move downwardly to pass beneath the first elevating switch cam 852 which had been moved into operative position at substantially the same time that the second lowering switch cam 887 moved into operative position.

Since the remaining needles in group A have already been in a raised position, only the needles ANL will be caused to pass beneath the cam 852. This cam 852 will have been moved into operative position at the time of the second lowering switch cam 887 by means of the cam 1211 (Figures 5–A and 64) on the first needle cam control pattern drum 191 moving into engagement with the follower member 1212 on the arm 1214, to thus cause the arm 857 to move the first elevating switch cam 852 into operative position. This cam 852 initially moves into operative position far enough only to engage the long and medium butts of the needles, this occuring

at the time the short butt needles CNS, in Figure 44, move past the same so that the long butt needles DNL, and the medium butt needles DNM in group D are elevated by the cam 852, the short butt needles DNS remaining in a lowered position and the two long butt needles ANL engaging the cam 887, which had moved into operative position after the needles DNL had passed by the same, so the two long butt needles ANL are moved downwardly to pass beneath the cam 852

The needle cylinder then goes into a clockwise revolution at which time the cam 1211, in Figure 64, moves out of engagement with the follower member 1212 to permit the first elevating cam switch 852 to move outwardly to inoperative position at which time any of the needles which had not been raised by the needle cam 852, in Figure 77, which in this instance, are the short butt needles DNS in group D, will engage the upper surface of the second lowering switch cam 887 to be elevated thereby and the leading four needles, which are the four short butt needles DNS adjacent the long butt needles ANL, will be engaged and lowered by the left-hand widening picks 895 and 896 and the remaining needles which are directed to the level of the widening picks 895 and 896 when they are in operative position will engage and be elevated by the auxiliary needle leveling cam 1204. It is evident that the needles which had been elevated by the needle cam 852 will be moved downwardly by the left-hand widening pick feed cam 875 but will again be elevated by the auxiliary needle leveling cam 1204 to pass above the stitch cams.

Now, since the two long butt needles ANL were in a lowered position during the preceding counter-clockwise revolution of the needle cylinder or as they move from right to left in Figure 76, the two leading needles, which are the long butt needles ANL upon a clockwise revolution of the needle cylinder, will be engaged and elevated to an inoperative position by the left-hand narrowing pick 1060 and the four subsequent needles adjacent the needles ANL in group D will pass through the stitch cams to initiate the first widening operation in the knitting of the gusset G–10 and following which the remaining courses will be knitted in the gusset G–10 in the usual manner of widening heretofore described.

During the final clockwise revolution of the needle cylinder 103, in Figure 44, in reciprocally knitting the gusset G–10, the second elevating switch cam 1202 is permitted to move to inoperative position by means of the spring loaded plunger 1241, in Figure 22, because of the cam 1248 on the first needle cam control pattern drum 191 moving out of engagement with the control finger 1244. This conditions the needle cams, in Figure 76, for continuous rotary knitting.

However, upon the next counter-clockwise revolution of the needle cylinder, during which the butts of the needles move from right to left in Figure 76, all of the needles which have remained in an elevated position during the knitting of the gusset G–10 will be lowered to pass through the stitch cams and, simultaneously, the cam 1041 will move into engagement with the control finger 1030 and then out of engagement therewith to move the locking finger 1012 out of engagement with the notch 1003 of the locking disk 1000 (Figure 17) and to permit the locking finger 1012 to move into engagement with the notch 1001, which is the same notch in which the locking finger 1012 was disposed during the knitting of the top 1350 and the ring top 1351.

Since there is no change in the yarn after knitting the gusset G–10, the ring heel 1353 (Figures 88 and 89) is then knitted in the usual manner of rotary knitting.

During the shogging operation which occurs following the knitting of the gusset G–10, the cam 1316, in Figure 66, moves out of engagement with the follower member 1313 and would, ordinarily, permit the second lowering switch cam 887 to move into operating position. However, the cam 1327 (Figure 55) on the main cam drum 121 will have moved into engagement with the lower end of the thrust rod 1325 to cause the connecting rod 1321 to move forwardly in Figures 3 and 55, or towards the observer in Figure 6, to thus hold the second lowering switch cam 887 in an inoperative position, in which position it remains during the knitting of the ring courses in the ring heel 1353.

Knitting heel, foot and toe

In the course of the shogging operation which took place after knitting the gusset G–10, the needles BNL at the juncture of groups A and B are caused to move equidistant past the knitting station and the needles in groups A and B are employed in the widening and narrowing at the heel and toe pockets. It is thus seen that it is necessary upon going into the knitting of the heel pockets to elevate all of the needles in groups C and D so they will pass above the stitch cams and to narrow the needles in the groups A and B upon each rotary movement of the needle cylinder in each direction until approximately twenty-four needles remain in a lowered position after which the widening operation takes place until all of the needles in groups A and B are again in a lowered position and then the needles in groups C and D are again lowered to knit the foot of the stocking and the machine goes into rotary knitting. It is also necessary that the narrowing picks 1060 and 1061 are conditioned for receiving the butt of a single needle upon each reciprocation of the needle cylinder during the narrowing operations in the heel and toe.

Therefore, during the knitting of the latter few of the courses in the ring heel 1353, the cams 1114 and 1117 on the main cam drum 121 (Figures 51 and 54) move out of engagement with the respective thrust rods 1110 and 1111 permitting them to move downwardly to, in turn, move the pick restrictor control lever 1102 associated with each of the narrowing picks 1060 and 1061 upwardly at its outer end.

Referring to Figures 40 and 41, it will be observed that, upon the pick restrictor control lever 1102 moving upwardly, the tension spring 1083 will cause the bell crank 1082, in Figure 41, to move in a clockwise direction to, in turn, move the pick restrictor 1075 inwardly to partially close the notch 1067 in the free end of each of the narrowing picks 1060 and 1061, thus limiting the capacity of the notch 1067, associated with each of the narrowing picks 1060 and 1061, to the butt of a single needle.

Although the cams 1112 and 1115 move into engagement with the lower ends of the respective thrust rods 1110 and 1111 during the knitting of the heel and toe pockets, the corresponding bell crank 1082 may rotate only to the position shown in Figure 41 and the latch 1090 will prevent the corresponding pick restricting member 1075 from being moved outwardly by the associated spring 1077 (Figure 40).

Also, during the knitting of the ring heel 1353, the cam 1154 on the main cam drum 121 (Figure 57) moves into engagement with the lower end of the thrust rod 1153, since this thrust rod 1153 had been in engagement with the periphery of the cam drum 121 during the knitting of the pattern portion of the stocking. This causes the thrust rod 1153 to move upwardly, in Figure 57, to move the enlarged portion of the pilot 1143 out of engagement with the coinciding slots 1140 and 1141 in the respective members 1134 and 1133 of the composite link 1130, resulting in the reduced portion 1144 of the pilot 1143 being disposed within the coinciding slots 1140 and 1141 in the respective members 1134 and 1133 (Figure 43) to permit relative movement between the members 1133 and 1134 to increase the overall length of the composite link 1130, this being necessary during the narrowing of a single needle upon reciprocation of the needle cylinder as heretofore described.

During the knitting of the final course in the ring heel **1353** of the stocking shown in Figures 88 and 89, the needle cylinder **103** rotates in a counter-clockwise direction and the needle cams **852** and **887** are successively moved into the path of the needles for elevating half of the needles to pass above the stitch cams and for causing the remaining half of the needles to remain in a lowered position to pass through the stitch cams. In this instance, the needles in groups C and D are successively raised to inoperative position and the needles in groups B and A remain in a lowered or operating position.

The needle cam **852** is moved into operative position due to the cam **872** on the second needle cam control pattern drum **797** (Figure 63) moving into engagement with the follower portion **867** on the control arm **866** to move the link **865** downwardly in Figures 6, 25 and 63 to thus move the needle cam **852** into operative position. It will be observed, in Figure 63, that the leading end of the cam **872** is stepped so as to move the needle cam **852** inwardly in a step-by-step manner and it is thus seen that the first elevating switch cam **852** will move partially into operating position as the needles BNS move adjacent said cam and will thus raise the long butt needles CNL and a few of the medium butt needles CNM in group C and will then move inwardly to full operating position to engage the remaining needles in groups C and D.

However, as the needles DNS in group D move adjacent the second lowering switch cam **887** (Figures 76 and 77) the second lowering switch cam **887** is moved by the tension spring **890**, in Figure 36, to resiliently engage the outer edges of the butts of the short butt needles DNS so as to be in condition for lowering the two long butt needles ANL and any other needles remaining in group A which may move past said cam and to prevent these needles in group A (Figure 44) from being elevated by the first elevating switch cam **852**.

In this instance, the second lowering switch cam **887** is moved into operative position because of the cam **1327** moving out of engagement with the lower end of the thrust rod **1325** in Figure 55 and through the intervening connections heretofore described.

It is thus seen in all of the needles in groups C and D are elevated by the first elevating switch cam **852** while the remaining needles, including the needles in groups A and B remain in a lowered position for knitting one-half of the stocking and the needles in groups A and B are then successively engaged by the narrowing picks **1060** and **1061**, depending upon the direction of rotation of the needle cylinder, as the needle cylinder goes into reciprocatory knitting in the manner heretofore described, this manner also being conventional in knitting machines of this type. Therefore, the narrowing picks will narrow one needle during each movement of the needle cylinder in each direction until approximately only twenty-four needles in groups A and B remain in a lowered position.

Following the revolution of the needle cylinder in a counter-clockwise direction during which the needle cams **852** and **887** are instrumental in elevating the needles, the needle cams **852** and **887** are withdrawn from operating position by the cam **1328** moving into engagement with the thrust rod **1325**, in Figure 55, and by the cam **872**, in Figure 63, moving out of engagement with the follower portion **867**.

Before the narrowing operations have been completed in the heel pocket, it is necessary that the left-hand widening pick **895** be lowered to where any of the butts directed downwardly by the left-hand widening pick feed cam **875** (Figure 76) will not engage the first left-hand narrowing pick **895** but will engage only the second left-hand narrowing pick **896** so as to lower two needles upon each movement of the needle cylinder in either a clockwise or a counter-clockwise direction, one of the previous needles lowered is moved upwardly into inoperative position by the corresponding narrowing pick **1060** or **1061** before the needles pass through the stitch cams.

In this instance, the cam **1196**, in Figure 50, moves out of engagement with the lower end of the thrust rod **1194** to permit the same to move downwardly to assume the position shown in Figure 50. This will permit the tension spring **1187**, in Figures 3 and 55 to move the connecting rod **1185** from left to right to thus cause the widening pick knock-off lever **1181** to move upwardly at its front end, engaging the tail of the first left-hand widening pick **895** and thus moving the inner portion thereof downwardly to inoperative position.

The first widening operation takes place with a clockwise revolution of the needle cylinder in knitting the heel pocket, that is, the butts of the needles move from left to right in Figure 76. Therefore, the butts of the leading needles which have been in a raised position, will engage and be moved downwardly by the left-hand widening pick feed cam **875**, since the follower portion **942** of the switch bar **935**, in Figure 17, will have again moved into operating position, and the leading two needles projected downwardly by the left-hand widening pick feed cam **875** will move past the first left-hand widening pick **895** without engaging the same but will engage the second left-hand widening pick **896** to be moved downwardly and to pass below the lower edge of the auxiliary needle leveling cam **1204** and on to the stitch cams.

However, the leading needle which had been in a lowered position will be elevated by the left-hand narrowing pick **1060** as the needles pass above the left-hand stitch cam **1056** and the remaining needles will continue on through the stitch cams to draw stitches. It is thus seen that a single additional needle will be lowered upon each movement of the needle cylinder in either a clockwise or a counter-clockwise direction during the widening operations at the heel and toe. Now, since the first left-hand narrowing pick **895** had been projected downwardly at its inner end and the left-hand widening pick had been projected downwardly at its inner end, this widening pick **895** will not be engaged by the butts of any of the needles and therefore, the tail of the first left-hand widening pick **895** will not cause the first widening pick swing arm **912** to swing the first right-hand widening pick **893** into operative position and, as a result, both of the first widening picks **893** and **895** will remain inoperative during the widening operations at the knitting of the heel pocket.

The widening operation then continue in the manner described until all of the needles in groups A and B have been lowered and following which the remaining needles, including the needles in groups C and D are lowered to knit the foot portion **1354** of the stocking. It is evident that those needles which are not lowered by the left-hand widening pick **896** will pass upwardly to inoperative position in engagement with the auxiliary needle leveling cam **1204** and those needles which are not lowered by the second right-hand widening pick **894**, as the butts of the needles move from right to left in Figure 76, are moved upwardly to inoperative position by the second elevating switch cam **1202**.

Immediately following the knitting of the final course in the heel pocket, the second elevating switch cam **1202** (Figure 76) is moved outwardly because of the cam **1251**, in Figure 62, on the main cam drum **121** moving out of engagement with the lower end of the thrust rod **1253**. The right-hand widening pick feed cam **825** is caused to remain in an operative position because of the cam **805** (Figure 71) on the second needle cam control pattern drum **797** moving into engagement with the follower portion **806** of the control arm **807** and since the needle cylinder **103** normally rotates in a counter-clockwise direction during continuous rotary knitting, the cam **825** will then direct all needles which have remained in an elevated position during the knitting of the heel pocket,

such as the needles in groups C and D, to a lowered position and the butts of all the needles will then pass through the stitch cams from right to left, in Figure 76, to knit the ring courses in the foot 1355 of the stocking shown in Figures 88 and 89.

The toe pocket 1356 (Figures 88 and 89) is knitted in identically the manner in which the heel pocket 1354 was knitted and the same needles are employed in knitting the toe pocket and the same needle cams are moved into operative position in the same order in which they were moved into operative position in the knitting of the heel pocket. In this instance the second lowering switch cam 887 is moved into operative position by the cam 1328 on the main cam drum 121 (Figure 55) moving out of engagement with the thrust rod 1325. The first elevating switch cam 852 is moved into operative position by the cam 873 (Figure 63) moving into engagement with the follower portion 867 on the control arm 866.

The narrowing operations for the toe pocket then proceed in identically the manner in which they were performed in the knitting the heel pocket, the narrowing pick restrictor 1075 having remained in position throughout the knitting of the foot of the stocking.

The widening operations following the narrowing operations in the toe pocket are also repeated in the same manner in which the widening operations were carried out in knitting the heel pocket, the first left-hand widening pick 895 having remained in an inoperative position throughout the knitting of the foot 1355 of the stocking and the second elevating switch cam 1202, in this instance, being moved into operative position in the manner heretofore described by the main cam drum 121 (Figure 62) moving into engagement with the lower end of the thrust rod 1253.

The widening operations then take place until all of the needles in groups A and B, in Figure 44, have been lowered to pass through the stitch cams and the second elevating switch cam 1202 then moves outwardly to inoperative position by virtue of the cam 1252 moving out of engagement with the thrust rod 1253, after which the cam 802 (Figure 71) moves into engagement with the follower portion 806 of the control arm 807 to move the right-hand widening pick feed cam 825 into operative position to lower the remaining raised needles, including the needles in groups C and D, so that all of the needles pass through the stitch cams as the butts of the needles move from right to left, in Figure 76, in knitting the loopers rounds, after which the yarn feed finger 341 moves to inoperative position, in the manner heretofore described, and the gray yarn is clamped and cut and the butts of the needles upon passing through stitch cams then cast off the loops to complete the knitting of the stocking.

The stockings in Figures 90 and 91 are shown to illustrate a few of the many types of variegated patterns which may be produced with this machine. In the instance of knitting the stockings shown in Figures 90 and 91, it is evident that the shogging operation following the knitting of the top will not be necessary since the gussets are knitted at the front and rear of the stockings rather than at the opposed sides thereof as is the case in knitting the stocking shown in Figures 88 and 89. It is evident that a few changes in the arrangements of the cams on the yarn control pattern drum 390, the main cam drum 121, the first needle cam control pattern drum 191, the second needle cam control pattern drum 797 and the arrangement of the lugs on the main pattern chain 163 and the auxiliary pattern chain 265 would be necessary in producing the patterns shown on the stockings in Figures 90 and 91.

Referring to Figure 92 there is shown in detail the structure of the knitted fabric at the juncture of four diamonds, such as the diamonds G–2, R–3, Y–4 and B–5 of the stocking shown in Figures 88 and 89. The arrows in the courses in the various knitted areas shown in Figure 92 are provided to indicate the direction in which the knitting takes place in knitting each of these areas. It will be noted that in knitting a partial course, such as a course 1361 in the gusset G–2, the stitches are formed successively from right to left, in Figure 92, and then a partial course 1362 is knitted and the yarn is carried from the course 1361 to the course 1362 and a loop is formed in the beginning of the course 1362 spaced two wales inwardly of the preceding course 1361. Stitches are then drawn from left to right in the partial course 1362 and the last stitch in the course 1362 is formed in the same wale as the first stitch in the course 1361. In knitting a succeeding course 1363 to the course 1362, it will be noted that the narrowing occurs at the beginning or at the right-hand end of the course 1363 in the same manner in which it occurred at the left-hand end of the course 1362, in Figure 92, and this continues, alternately reducing the number of wales in the gusset G–1 by two wales at the beginning of each course.

It will be noted, in Figure 92, that in knitting the areas R–3 and Y–4 the courses which are knitted from right to left, for instance, in the area Y–4 are knitted so that the loops at the suture between the areas G–2 and Y–4 are knitted beneath the loops in the gusset G–2. For example, in a course 1365 in the area Y–4, the loops are formed from right to left and these loops are knitted in a course coincident with a course 1366 in the area G–2 which had previously been knitted. In all instances, the courses in adjacent areas are knitted successively in opposite directions relative to each other and, therefore, in knitting the course 1365, the loops are formed up to the suture in alinement with the loops in the course 1366 and then these loops are interknitted in overlapping relation to the loops in the course 1366 so that they are actually formed in a subsequent course 1367 of the area Y–4 wherein two loops are formed from right to left in Figure 92 beneath the two loops thereabove in the course 1366 of the area G–2 which are formed from left to right in Figure 92.

The course 1367 is then knitted from left to right and the yarn is carried from the terminal loop at the left-hand end of the course 1367 to a loop 1371 where the first loop is formed in the course 1367 with the loops in the course 1367 being formed from left to right in Figure 92. It will be observed that a course 1374 in the area R–3 extends in overlapping relation to an extension of the course 1375 in the area Y–4. That is, the course 1375 is knitted from right to left, in Figure 92, and the yarn is then carried through the terminal loop in the course 1374 of the area R–3 thus resulting in the terminal loops of the course 1375 being knitted in the same wales in which the terminal loops of the course 1374 are knitted and in the succeeding course thereto. This serves to tie the knitted areas Y–4 and R–3 together and since the wales at the proximate points of the areas G–2 and B–5 are also the same wales in which the terminal loops of the courses 1374 and 1375 are knitted, it is seen that the adjacent areas G–2 and B–5, in vertical alinement, are also tied into the adjacent areas R–3 and Y–4 in horizontal alinement.

This fabric structure shown, in Figure 92, is substantially the same as the structure of hand knitted Argyle fabrics or the structure of Argyle fabrics knitted on hand frame machines. However, it is likely that in hand frame or hand knitted fabric structures the narrowing and widening of each area would occur at opposed ends of each course rather than at a single end of each course and alternatnig from one end of one course to the opposite end of the subsequent course as it is shown in Figure 92. However this does not affect, materially, the appearance of the knitted fabric, the knitted fabric shown in Figure 92 having a slightly stepped appearance at the sutures between adjacent knitted areas as is clearly shown in Figure 92.

In the drawings and specification there has been set

forth a preferred embodiment 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.

I claim:

1. In a circular independent needle knitting machine having a needle cylinder provided with vertically movable needles and also having a set of stitch cams and also having means for alternatively imparting rotary and reciprocatory motion to the needle cylinder and also having means for respectively, lowering and elevating the needles to and from a position to pass through the stitch cams, means for at times lowering four needles and elevating two lowered needles to permit the number of needles passing through the stitch cams to be increased by two upon each of certain movements of the needle cylinder in either direction during reciprocation thereof, means for varying the capacity of the elevating means so the elevating means will elevate a single needle upon each of certain other movements of the needle cylinder in either direction, said elevating means including a pair of elevating picks, said means for varying the capacity of the elevating means comprising a pick restrictor mounted for movement on each of said elevating picks, spring means normally holding the pick restrictor out of operative position on each of the elevating picks, pattern controlled means for moving the pick restrictor into operative position on each of the elevating picks for decreasing the capacity thereof, latch means for holding the pick restrictor in an operative position for predetermined intervals and said pattern controlled means being operable to release said latch means to again permit the spring means to move the pick restrictor to inoperative position.

2. In a circular knitting machine, the combination of a needle bed, needles, pattern controlled means for feeding a plurality of yarns to the needles at a single feeding station, means for reciprocating the needle bed, a first pattern controlled means for shogging the needle cylinder and pattern mechanism functioning on the needles so as to knit separate triangularly shaped areas in the same courses but upon separate reciprocations of the needle bed and interknitting the terminal loops of the courses in adjacent triangular areas to form a suture therebetween, said pattern mechanism functioning on the needles including stitch cams and radially movable cams, said needles having radially extending butts thereon of three different lengths namely short, medium and long butts, said needles being divided into successive groups of short, long and medium butt needles, a second pattern controlled means for moving at least one of the movable cams inwardly as a short butt group passes thereby so as to cause the cam to operate upon the succeeding long, medium and short butt needles, the long and medium butts serving to extend the interval during which the last-named cam may move into the plane of the succeeding short butts.

3. In a circular knitting machine having a needle cylinder and also having stitch cams and also having a pair of relatively movable narrowing picks and also having means for imparting reciprocatory and rotary motion to the needle cylinder, each of said narrowing picks being pivotally mounted intermediate their ends on the knitting machine, a composite link pivotally connecting the outer ends of the narrowing picks relative to the needle cylinder to each other, means for varying the capacity of the narrowing picks so as to vary the number of needles rendered inactive thereby upon certain movements of the needle cylinder in either direction during reciprocation thereof, and means for varying the effective length of the composite link so the movement of one pick relative to the other may be varied according to the capacity thereof.

4. In a circular knitting machine having a needle cylinder and also having stitch cams and also having a pair of relatively movable narrowing picks associated with the stitch cams and also having means for imparting reciprocatory and rotary motion to the needle cylinder, each of said narrowing picks being pivotally mounted intermediate its ends on the knitting machine, a composite link pivotally connected at opposed ends thereof to the outer portions of the narrowing picks, pattern controlled means for varying the capacity of the narrowing picks so as to vary the number of needles rendered inactive thereby upon certain movements of the needle cylinder in either direction during reciprocation thereof, and other pattern controlled means for varying the effective length of the composite link so as to vary the movement of the narrowing picks relative to each other in accordance with the variations in capacity of the narrowing picks.

5. An improvement in a circular knitting machine having a needle cylinder with vertically movable needles carried thereby, said machine also having a knitting station and means for feeding a first yarn to the needles, said improvement comprising means for shogging the needle cylinder so as to cause the centers of successive groups of the needles carried by the needle cylinder to move equidistant past the knitting station during reciprocatory knitting, means for momentarily stopping movement of the needle cylinder in the course of the shogging operation, means for clamping, cutting and withdrawing the first yarn from the needles and for selectively independently feeding other yarns to the needles, said means for withdrawing and selectively feeding the yarns to the needles comprising an improved latch ring having a circumferentially extending yarn feed opening therein which is closed at its upper end and partially closed at its lower end, said latch ring also having a yarn passageway at the lower edge thereof communicating with said opening, a plurality of yarn feeding fingers mounted for swinging movement on a vertical axis adjacent said latch ring, means independently swinging each of the fingers past said latch ring, pattern controlled means for selectively positioning the fingers so that the particular finger swung will pass beneath and beyond said passageway, said clamping means being automatically operable in coacting relation to said means for swinging the yarn fingers so as to aline the yarn extending therefrom to the corresponding yarn feed finger with the passageway as the finger is moved past the same, means for elevating the last-named yarn feed finger to move the yarn through said passageway into the opening and simultaneously into the hooks of a few adjacent needles and means for again swinging said last-named finger to cause the yarn fed thereby to pass through said slot to the needles but out of registry with said passageway.

6. In a circular knitting machine having a needle cylinder with vertically movable needles carried thereby, a knitting station and means for imparting reciprocatory and rotary movement to the needle cylinder, means for shogging the needle cylinder so as to cause the centers of successive groups of the needles carried by the needle cylinder to move equi-distant past the knitting station during reciprocatory knitting, means for stopping the needle cylinder momentarily in the course of a shogging operation, improved means for introducing yarn to the needles comprising a latch ring having an annular depending flange thereon surrounding the upper ends of the needles, said annular flanges being provided with a circumferentially disposed yarn feed opening therein and also having a slot in the lower edge thereof communicating with said yarn feed opening, said slot extending substantially tangent to the path of travel of the needles past the yarn feed opening in one direction, yarn clamping means disposed in substantial alinement with the slot, a plurality of horizontally swingable yarn feed fingers mounted adjacent said latch ring, spring means normally holding each of the yarn feed fingers in an inoperative position, a first pattern controlled means for presenting any particular one of the yarn feed fingers at a predetermined elevation in a horizontal plane substantially ad-

jacent the lower edge of the annular flange of the latch ring, a second pattern controlled means for swinging the corresponding one of the yarn feed fingers with the yarn extending from the yarn feed fingers to the clamping means and to where a yarn will be disposed in alinement with said tangentially extending slot in the latch ring, a third pattern controlled means for elevating the yarn feed fingers to cause the yarn carried by the said particular yarn feed finger to enter the yarn feed opening through said tangentially extending slot, said second pattern controlled means also being operable to again swing the said particular yarn feed finger slightly in the opposite direction from which it had originally swung to prevent the yarn from passing through said tangentially extending slot as it is fed to the needles upon further movement of the needle cylinder.

7. In a structure according to claim 6, said second pattern controlled means also being operable to move said particular yarn feed finger slightly in its original direction of movement following the knitting of a predetermined number of courses to again aline the yarn carried thereby with the tangentially extending slot and said third pattern controlled means also being operable to again lower the yarn feed fingers slightly to cause the yarn carried by said particular yarn feed finger to pass through said tangentially extending slot and the said second pattern controlled means again being operable to release the said particular yarn feed finger to permit the spring means associated therewith to move the same to inoperative position.

8. In a circular knitting machine having a needle cylinder with vertically movable latch needles carried thereby, a knitting station and means for imparting reciprocatory and rotary movement to the needle cylinder, a first pattern controlled means for shogging the needle cylinder so as to cause the centers of successive groups of the needles carried thereby to move equi-distant past the knitting station during reciprocatory knitting, a plurality of horizontally swingable yarn feed fingers disposed adjacent the needle cylinder, a second pattern controlled means for positioning any one of the yarn feed fingers at a predetermined elevation so as to be disposed in substantially the horizontal plane of the latches of the needles, individual yarn clamping means associated with each of the yarn feed fingers, means for momentarily stopping movement of the needle cylinder in the course of a shogging operation, means for moving the corresponding yarn clamping means into a position closely adjacent the needle cylinder so as to cause the yarn clamped thereby to extend therefrom to the corresponding yarn feed finger and between the latches and hooks of the adjacent needles in the needle cylinder as reciprocatory movement is again imparted to the needle cylinder and means for withdrawing the corresponding yarn clamping means from closely adjacent the needle cylinder upon the occurrence of a subsequent shogging operation of the needle cylinder.

9. In a circular knitting machine having a needle cylinder with vertically movable needles carried thereby, a knitting station and means for imparting reciprocatory and rotary movement to the needle cylinder, means for shogging the needle cylinder so as to cause the centers of successive groups of the needles carried by the needle cylinder to move equi-distant past the knitting station during reciprocatory knitting, an annular latch ring surrounding the upper ends of the needles and having a yarn feed opening therein and also having a slot therein extending substantially tangentially relative to the path of travel of the needles, a plurality of horizontally swingable yarn feed fingers disposed adjacent the latch ring, a first pattern controlled means for swinging selected yarn feed fingers into a position adjacent said tangentially extending slot, a plurality of horizontally movable yarn clamping means also disposed adjacent the latch ring, a second pattern controlled means for positioning any one of the yarn clamping means at a predetermined elevation in a horizontal plane immediately below the annular latch ring, a third pattern controlled means for moving the selected yarn clamping means into operative position so the yarn extending therefrom to the corresponding yarn feed finger will be disposed in alinement with the tangentially extending slot in the latch ring, means for stopping the needle cylinder momentarily in the course of a shogging operation as the selected yarn feed finger and the yarn clamping means are moved into operative position, a fourth pattern controlled means for moving the last-named yarn feed finger upwardly to cause the yarn carried thereby to pass through said tangentially extending slot in to the yarn feed opening, and a fifth pattern controlled means to cause the last-named yarn clamping means to release the yarn upon movement again being imparted to the needle cylinder.

10. In a structure according to claim 9, said third pattern controlled means also being operable to again cause the last-named clamping means to clamp the yarn following the knitting of a predetermined number of courses, coacting yarn cutting means cooperating with the yarn clamping means for clamping the yarn fed by said yarn feed finger and said first and third pattern controlled means being operable substantially simultaneously for causing the corresponding yarn feed finger and the clamping means to again withdraw from operating position as the needle cylinder is again momentarily stopped during the course of a shogging operation so the yarn will extend from the yarn clamping means to the coinciding yarn feed finger.

11. In a circular knitting machine, the combination of a needle cylinder having needles and having means for feeding yarns to said needles, and having means for reciprocating said needle cylinder and needles, means for widening and narrowing so as to knit reciprocatory courses of varying length, means for shogging the needle cylinder so as to knit other reciprocatory courses of varying length in the planes of the first-named reciprocatory courses, means for raising terminal needles in knitting each of certain courses to retain the loops thereon so that terminal loops of all reciprocatory courses in the same plane may be interknitted to form a suture between respective areas formed by each set of reciprocatory courses, said means for widening and narrowing including means for increasing and decreasing the number of needles knitting each of a plurality of successive courses by more than one needle and means for increasing and decreasing the number of needles in knitting each of another plurality of successive courses by a single needle.

12. In a circular knitting machine havng a needle cylinder and needles, means for feeding yarns to said needles, means for reciprocating the needle cylinder and elevating some of the needles so that a fractional part of a course may be knitted by the non-elevated needles upon each of a plurality of reciprocatory strokes of the needle cylinder and means for shogging the needle cylinder so as to knit an additional fractional part of a course in the plane of each of the previously knitted fractional parts of courses, means for elevating the terminal needles knitting certain fractional parts of courses to retain their loops so that terminal loops of each of the latter fractional parts of reciprocatory courses may be interknitted with terminal loops of other fractional parts of courses to form a suture therebetween, other means for rotating said needle cylinder and moving the needles so as to knit rotary work at other times, means for varying the number of elevated needles by more than one needle in knitting certain fractional parts of courses and means for varying the number of elevated needles by only a single needle in knitting certain other fractional parts of courses in the knitting of a single article.

13. In a circular knitting machine having a needle cylinder provided with independent vertically slidable needles and also having means for transmitting rotary and reciprocatory motion to the needle cylinder, means for

shogging the needle cylinder a predetermined amount so as to cause the center of a group of the needles in the needle cylinder to move equidistant past the knitting station during reciprocatory motion of the needle cylinder and then to cause the vertical center of a succeeding group of the needles to move equidistant past the knitting station, means for varying the number of needles which knit in a plurality of courses by at least two needles, means for varying the number of needles which knit in another plurality of courses by only a single needle and means for elevating terminal needles in knitting each of certain courses to cause their loops to be retained thereon.

14. An improvement in a circular knitting machine having a needle cylinder and needles, and also having means for feeding yarns to said needles and also having means for reciprocating the needle cylinder and elevating some of the needles so that a first partial course may be knitted by the non-elevated needles upon each of a plurality of reciprocatory strokes of the needle cylinder, said improvement comprising means for shogging the needle cylinder so as to knit an additional or second partial course in the plane of each of the first knitted partial courses, means for elevating the terminal needles in each first partial course to retain their loops so that terminal loops of each first partial reciprocatory course may be interknitted with terminal loops of a corresponding second partial course to form a suture therebetween, pattern controlled means for varying the number of needles employed in knitting certain of a plurality of said first partial courses by at least two needles from course to course, other pattern controlled means for varying the number of needles employed in knitting certain others of a plurality of said first partial courses by only a single needle from course to course, and means for varying the number of needles employed in knitting a plurality of said second partial courses so that terminal loops of the latter partial courses may be interknitted with terminal loops of said certain and said certain others of said first partial courses in the knitting of a single article.

15. In a circular knitting machine, the combination of a needle cylinder having vertically movable needles, a single feeding station having a plurality of means for feeding yarns to the needles, means for shogging the needle cylinder, means for reciprocating the needle cylinder and needles so as to knit a portion of a tubular fabric having a plurality of independently knitted yarns in a single course, means for varying the number of needles knitting by a single needle upon each of a plurality of successive movements of the needle cylinder in either direction, and means for varying the number of needles knitting by more than one needle upon each of another plurality of movements of the needle cylinder in either direction in the knitting of a single article.

16. In a circular knitting machine having a needle cylinder provided with vertically movable latch needles and also having means for imparting reciprocatory and rotary movement in the needle cylinder, a first pattern controlled means for shogging the needle cylinder so as to cause the centers of successive groups of the needles carried thereby to move equi-distant past the knitting station during reciprocatory knitting, a plurality of horizontally swingable yarn feed fingers disposed adjacent the needle cylinder and each having a strand of yarn extending therethrough, a plurality of individual yarn clamping members associated with the yarn feed fingers, a vertically movable carriage for said yarn clamping members, said yarn clamping members being mounted for horizontal movement on said vertically movable carriage, a second pattern controlled means for individually positioning selected yarn feed fingers at a predetermined elevation in substantially the horizontal plane of the latches of the needles, a third pattern controlled means for elevating the carriage for the yarn clamping members to position a selected yarn clamping member at a predetermined elevation in substantially the horizontal plane of the latches of the needles, a toothed member fixed on the carriage for the yarn clamping members, a pivoted toothed member disposed adjacent the carriage, a fourth pattern controlled means for moving the pivoted toothed member into engagement with the toothed member fixed on the carriage, said third pattern controlled means being adapted to release the carriage upon elevating the same to a predetermined position and said pivoted toothed member being adapted to engage the fixed toothed member on the carriage so as to accurately position the carriage at a desired elevation for presenting the selected yarn clamping member at the desired elevation.

17. In a circular knitting machine having a needle cylinder provided with vertically movable latch needles and also having means for imparting reciprocatory and rotary movement to the needle cylinder, a first pattern controlled means for shogging the needle cylinder so as to cause the centers of successive groups of the needles carried thereby to move equi-distant past the knitting station during reciprocatory knitting, a plurality of horizontally swingable yarn feed fingers disposed adjacent the needle cylinder and each having a strand of yarn extending therethrough, a plurality of individual yarn clamping members associated with the yarn feed fingers, a vertically movable carriage for said yarn clamping members, said yarn clamping members being mounted for horizontal movement on said vertically movable carriage, a second pattern controlled means for individually positioning selected yarn feed fingers at a predetermined elevation in substantially the horizontal plane of the latches of the needles, a third pattern controlled means for elevating the carriage for the yarn clamping members to position a selected yarn clamping member at a predetermined elevation in substantially the horizontal plane of the latches of the needles, a toothed member fixed on the carriage for the yarn clamping members, a pivoted toothed member disposed adjacent the carriage, a fourth pattern controlled means for moving the pivoted toothed member into engagement with the toothed member fixed on the carriage, said third pattern controlled means being adapted to release the carriage upon elevating the same to a predetermined position, said pivoted toothed member being adapted to engage the fixed toothed member on the carriage so as to accurately position the carriage at a desired elevation for presenting the selected yarn clamping member at the desired elevation, a fifth pattern controlled means for moving the selected yarn clamping member into a position closely adjacent the needle cylinder, a sixth pattern controlled means for moving the selected yarn feed finger into a position closely adjacent the needle cylinder so as to cause the yarn to extend therefrom to the corresponding yarn clamping member and between the latches and hooks of the adjacnt needles in the needle circle and a seventh pattern controlled means for releasing the yarn from the yarn clamping means so as to permit the last-named needles to take the yarn therefrom as it is directed thereto from the last-named yarn feed finger.

18. An improvement in a circular knitting machine having a needle cylinder with vertically movable independent needles carried thereby and also having means for imparting reciprocatory and rotary movement to the needle cylinder and also having a pattern chain and also having pattern controlled means for imparting movement to the pattern controlled means for imparting movement to the pattern chain and also having a plurality of yarn feeding, cutting and clamping elements thereon for controlling the feeding of different yarns to the needles and also having a pattern drum for controlling the operation of said yarn feeding, cutting and clamping elements and also having a shaft thereon, said improvement comprising pattern controlled means for imparting rotation to the said pattern drum at varying intervals in a step-by-step manner including a cam wheel carried by said shaft and having a plurality of irregular cams there-

on, means to impart rotation to said cam wheel a ratchet wheel fixed on the pattern drum, a ratchet pawl disposed adjacent said ratchet wheel, a series of pivotally interconnected pivoted members, one of the endmost of said pivoted members being pivotally connected to said ratchet pawl, a cam follower connected to the pivoted member at the opposite end of the series of interconnected pivoted members, spring means normally urging the cam follower into engagement with the cams on said cam wheel for imparting movement to the ratchet pawl, a notch in one of the pivoted members of said series of interconnected pivoted members, a latch normally urged into said notch in the pivoted member and normally holding the cam follower out of engagement with said cams on the cam wheel, and means controlled by said pattern chain for moving said latch member out of engagement with the corresponding notch in one of the members to thus release the series of interconnected pivoted members at predetermined intervals so as to cause rotation to be imparted to said pattern drum at varying intervals according to a desired pattern.

19. In a circular knitting machine having means for knitting the top of a stocking thereon and wherein continuous rotation of a needle cylinder having vertically movable needles is involved, in combination, means for introducing a first yarn to all of the needles during the knitting of the top, pattern controlled means for activating selected groups of needles for taking and knitting the first yarn, means controlled by said pattern controlled means for decreasing the number of needles in action, at times, by a single needle in each course and, at other times, by a plurality of needles in each course in said selected groups for successively knitting a triangle, having one pointed end facing away from the top of the stocking, with each of said selected groups of needles, pattern controlled means for shogging the needle cylinder to cause each of said groups of needles to knit the yarn into the shape of said triangles successively and independently of each other, said pattern controlled means for shogging the needle cylinder also being effective a number of times in the knitting of a stocking to cause the needle cylinder to shog varying distances so that the remote halves of adjacent groups of needles may be rendered inactive while the proximate halves of adjacent groups of needles may be rendered active in a widening operation to knit a third triangle and having one pointed end of the third triangle facing in the opposite direction from the said pointed ends of the first-named triangles between the previously knitted triangles, means for elevating terminal needles to retain their loops while decreasing the number of needles in action during reciprocatory knitting, so terminal loops of said third triangle will subsequently be interknitted with terminal loops of said first-named triangles and said means controlled by said pattern controlled means including means for increasing the number of active needles at times by a single needle in knitting each of a plurality of courses and at other times by more than one needle in knitting another plurality of courses.

20. In a circular knitting machine having a needle cylinder with vertically movable independent needles carried thereby and also having stitch cams defining a knitting station and having a first pattern controlled means for effecting rotary and reciprocatory movement of the needle cylinder and also having means for shogging the needle cylinder so as to cause the centers of selected groups of the needles carried by the needle cylinder to move equi-distant past the knitting station during reciprocatory knitting, a second pattern controlled means for effecting the lowering of at least two additional needles to pass through the stitch cams during each of a plurality of successive rotary movements of the needle cylinder in either direction to effect a widening operation and a third pattern controlled means for effecting the lowering of a single additional needle to pass through the stitch cams upon each of another plurality of successive rotary movements of the needle cylinder in either direction to effect a widening operation, a third pattern controlled means for effecting the lowering of a single additional needle to pass through the stitch cams upon each of another plurality of successive rotary movements of the needle cylinder in either direction in the knitting of a single article, said second pattern controlled means being operable for effecting the elevating of at least two additional needles to pass above the stitch cams during each of a plurality of successive rotary movements of the needle cylinder in either direction to effect a narrowing operation and said third pattern controlled means being operable for effecting the elevating of a single additional needle to pass above the stitch cams upon each of a plurality of successive rotary movements of the needle cylinder in either direction.

22. In a circular knitting machine having a needle cylinder with vertically movable needles carried thereby and also having a knitting station including stitch cams and said machine having a first pattern controlled means for effecting rotary and reciprocatory movement of the needle cylinder and also having means for shogging the needle cylinder so as to cause the centers of selected groups of the needles carried by the needle cylinder to move equi-distant past the knitting station during reciprocatory knitting, a second pattern controlled means for effecting the elevating of at least two additional needles to pass above the stitch cams during each of a plurality of successive rotary movements of the needle cylinder in either direction to effect a narrowing operation, and a third pattern controlled means for effecting the elevating of a single additional needle upon each of another plurality of successive rotary movements of the needle cylinder in either direction in the knitting of a single article.

23. An improvement in a circular knitting machine having a needle cylinder provided with vertically movable needles and also having a set of stitch cams and also having a first pattern controlled means for alternately effecting reciprocatory and rotary movement of the needle cylinder, said improvement comprising second pattern controlled means for causing a widening operation upon a first series of successive rotary movements of the needle cylinder in either direction in which the number of needles which pass through the stitch cams upon each of said rotary movements are increased by a predetermined number of needles, said second pattern controlled means also being operable to cause the number of needles which pass through the stitch cams upon a second series of successive rotary movements of the needle cylinder in either direction to be increased by a lesser number of needles than said predetermined number of needles during the knitting of a single article, said means for increasing the number of needles which pass through the stitch cams upon said first series of successive rotary movements of the needle cylinder in either direction comprising a first pair of coacting widening picks, each having a capacity for lowering two needles and one of said first pair of widening picks being operable to lower two needles upon a rotary movement of the needle cylinder in one direction and the other of the first pair of widening picks having a capacity for lower-

ing two needles upon a rotary movement of the needle cylinder in the opposite direction, a second pair of widening picks disposed astraddle the first pair of widening picks and each also having a capacity for lowering two needles upon alternate rotary movements of the needle cylinder, whereby four needles are lowered upon each rotary movement of the needle cylinder in opposite directions, a pair of narrowing picks disposed astraddle the stitch cams and each having a capacity for elevating two needles to inoperative position upon alternate rotary movements of the needle cylinder whereby, upon four needles being lowered by the widening picks, the leading two needles which may be in a lowered position will be elevated to inoperative position by the corresponding narrowing pick to permit two additional needles to pass through the stitch cams upon each successive rotary movement of the needle cylinder in either direction.

24. In a structure according to claim 23, third pattern controlled means for rendering one of the pairs of widening picks inoperable during said second series of successive rotary movements of the needle cylinder in either direction and fourth pattern controlled means for decreasing the capacity of the narrowing picks to where the narrowing picks will elevate only a single needle upon each rotary movement of the needle cylinder in either direction and whereby the widening picks which have remained operative will lower only two needles upon each rotary movement of the needle cylinder in either direction and the narrowing picks will permit a single additional needle to pass through the stitch cams upon each rotary movement of the needle cylinder in either direction.

25. In a circular knitting machine, the combination of a needle bed, needles, pattern controlled means for feeding a plurality of yarns to the needles from a single station, means for reciprocating the needle bed, pattern controlled means for shogging the needle bed and pattern mechanisms functioning on the needles so as to knit separate areas in the same courses but upon separate movements of the needle bed in either direction and to interknit terminal loops of the courses in adjacent triangular areas to form a suture therebetween, said pattern mechanisms including means for widening to, at times, include at least two additional needles in the knitting wave upon each of certain successive movements of the needle bed in either direction and, at other times, to include a single additional needle in the knitting wave upon each of certain other successive movements of the needle bed in either direction, said pattern mechanisms also including means for narrowing to, at times, include at least two less needles in the knitting wave upon each of certain successive movements of the needle bed in either direction and, at other times, to include only one less needle in the knitting wave upon each of certain other successive movements of the needle bed in either direction.

26. In a circular knitting machine having a needle cylinder with vertically movable independent needles carried thereby and also having stitch cams and having a first pattern controlled means for effecting rotary and reciprocatory movement of the needle cylinder and also having means for shogging the needle cylinder so as to cause the centers of successive groups of the needles carried by the needle cylinder to move equi-distant past the knitting station during reciprocatory knitting, a second pattern controlled means for effecting the lowering of at least two additional needles to pass through the stitch cams during each of a plurality of successive movements of the needle cylinder in either direction to effect a widening operation, and a third pattern controlled means for effecting the lowering of an additional needle upon each of another plurality of successive movements of the needle cylinder in either direction in the knitting of a single article.

27. In a circular knitting machine having a needle cylinder with vertically movable independent needles carried thereby and also having stitch cams and having a first pattern controlled means for effecting rotary and reciprocatory movement of the needle cylinder and also having means for shogging the needle cylinder so as to cause the centers of successive groups of the needles carried by the needle cylinder to move equi-distant past the knitting station during reciprocatory knitting, a second pattern controlled means for effecting the lowering of at least two additional needles to pass through the stitch cams during each of a plurality of successive movements of the needle cylinder in either direction to effect a widening operation, and a third pattern controlled means for effecting the lowering of only one needle to pass through the stitch cams upon each of another plurality of successive movements of the needle cylinder in either direction in the knitting of a single article.

28. In a circular knitting machine having a needle cylinder with vertically movable independent needles carried thereby and also having stitch cams and having a first pattern controlled means for effecting rotary and reciprocatory movement of the needle cylinder and also having means for shogging the needle cylinder so as to cause the centers of successive groups of the needles carried by the needle cylinder to move equi-distant past the knitting station during reciprocatory knitting, a second pattern controlled means for effecting the lowering of at least two additional needles to pass through the stitch cams during each of a plurality of successive movements of the needle cylinder in either direction to effect a widening operation, a third pattern controlled means for effecting the lowering of a single additional needle to pass through the stitch cams upon each of another plurality of successive movements of the needle cylinder in either direction in the knitting of a single article, said second pattern controlled means being operable for effecting the elevating of at least two additional needles to pass above the stitch cams during each of a plurality of successive movements of the needle cylinder in either direction to effect a narrowing operation, and said third pattern controlled means being operable for effecting the elevating of only one additional needle to pass above the stitch cams upon each of a plurality of successive movements of the needle cylinder in either direction.

29. In a circular knitting machine, the combination of a needle bed, needles, pattern controlled means for feeding a plurality of yarns to the needles at a single feeding station, means for reciprocating the needle bed, pattern controlled means for shogging the needle cylinder and pattern mechanisms functioning on the needles so as to knit separate triangularly-shaped areas in the same courses but upon separate movements of the needle bed in either direction and interknitting the terminal loops of the courses in adjacent triangular areas to form a suture therebetween, said pattern mechanisms including means for widening and narrowing by increasing the number of active needles by at least two upon each movement of a first series of successive movements of the needle bed in each direction and by decreasing the number of active needles by at least two upon each movement in a second series of successive movements of the needle bed in each direction, and said pattern mechanisms also including means for widening and narrowing by increasing the number of active needles by a single needle upon each movement in a third series of successive movements of the needle bed in each direction and by decreasing the number of active needles by a single needle upon each movement of a fourth series of successive movements of the needle bed in each direction in knitting a single article.

30. In a circular knitting machine having a needle cylinder provided with needles, means for feeding yarns to said needles and means for reciprocating said needle cylinder and needles; the combination of means for widening and narrowing so as to knit reciprocatory courses of varying length, means for shogging the needle cylinder so as to knit other reciprocatory courses of varying length

in the planes of the first-named reciprocatory courses, means for raising terminal needles in knitting each of certain courses to retain the loops thereon so that terminal loops of all reciprocatory courses in the same plane may be interknitted to form a suture between respective areas formed by each set of reciprocatory courses, said means for widening and narrowing including means for increasing and decreasing the number of needles knitting each of a plurality of successive courses by a given number of needles, and means for increasing and decreasing the number of needles knitting each of another plurality of successive courses by a number of needles varying with respect to said given number.

31. In a circular independent needle knitting machine having a needle cylinder provided with vertically movable needles, a set of stitch cams, means for alternately imparting rotary and reciprocatory movement to the needle cylinder and means for respectively lowering and elevating needles to and from a position to pass through the stitch cams; the combination of means for at times lowering four needles and elevating two lowered needles to permit two additional needles to pass through the stitch cams upon each of certain movements of the needle cylinder in either direction during reciprocation thereof, means to vary the capacity of said elevating means so the latter will elevate a single needle upon each of certain other movements of the needle cylinder in either direction, said elevating means including a pair of elevating picks, said means for varying the capacity of the elevating means comprising a pick restrictor mounted for movement on each of said elevating picks, means normally holding the pick restrictor out of operative position on each of the elevating picks, selectively controlled means for moving the pick restrictor into operative position on each of the elevating picks for decreasing the capacity thereof, means cooperating with the last-named means for holding the pick restrictor in operative position for predetermined intervals, said selectively controlled means being operable to release said latch means, and said holding means being operable to move the pick restrictor to inoperative position.

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