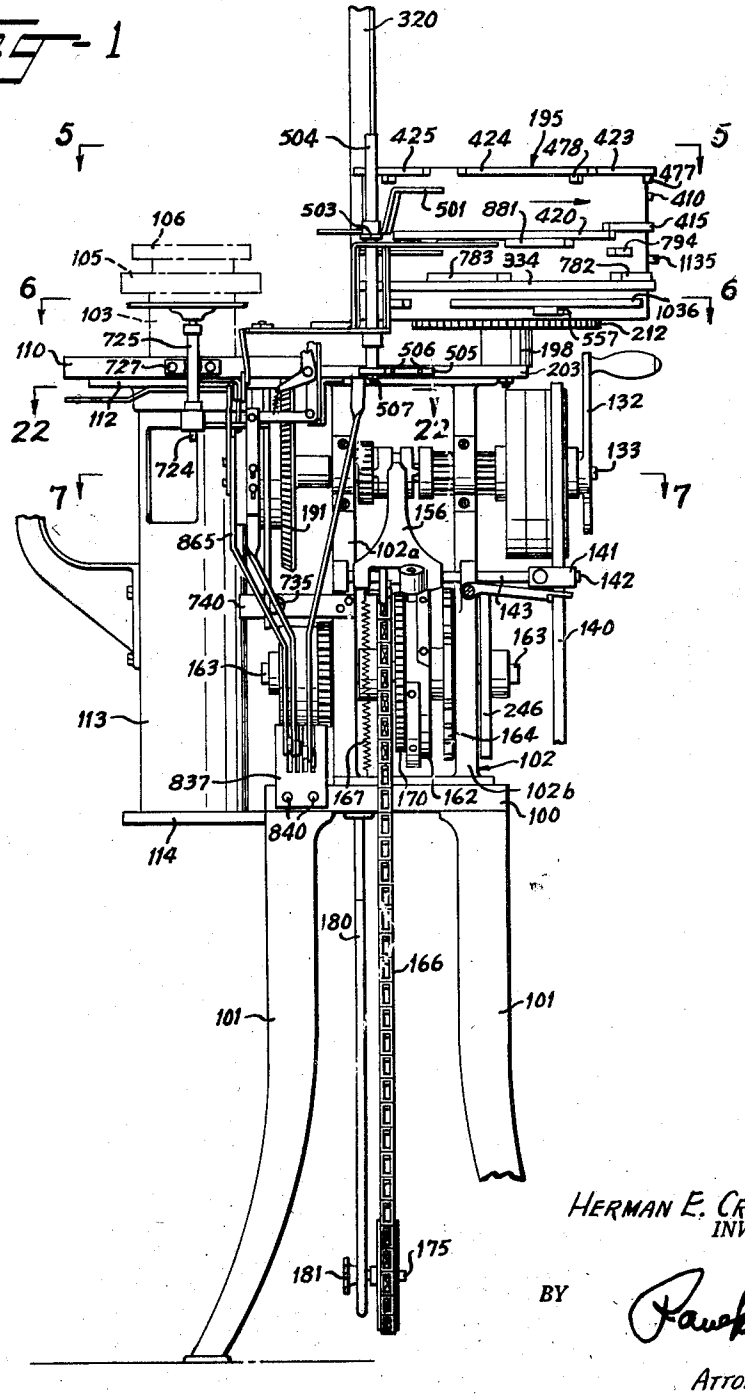
Nov. 18, 1958 H. E. CRAWFORD 2,860,500

KNITTING MACHINE FOR KNITTING HOSIERY AND OTHER FABRICS

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Fig. 1



HERMAN E. CRAWFORD,
INVENTOR.

BY

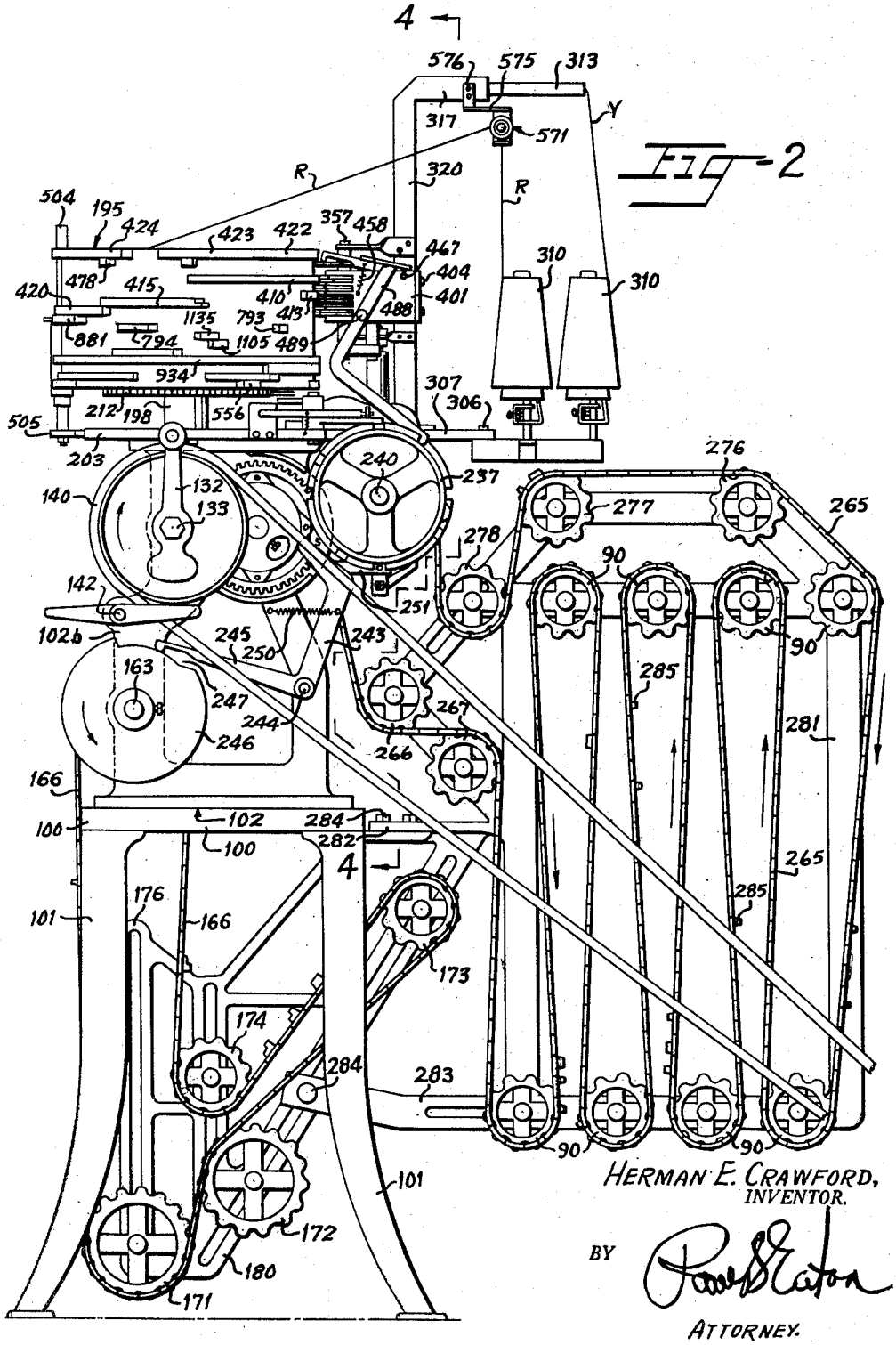
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KNITTING MACHINE FOR KNITTING HOSIERY AND OTHER FABRICS

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Fig-2



HERMAN E. CRAWFORD,
INVENTOR.

BY Paul Eaton

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KNITTING MACHINE FOR KNITTING HOSIERY AND OTHER FABRICS

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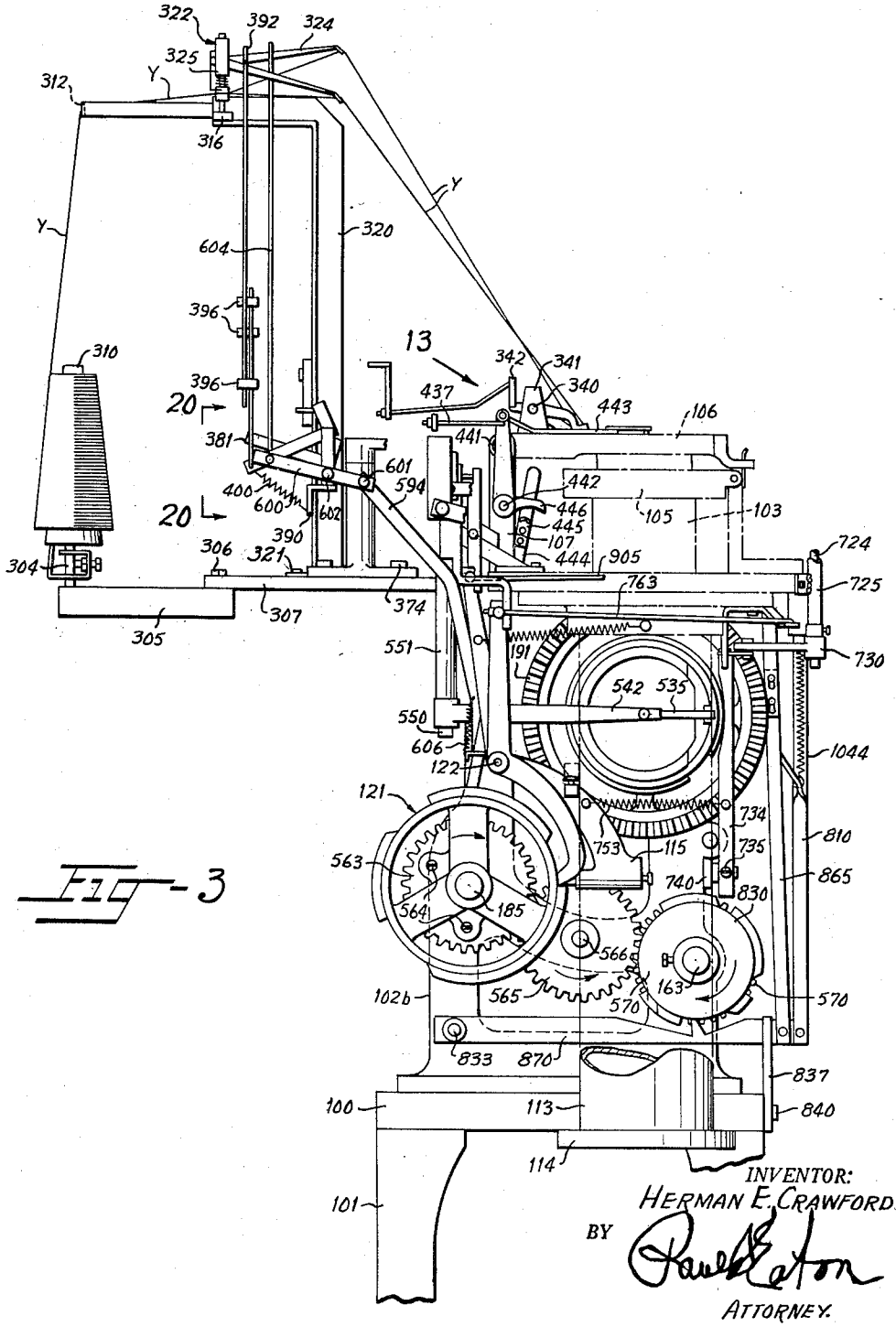


Fig-3

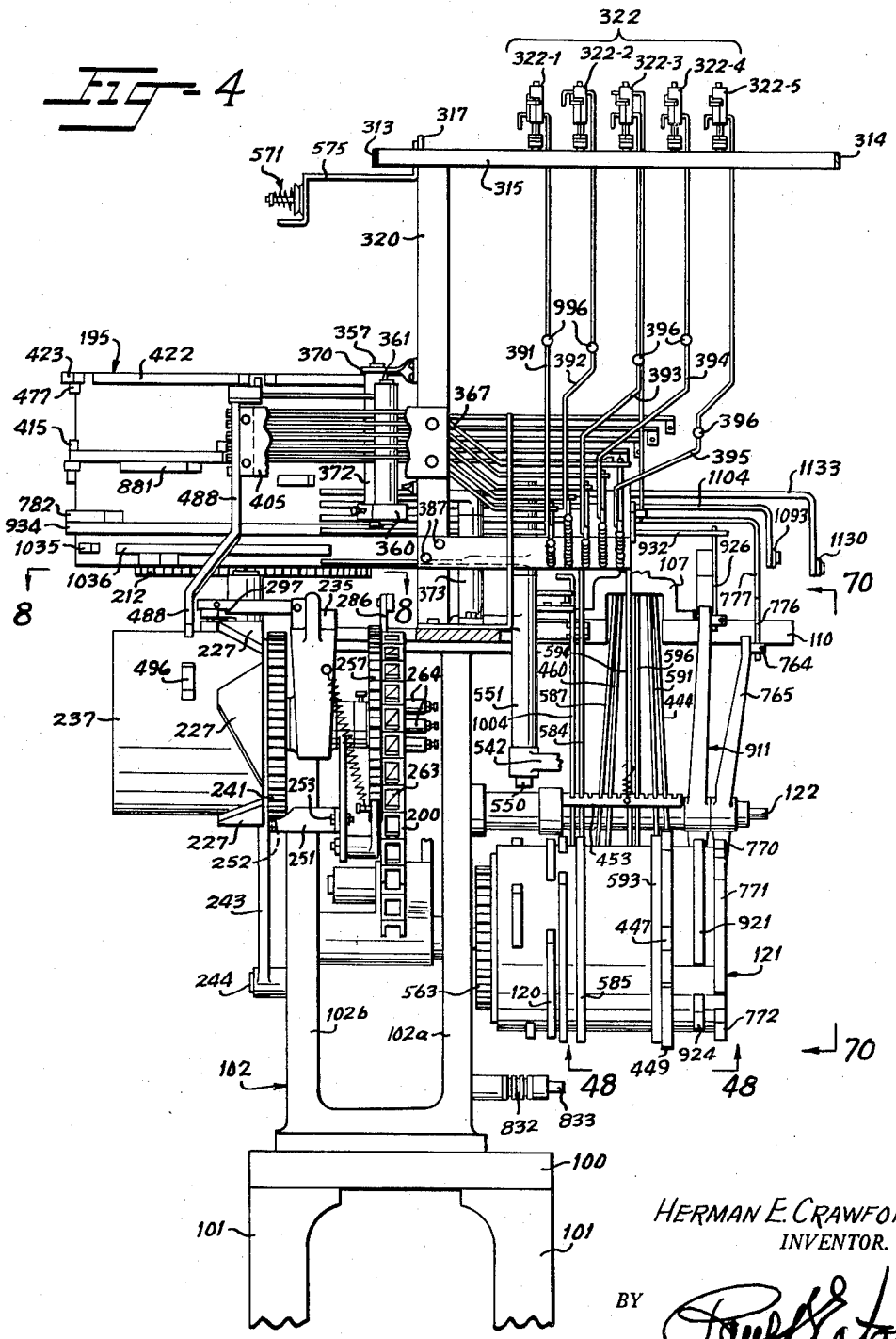
INVENTOR:
HERMAN E. CRAWFORD
BY
Paul Eaton
ATTORNEY.

Nov. 18, 1958 H. E. CRAWFORD 2,860,500

KNITTING MACHINE FOR KNITTING HOSIERY AND OTHER FABRICS

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Fig. 4



HERMAN E. CRAWFORD,
INVENTOR.

BY

ATTORNEY.

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33 Sheets-Sheet 5

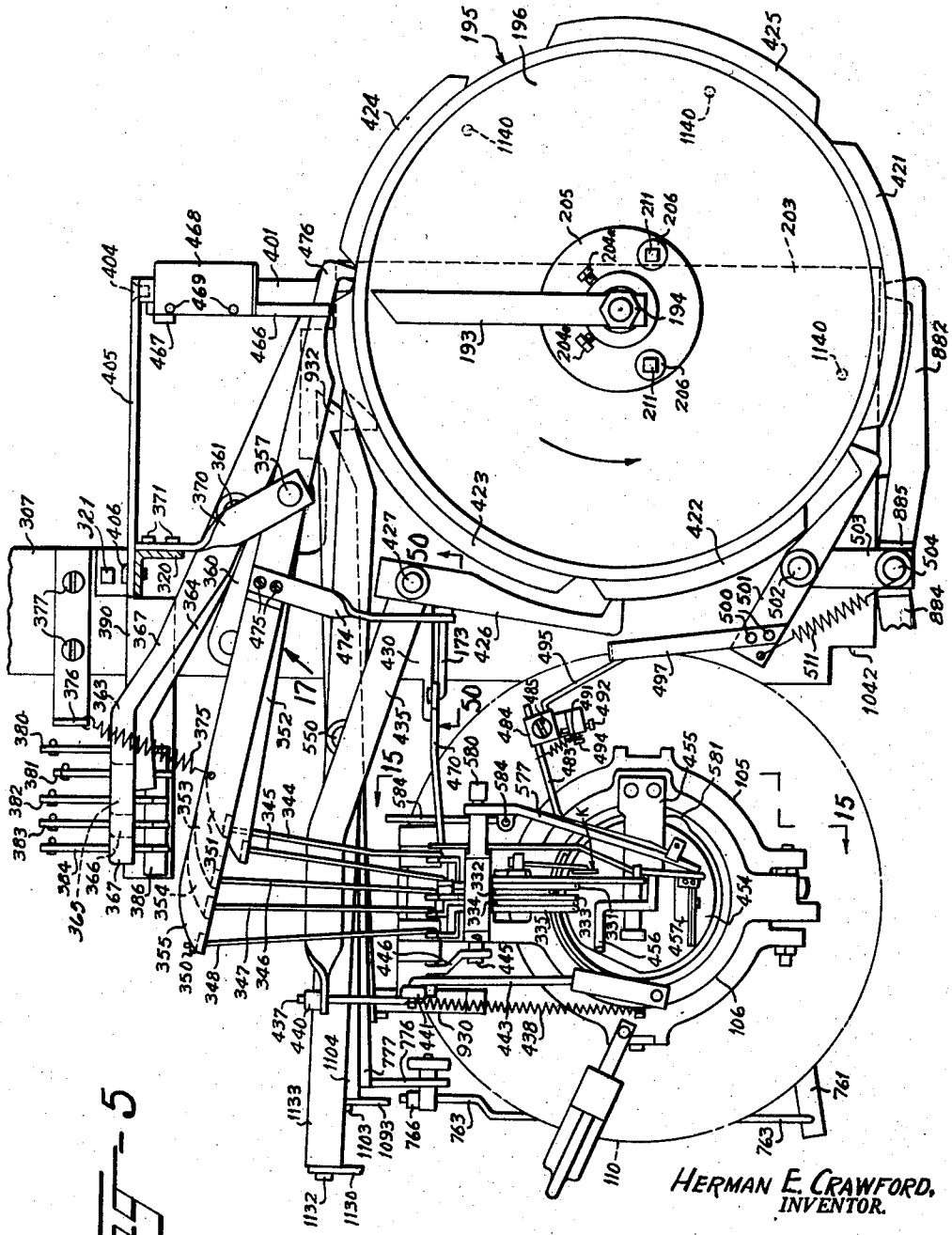


FIG. 5

HERMAN E. CRAWFORD,
INVENTOR.

BY

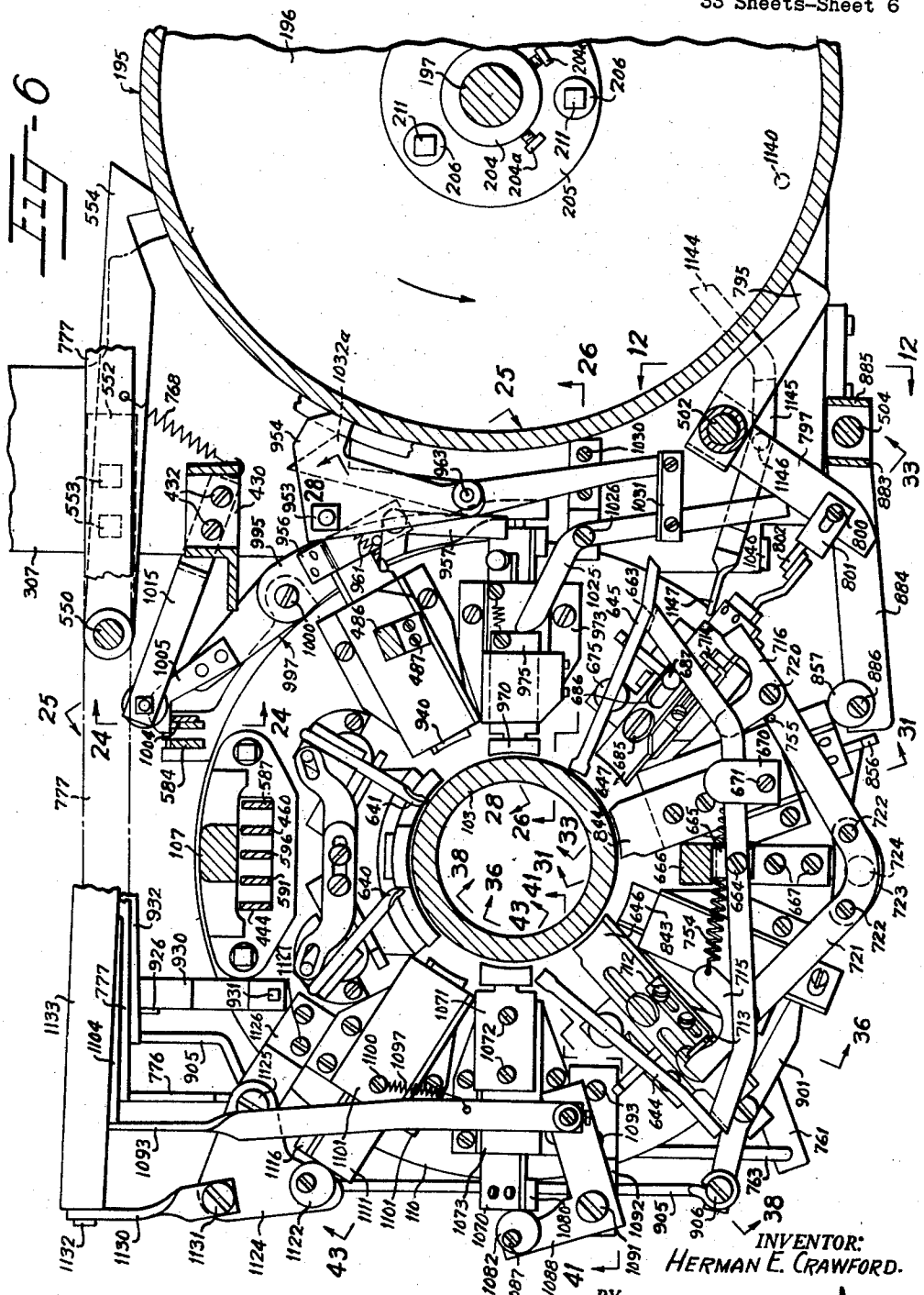
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FIG. 6



INVENTOR:
HERMAN E. CRAWFORD.
BY
ATTORNEY.

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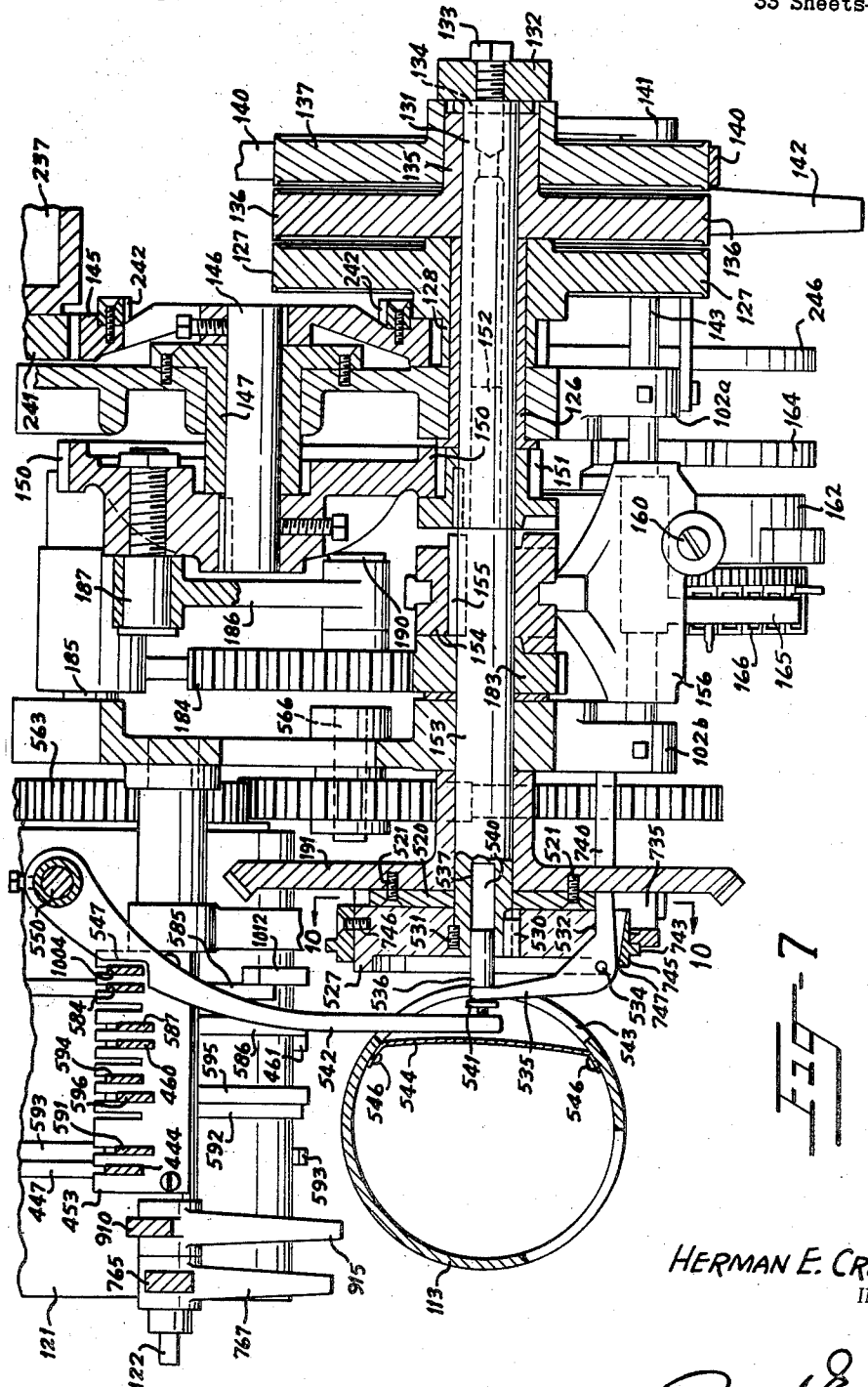


FIG. 7

HERMAN E. CRAWFORD,
INVENTOR.

BY

ATTORNEY

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KNITTING MACHINE FOR KNITTING HOSIERY AND OTHER FABRICS

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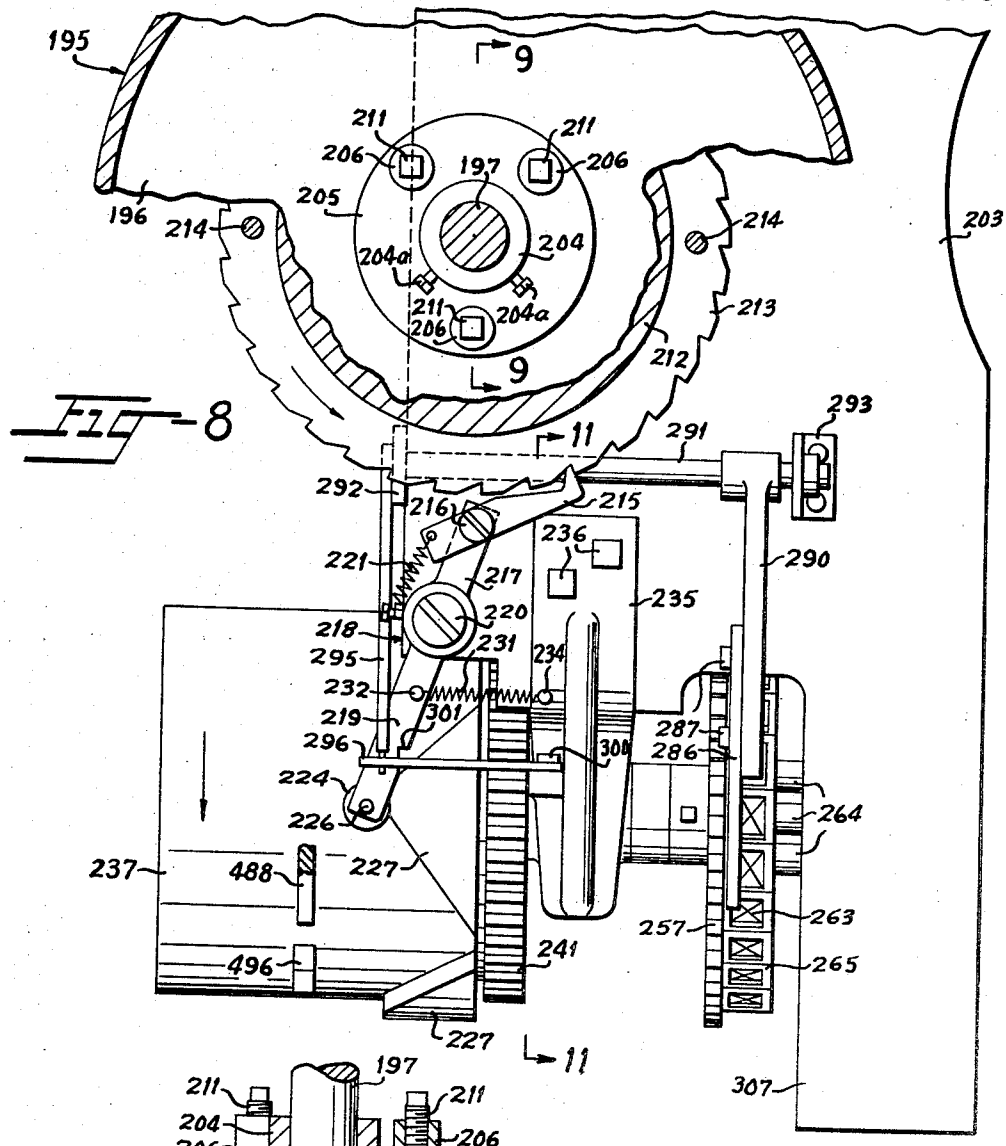


Fig. 8

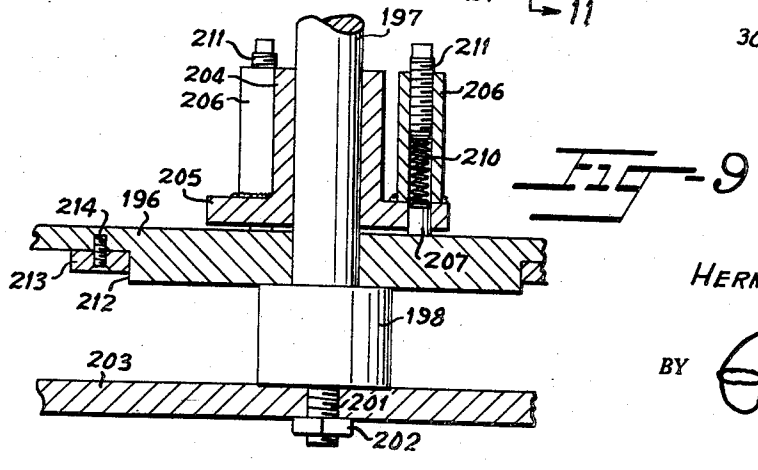


Fig. 9

HERMAN E. CRAWFORD,
INVENTOR.

BY

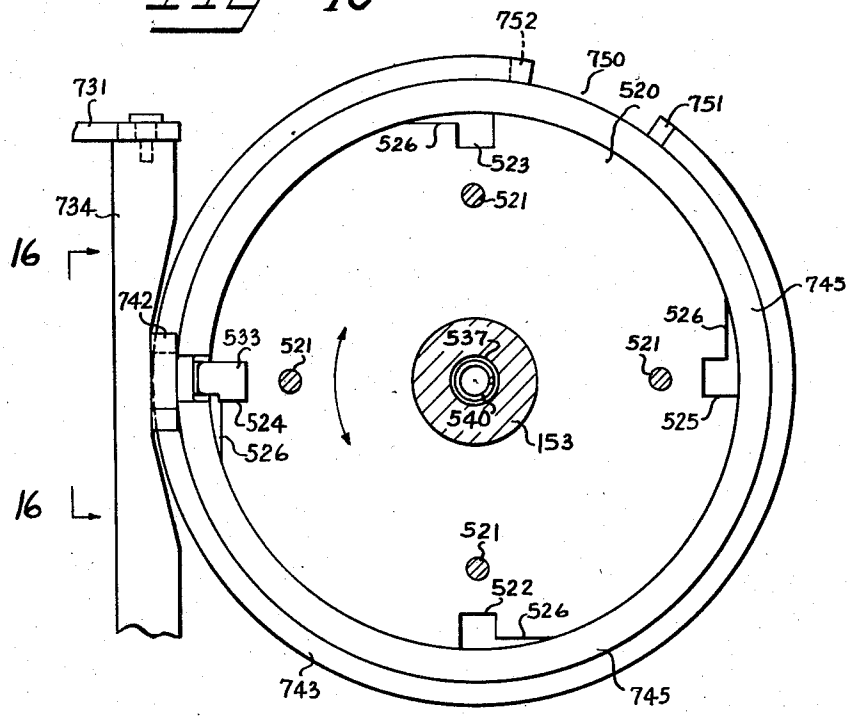
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KNITTING MACHINE FOR KNITTING HOSIERY AND OTHER FABRICS

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Fig-10



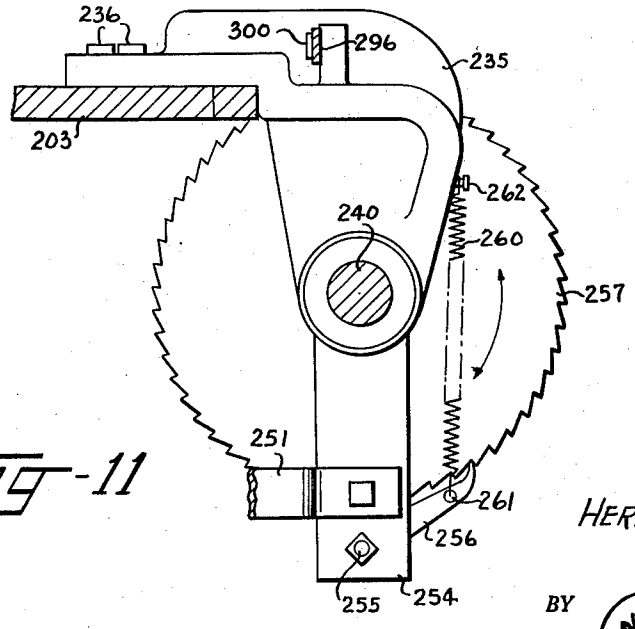


Fig-11

HERMAN E. CRAWFORD,
INVENTOR.

BY Rowe & Eaton

ATTORNEY.

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KNITTING MACHINE FOR KNITTING HOSIERY AND OTHER FABRICS

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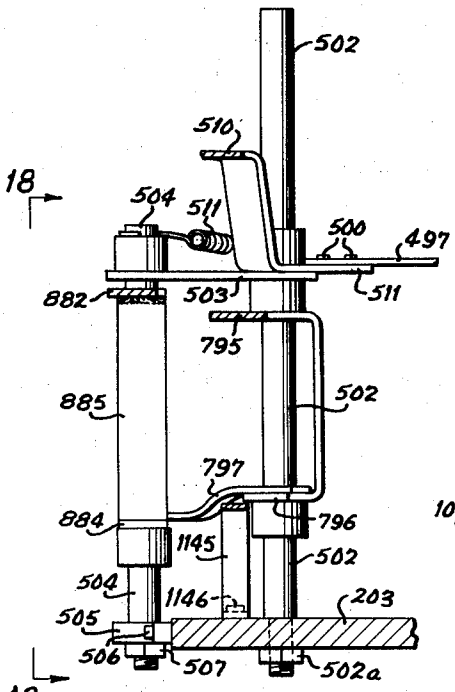


Fig-12

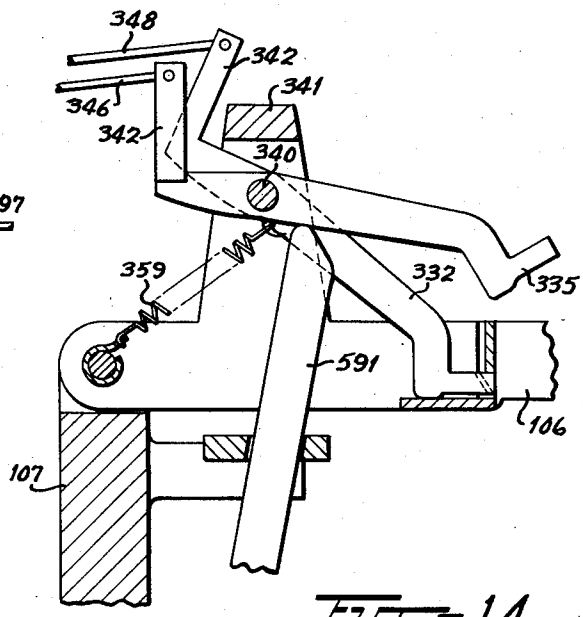
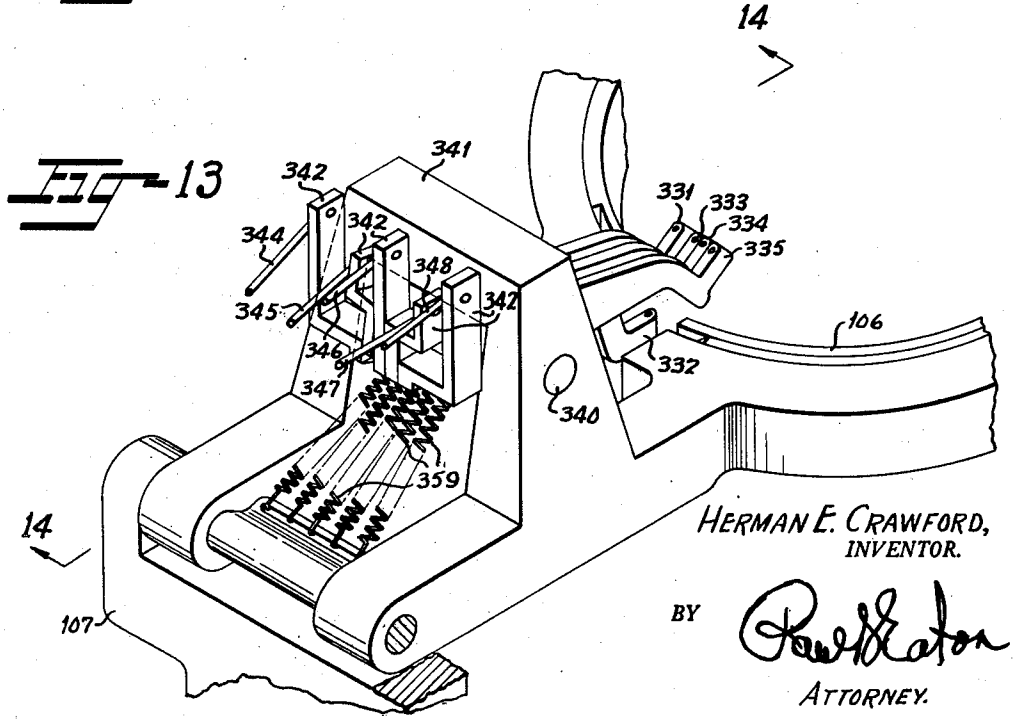


Fig-14

14

Fig-13



HERMAN E. CRAWFORD,
INVENTOR.

BY Paul Eaton

ATTORNEY.

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KNITTING MACHINE FOR KNITTING HOSIERY AND OTHER FABRICS

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Fig-15

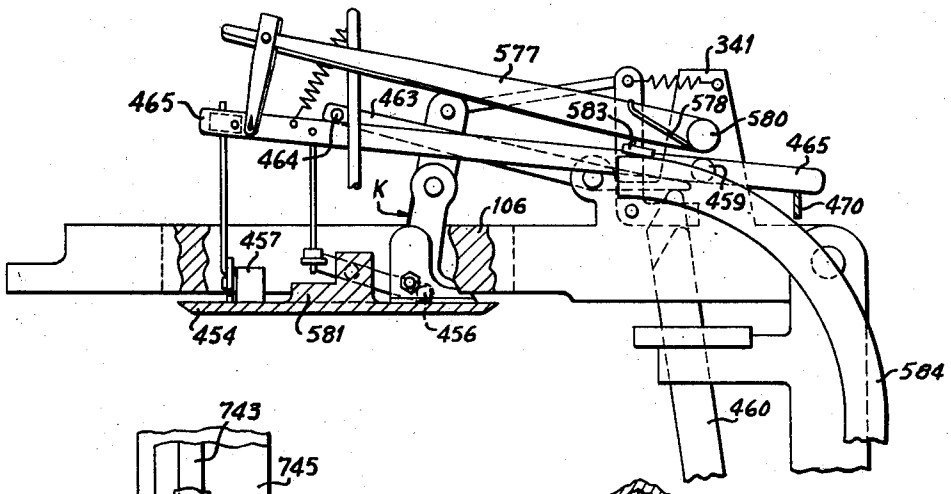


Fig-16

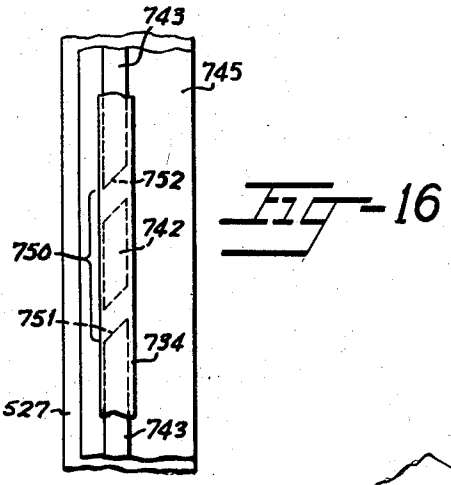
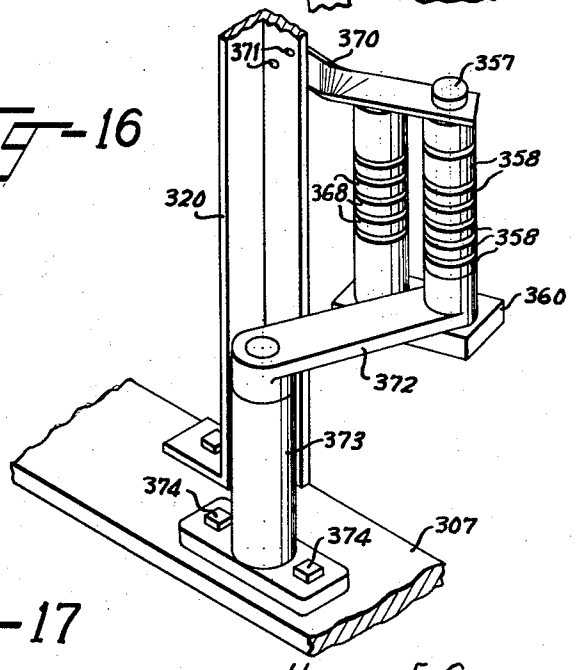


Fig-17



HERMAN E. CRAWFORD,
INVENTOR.

BY Rowe & Eaton

ATTORNEY.

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KNITTING MACHINE FOR KNITTING HOSIERY AND OTHER FABRICS

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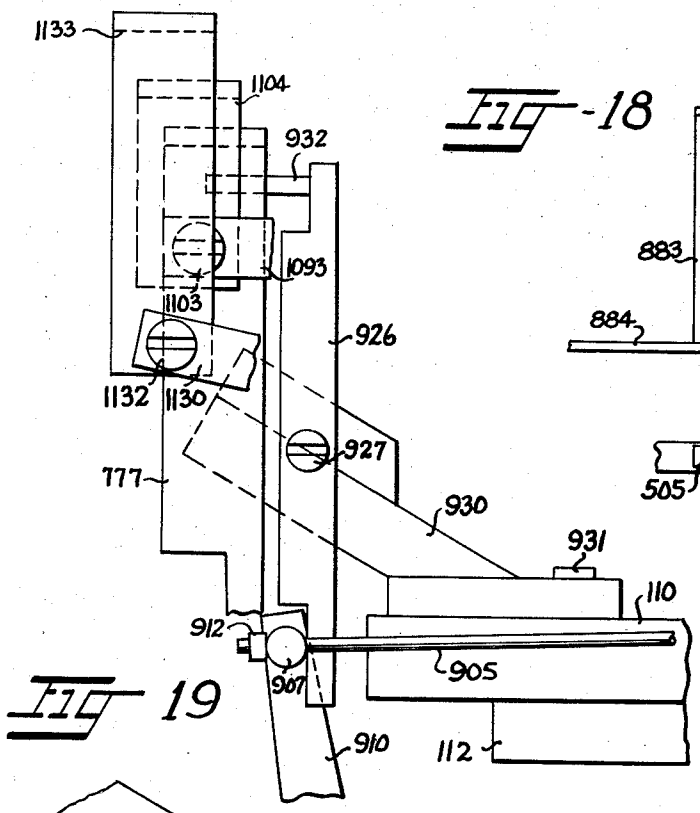


Fig. 19

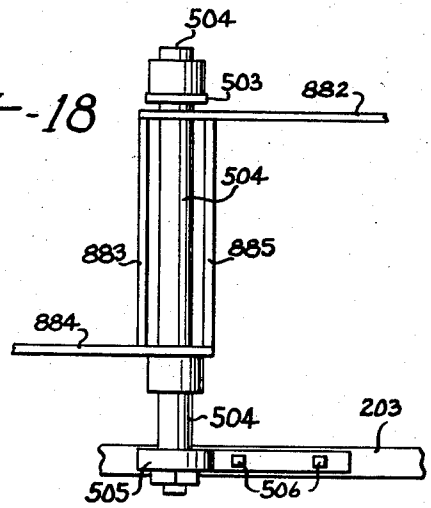


Fig. 18

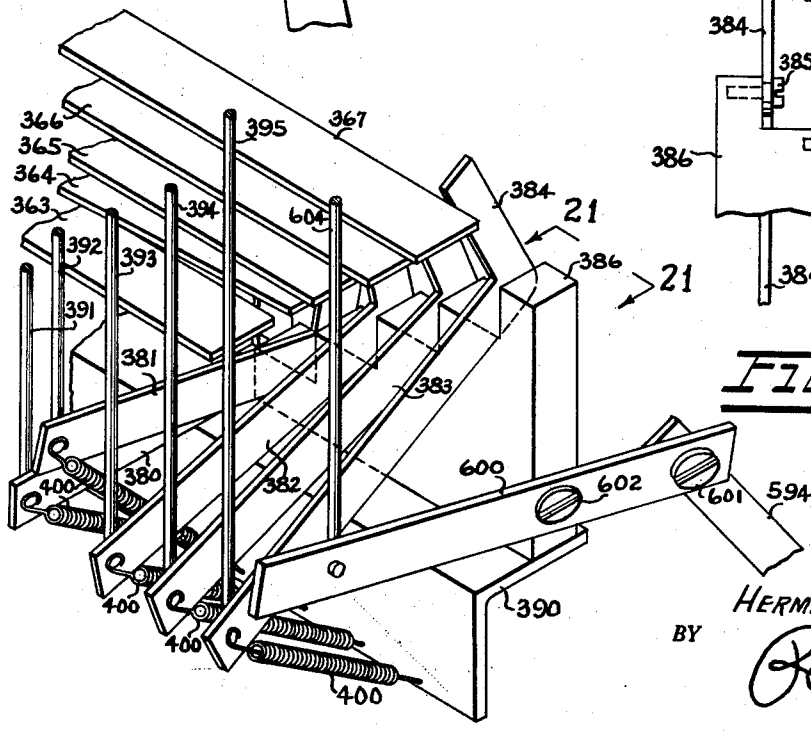


Fig. 20

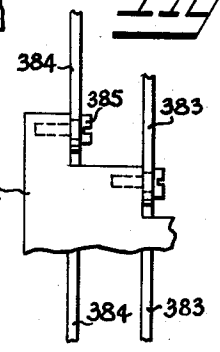


Fig. 21

INVENTOR:
HERMAN E. CRAWFORD.

BY

ATTORNEY.

Nov. 18, 1958 H. E. CRAWFORD 2,860,500

KNITTING MACHINE FOR KNITTING HOSIERY AND OTHER FABRICS

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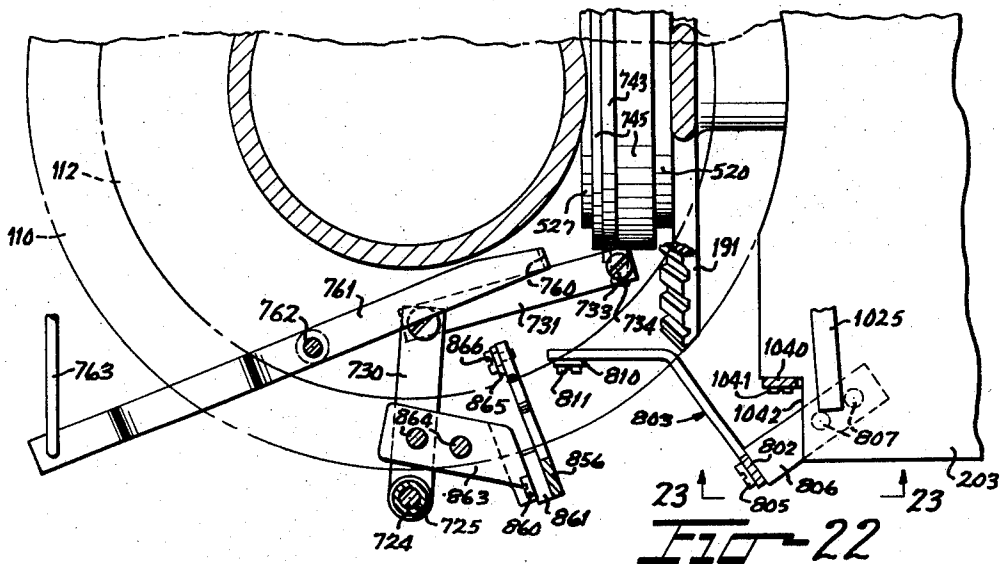


Fig-22

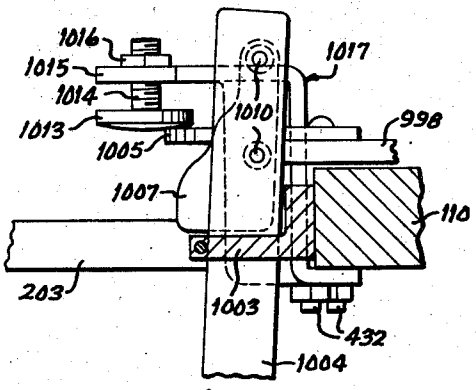


Fig-24

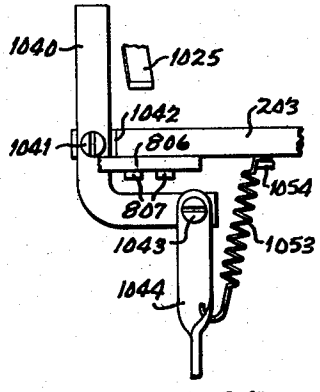


Fig-23

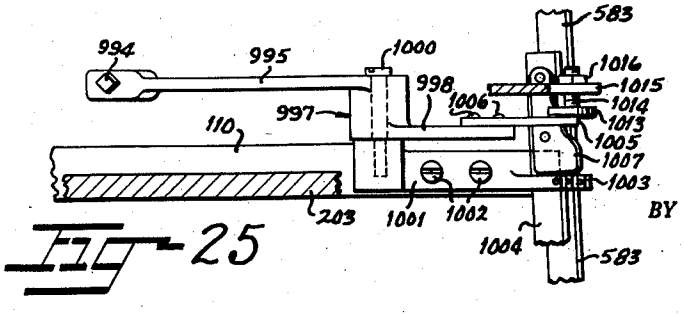


Fig-25

HERMAN E. CRAWFORD,
INVENTOR.

BY

ATTORNEY.

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KNITTING MACHINE FOR KNITTING HOSIERY AND OTHER FABRICS

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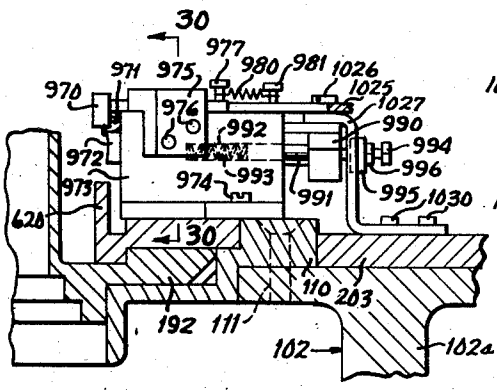


Fig-26

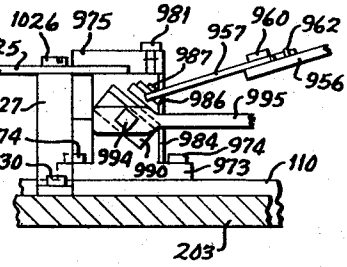


Fig-27

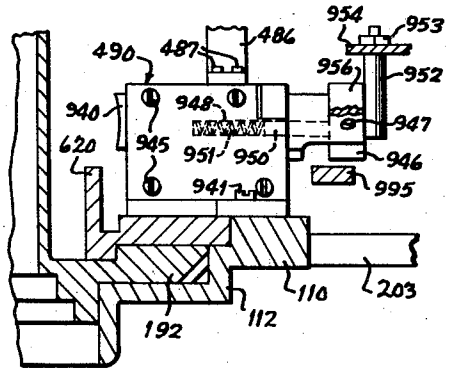


Fig-28

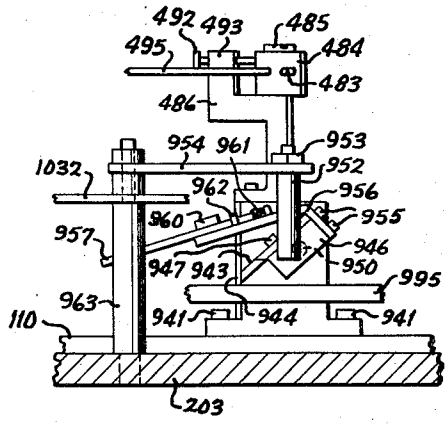


Fig-29

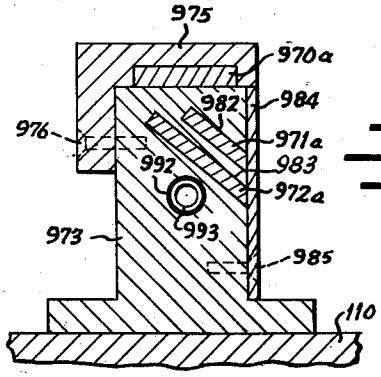


Fig-30

HERMAN E. CRAWFORD,
INVENTOR.

BY Paul Eaton

ATTORNEY.

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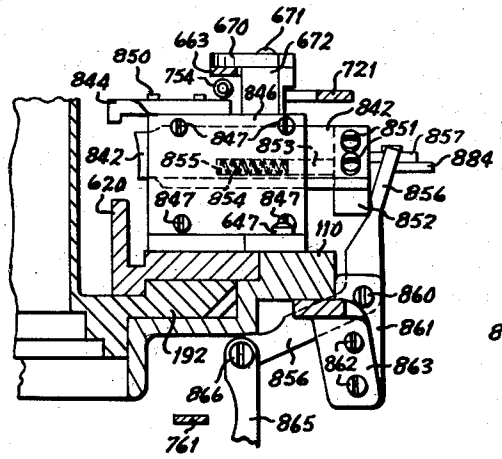


Fig. 31

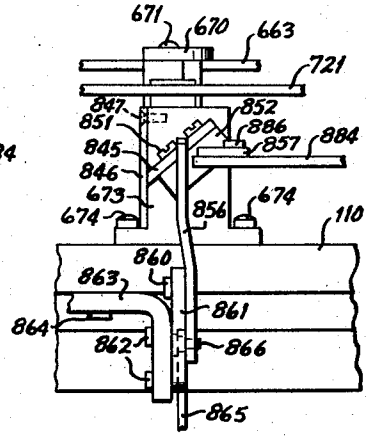


Fig. 32

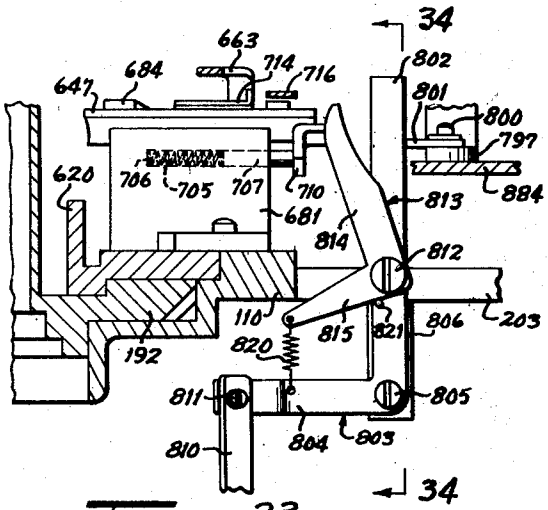


Fig. 33

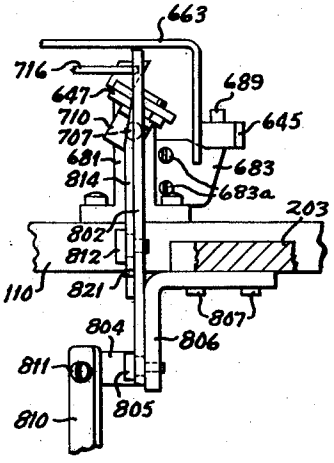


Fig. 34

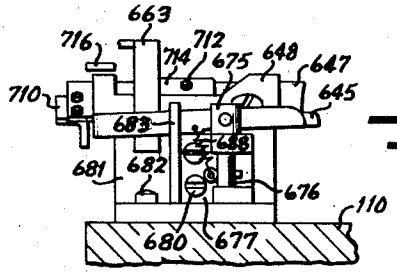


Fig. 35

HERMAN E. CRAWFORD,
INVENTOR.

BY

ATTORNEY.

Nov. 18, 1958 H. E. CRAWFORD 2,860,500

KNITTING MACHINE FOR KNITTING HOSIERY AND OTHER FABRICS

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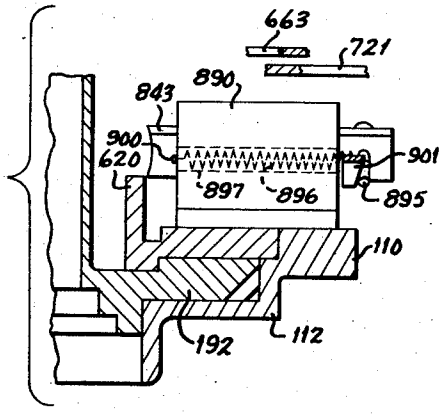


Fig. 36

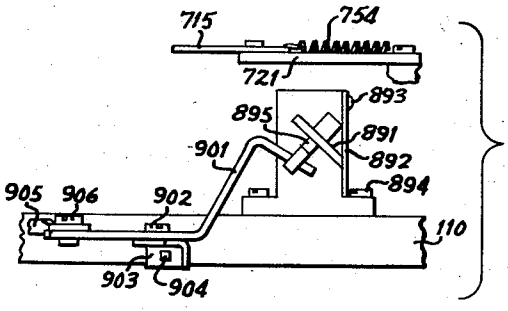


Fig. 37

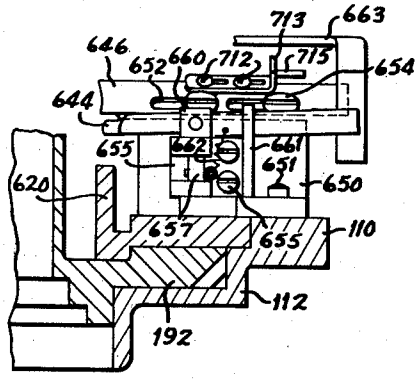


Fig. 38

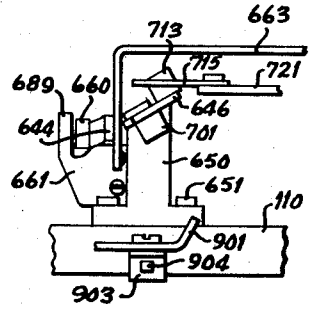


Fig. 39

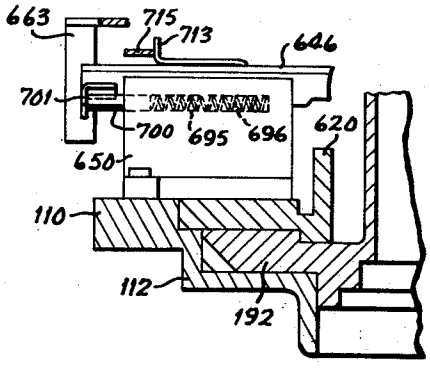


Fig. 40

HERMAN E. CRAWFORD,
INVENTOR.

BY Paul E. Eaton

ATTORNEY.

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KNITTING MACHINE FOR KNITTING HOSIERY AND OTHER FABRICS

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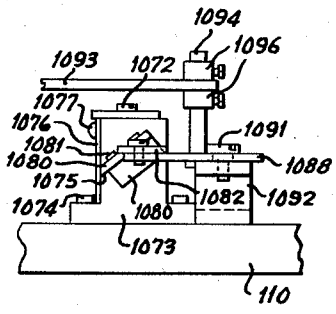


Fig-42

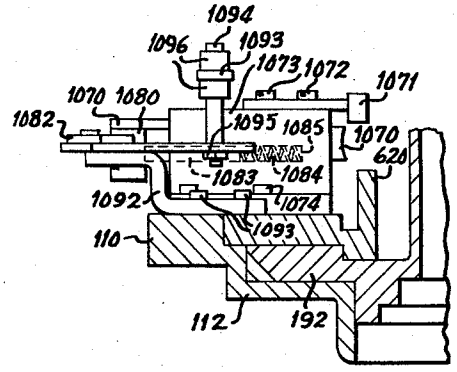


Fig-41

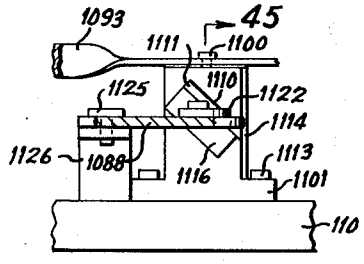


Fig-44

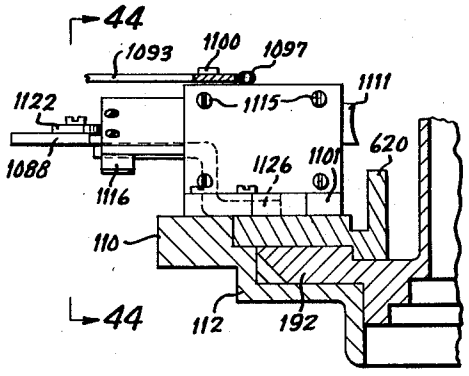


Fig-43

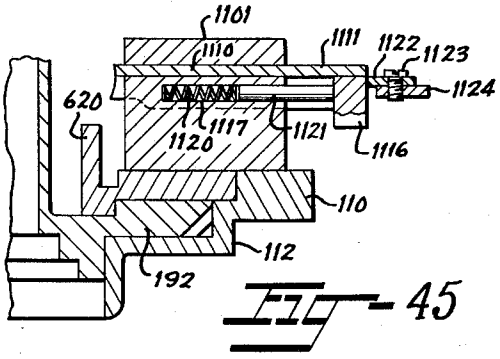


Fig-45

HERMAN E. CRAWFORD,
INVENTOR.

BY Paul Eaton

ATTORNEY.

Nov. 18, 1958 H. E. CRAWFORD 2,860,500

KNITTING MACHINE FOR KNITTING HOSIERY AND OTHER FABRICS

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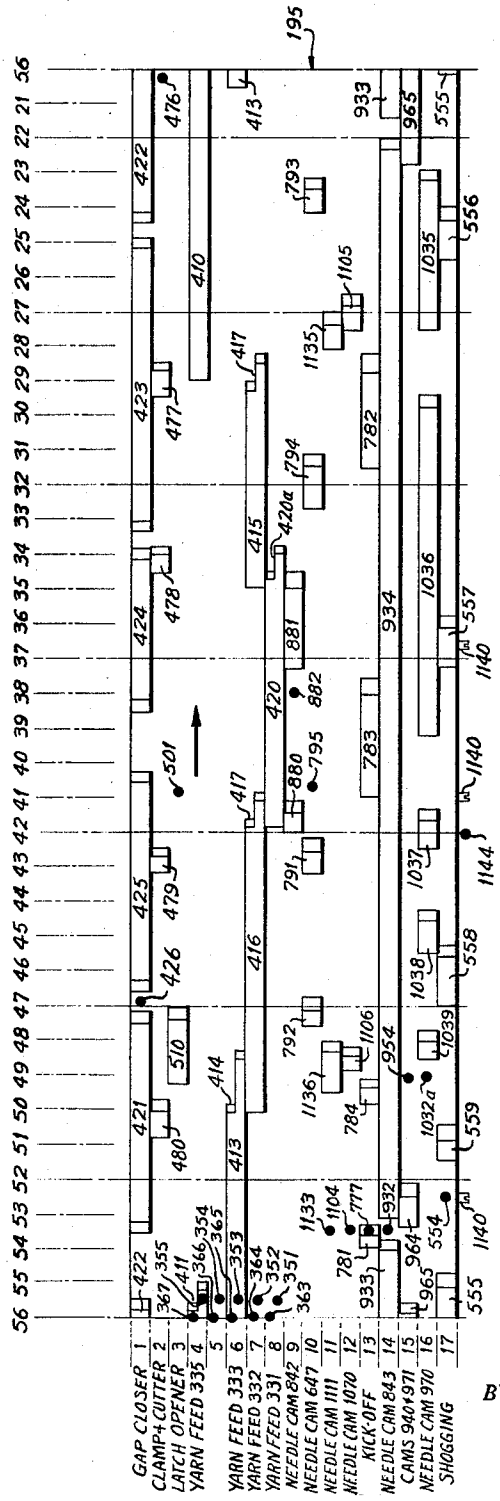


FIG-46

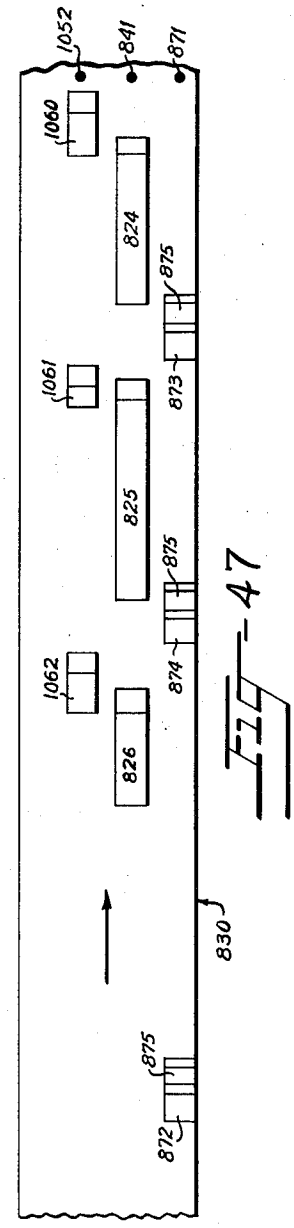


FIG-47

HERMAN E. CRAWFORD,
INVENTOR.

BY

ATTORNEY.

Nov. 18, 1958 H. E. CRAWFORD 2,860,500

KNITTING MACHINE FOR KNITTING HOSIERY AND OTHER FABRICS

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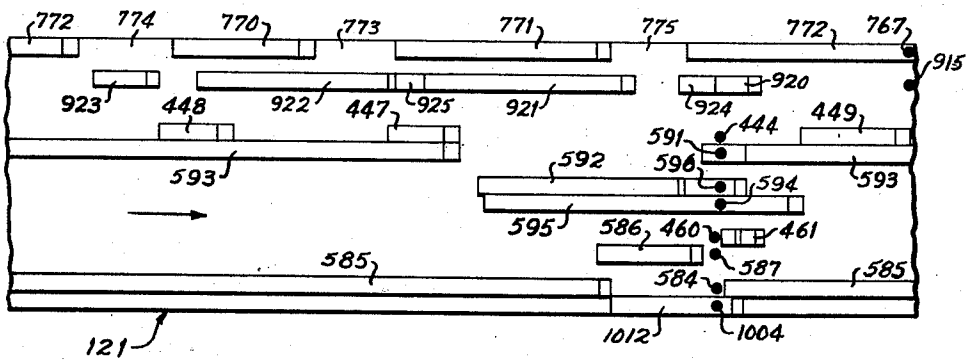


Fig - 48

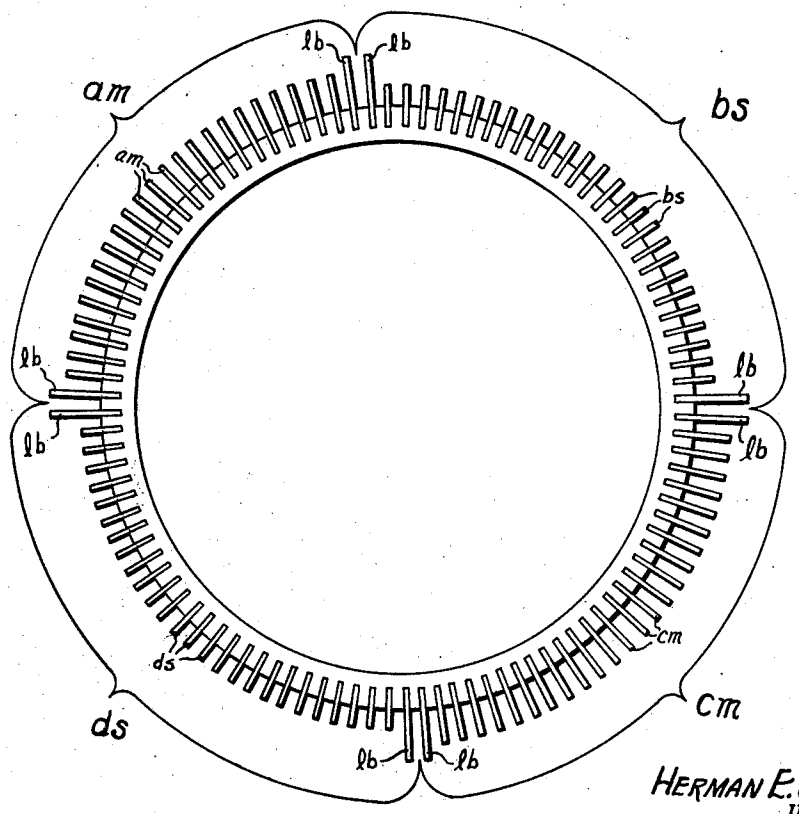


Fig - 49

HERMAN E. CRAWFORD,
INVENTOR.

BY Paul & Paton

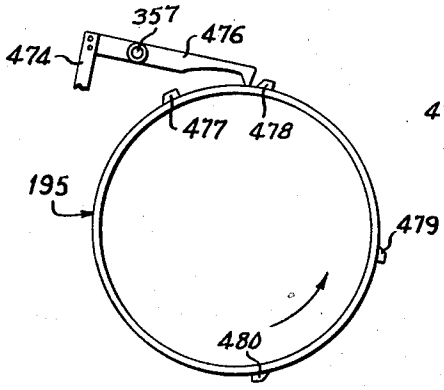
ATTORNEY.

Nov. 18, 1958 H. E. CRAWFORD 2,860,500

KNITTING MACHINE FOR KNITTING HOSIERY AND OTHER FABRICS

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Fig-51



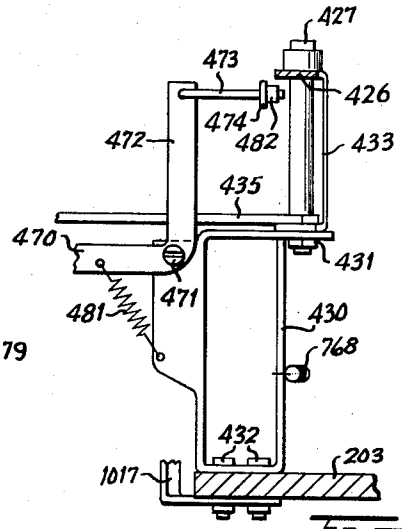


Fig-50

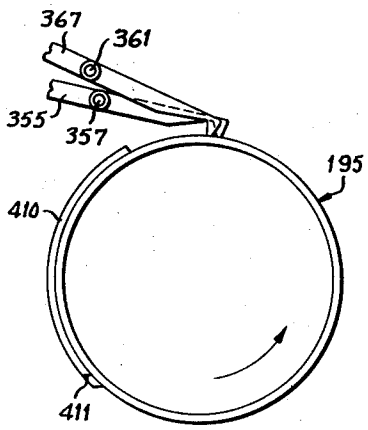


Fig-53

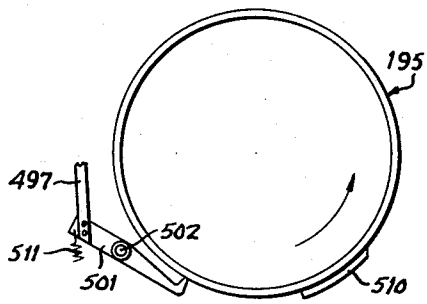


Fig-52

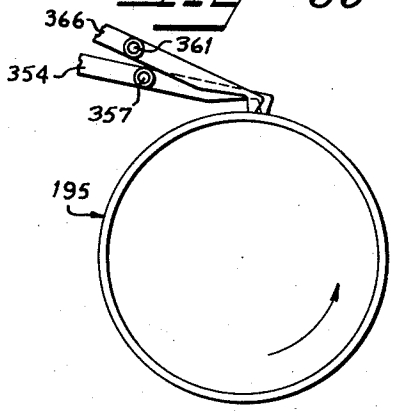


Fig-54

HERMAN E. CRAWFORD,
INVENTOR.

BY

ATTORNEY.

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KNITTING MACHINE FOR KNITTING HOSIERY AND OTHER FABRICS

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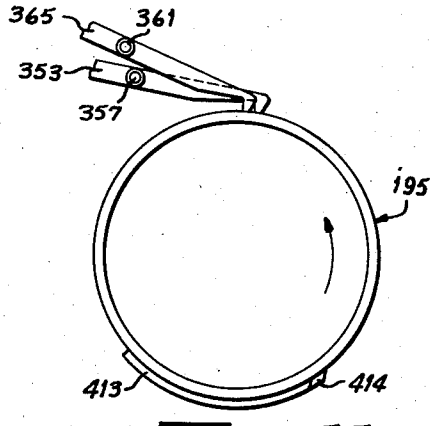


Fig-55

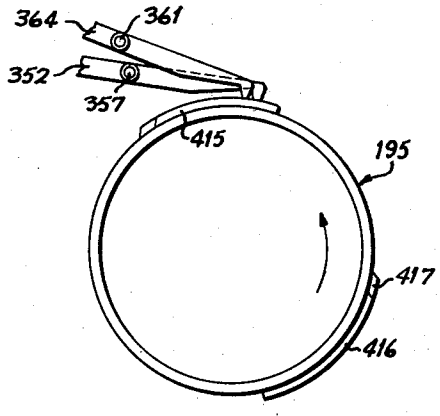


Fig-56

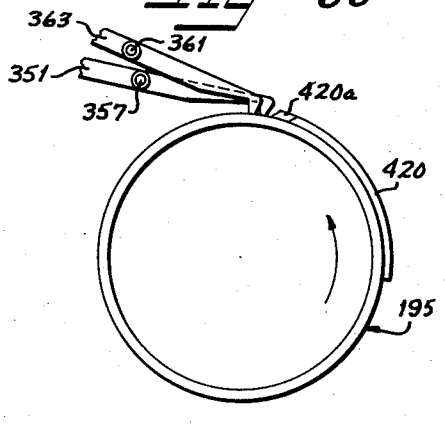


Fig-57

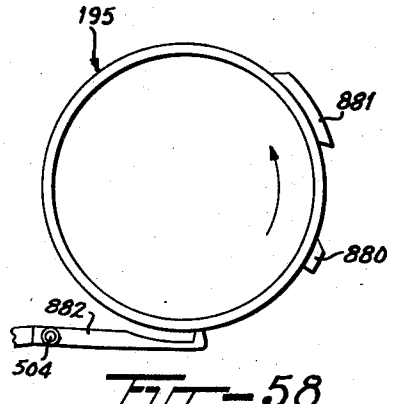


Fig-58

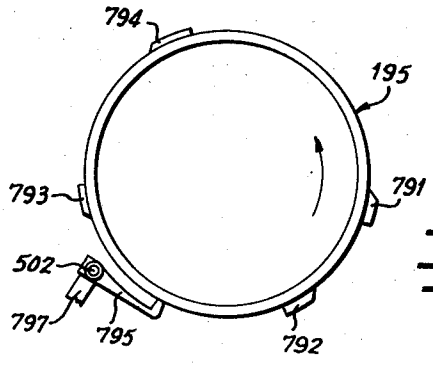


Fig-59

HERMAN E. CRAWFORD,
INVENTOR.

BY Paul Eaton

ATTORNEY.

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KNITTING MACHINE FOR KNITTING HOSIERY AND OTHER FABRICS

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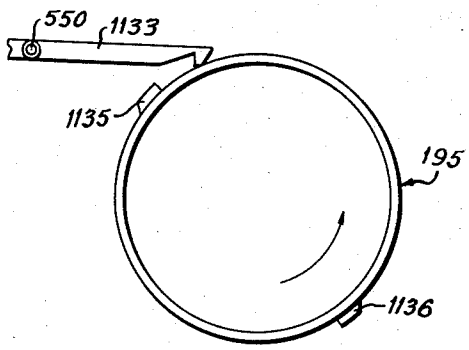


Fig-60

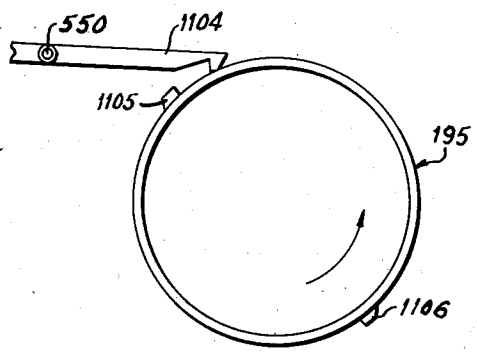


Fig-61

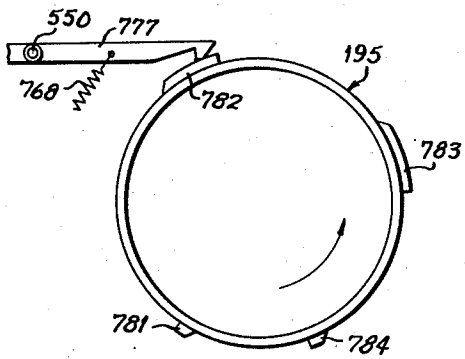


Fig-62

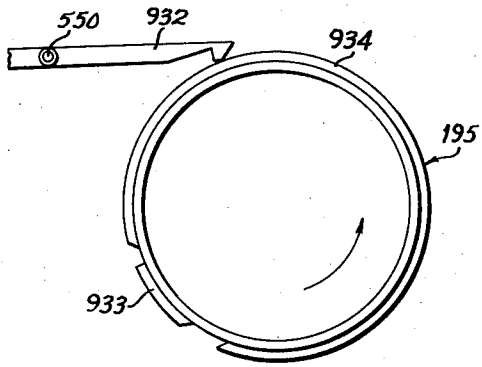


Fig-63

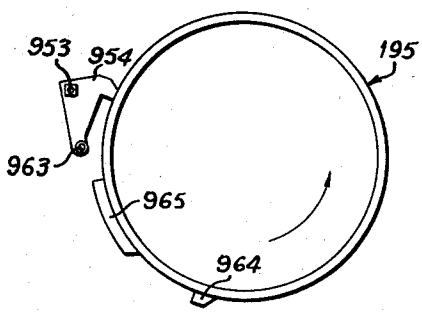


Fig-64

HERMAN E. CRAWFORD,
INVENTOR.

BY Raw & Eaton

ATTORNEY.

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KNITTING MACHINE FOR KNITTING HOSIERY AND OTHER FABRICS

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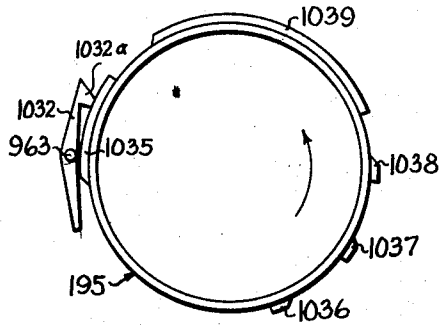


Fig-65

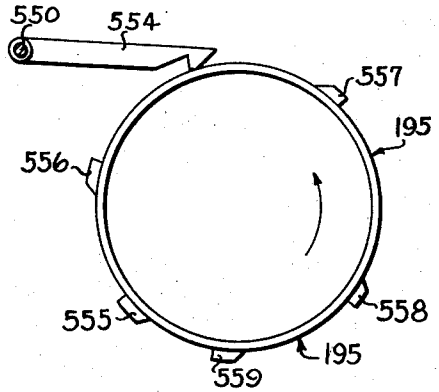


Fig-66

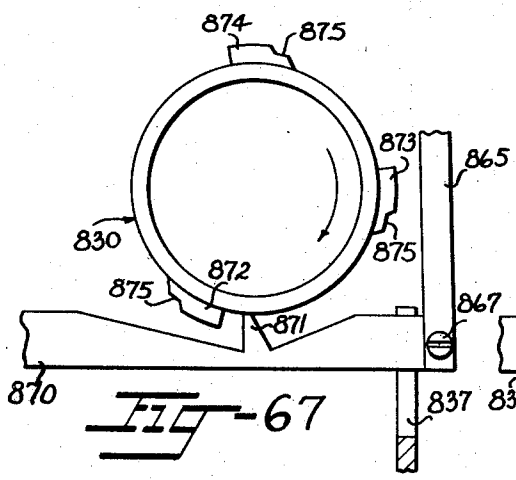


Fig-67

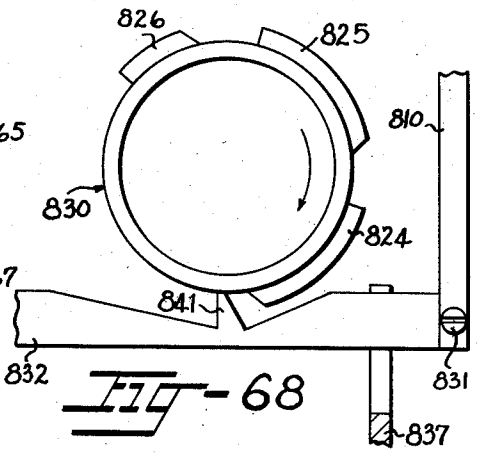


Fig-68

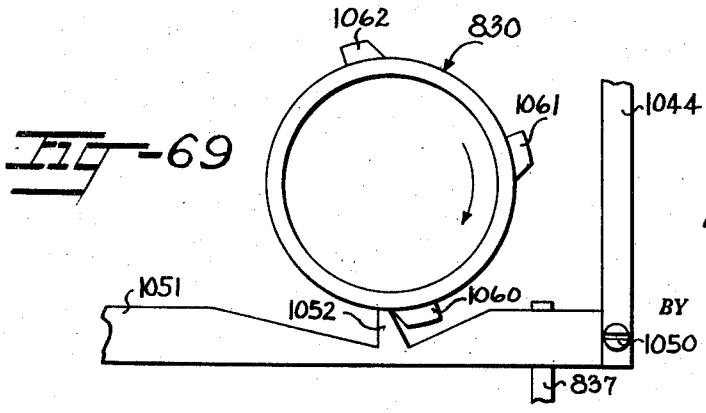


Fig-69

HERMAN E. CRAWFORD,
INVENTOR.

BY Rowe & Eaton

ATTORNEY.

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KNITTING MACHINE FOR KNITTING HOSIERY AND OTHER FABRICS

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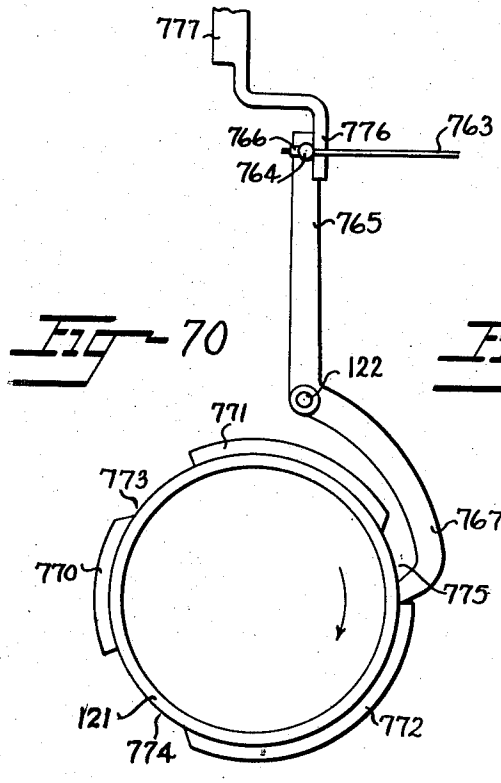


Fig. 70

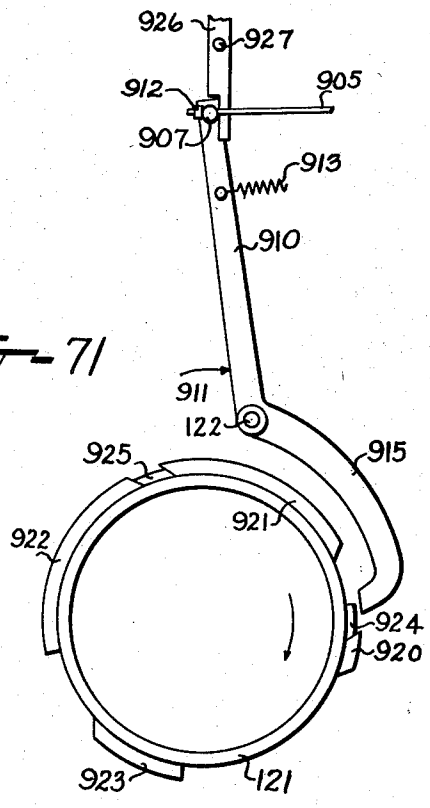


Fig. 71

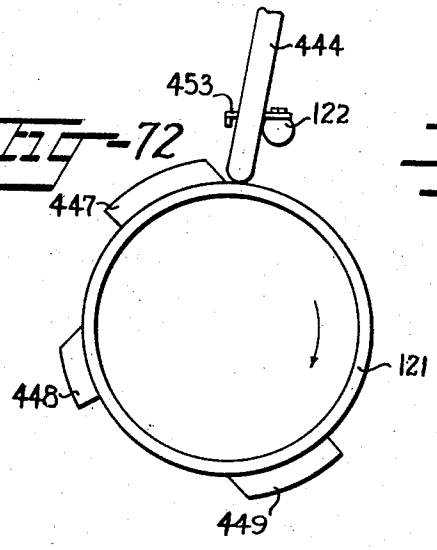


Fig. 72

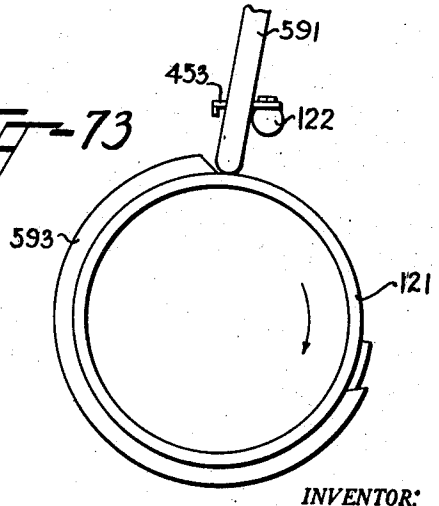


Fig. 73

INVENTOR:
HERMAN E. CRAWFORD.
BY
ATTORNEY.

Nov. 18, 1958 H. E. CRAWFORD 2,860,500

KNITTING MACHINE FOR KNITTING HOSIERY AND OTHER FABRICS

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Fig. 74

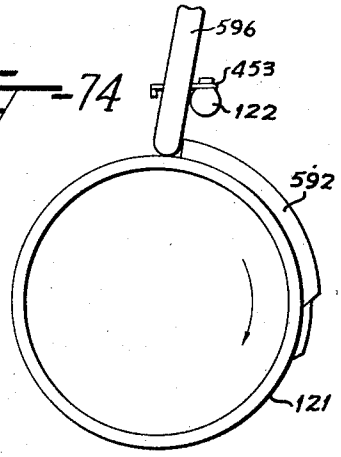


Fig. 75

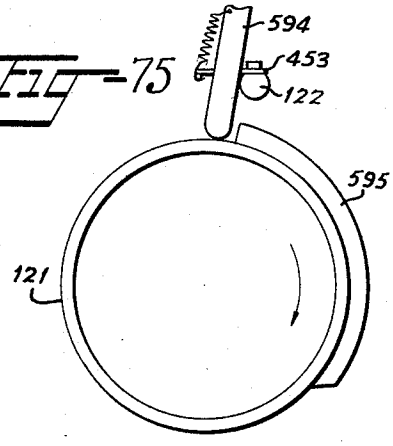


Fig. 76

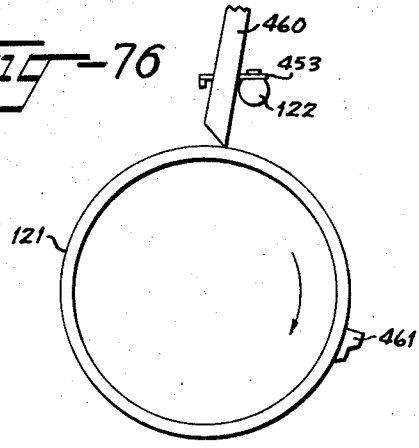


Fig. 77

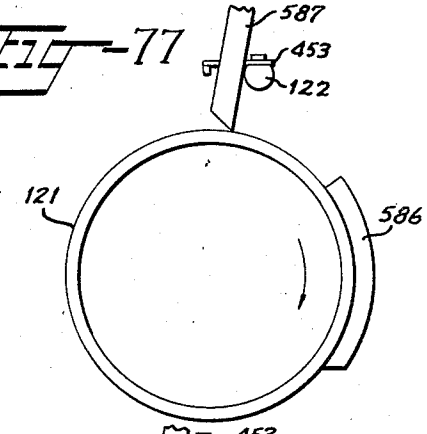


Fig. 78

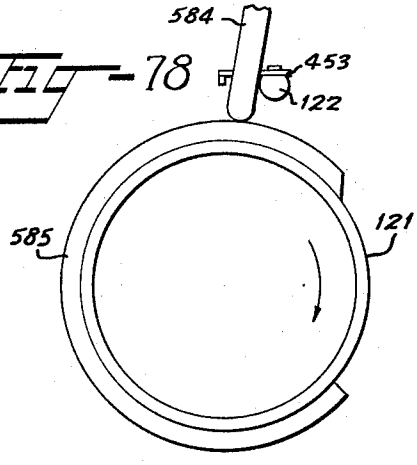
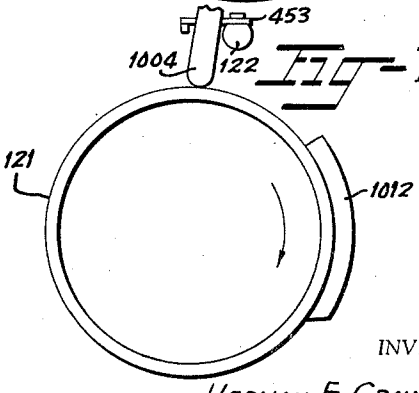


Fig. 79



INVENTOR:
HERMAN E. CRAWFORD.

BY

ATTORNEY

Nov. 18, 1958 H. E. CRAWFORD 2,860,500

KNITTING MACHINE FOR KNITTING HOSIERY AND OTHER FABRICS

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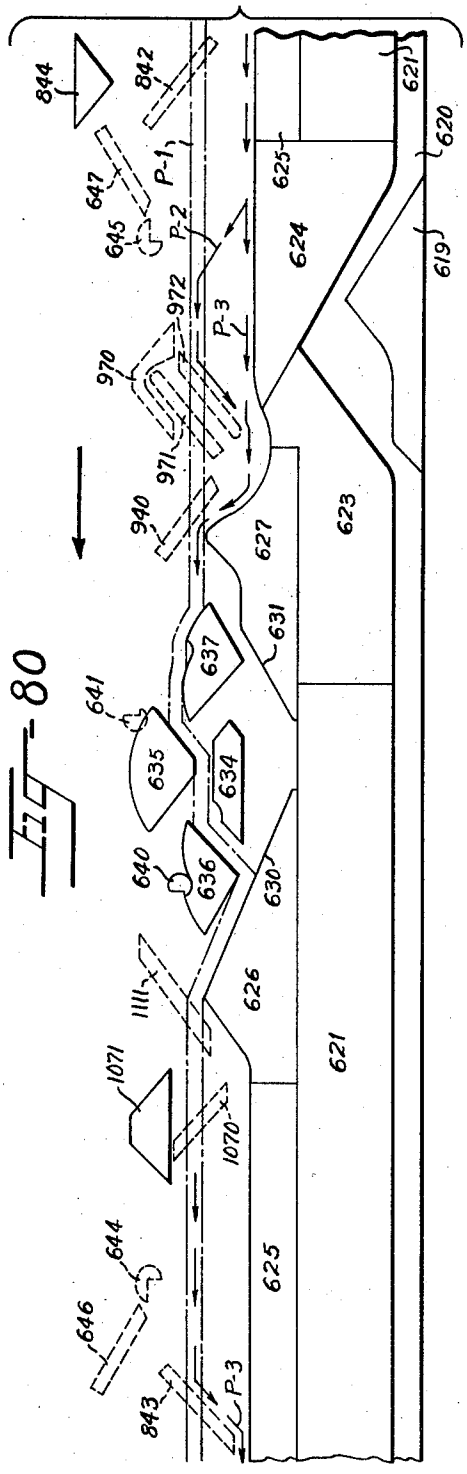


Fig-80

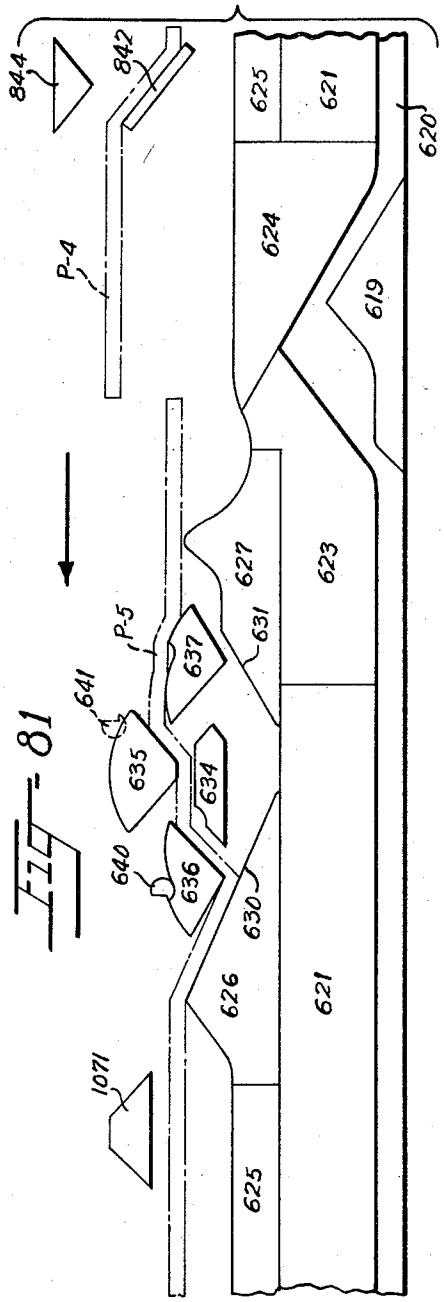


Fig-81

HERMAN E. CRAWFORD,
INVENTOR.

BY

ATTORNEY.

Nov. 18, 1958 H. E. CRAWFORD 2,860,500

KNITTING MACHINE FOR KNITTING HOSIERY AND OTHER FABRICS

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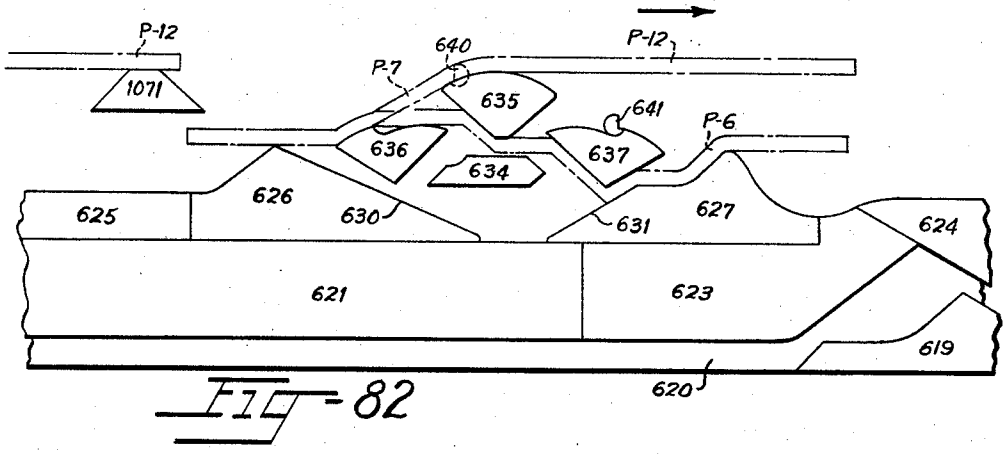


Fig-82

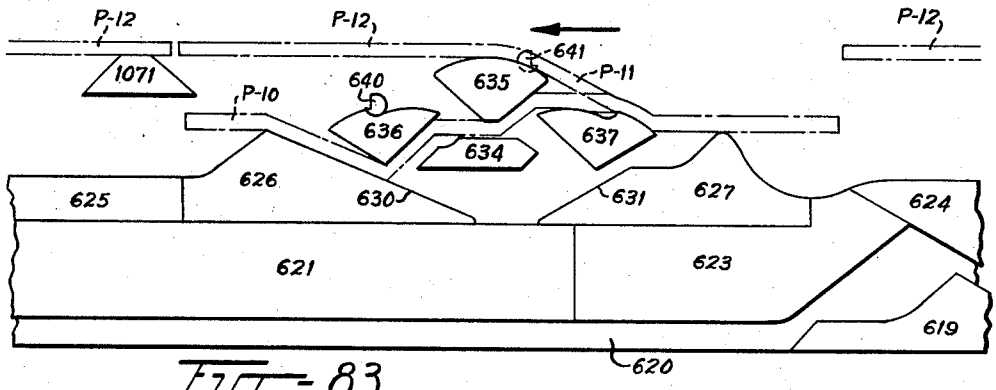


Fig-83

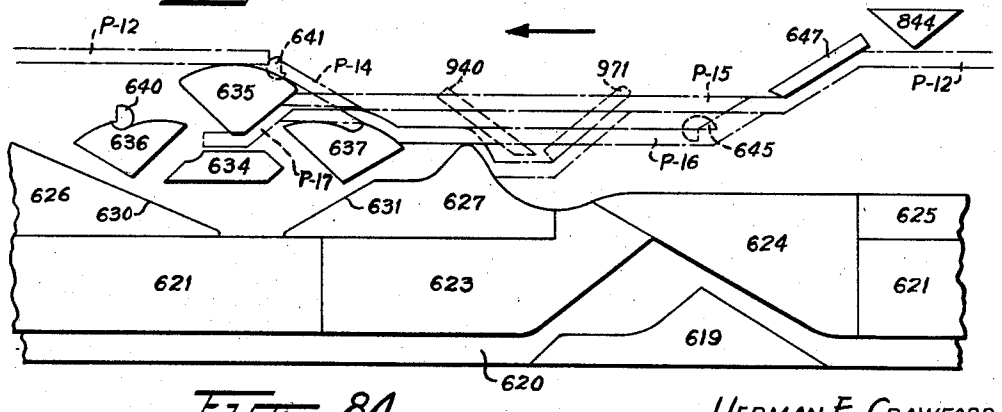


Fig-84

HERMAN E. CRAWFORD,
INVENTOR.

BY

ATTORNEY.

Nov. 18, 1958 H. E. CRAWFORD 2,860,500

KNITTING MACHINE FOR KNITTING HOSIERY AND OTHER FABRICS

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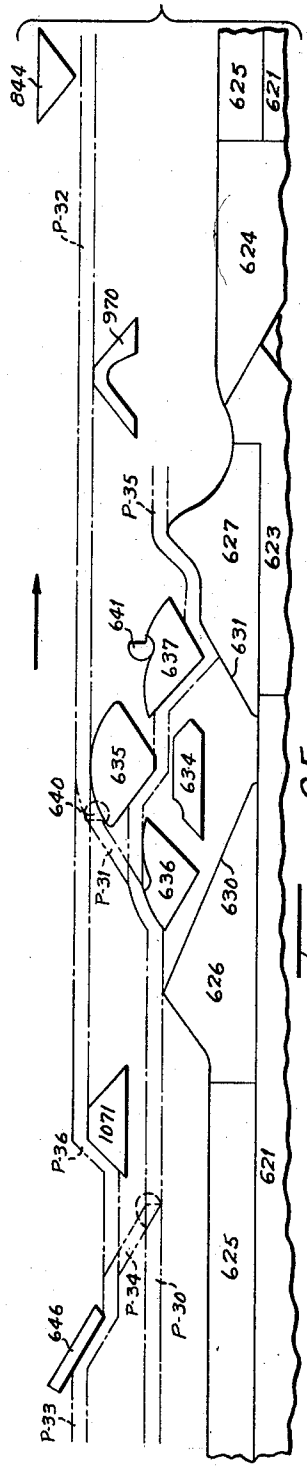


FIG-85

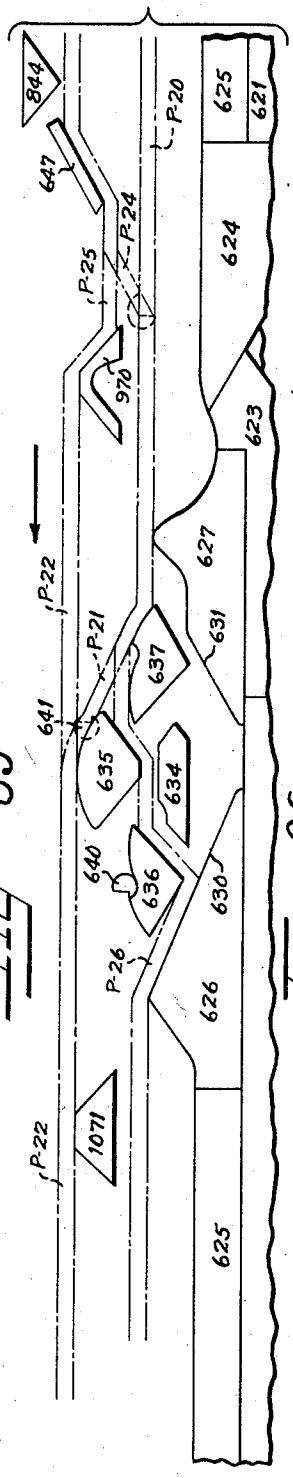


FIG-86

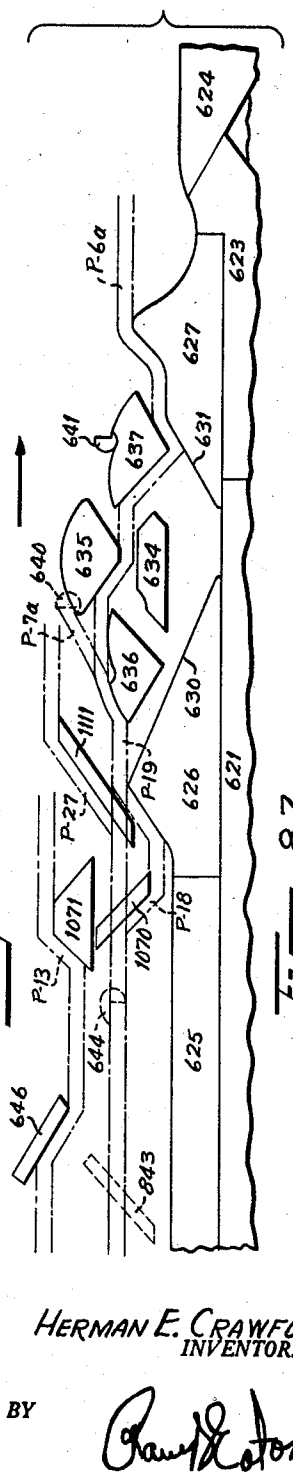


FIG-87

HERMAN E. CRAWFORD,
INVENTOR.

BY

ATTORNEY.

Nov. 18, 1958 H. E. CRAWFORD 2,860,500

KNITTING MACHINE FOR KNITTING HOSIERY AND OTHER FABRICS

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Fig-88

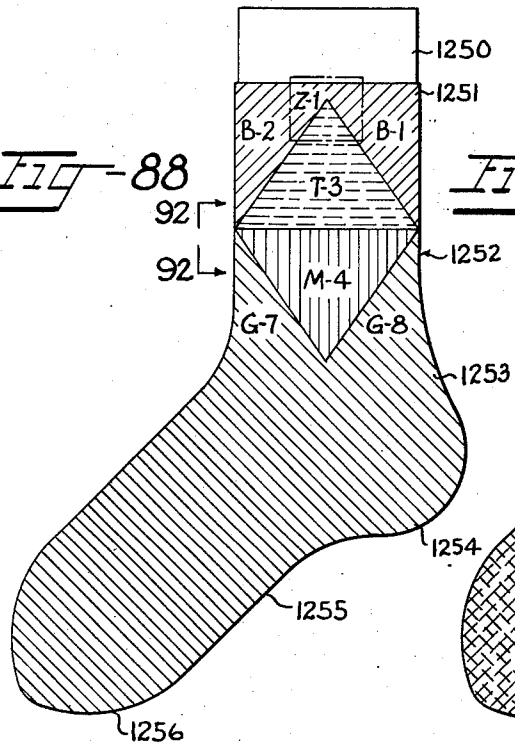


Fig-89

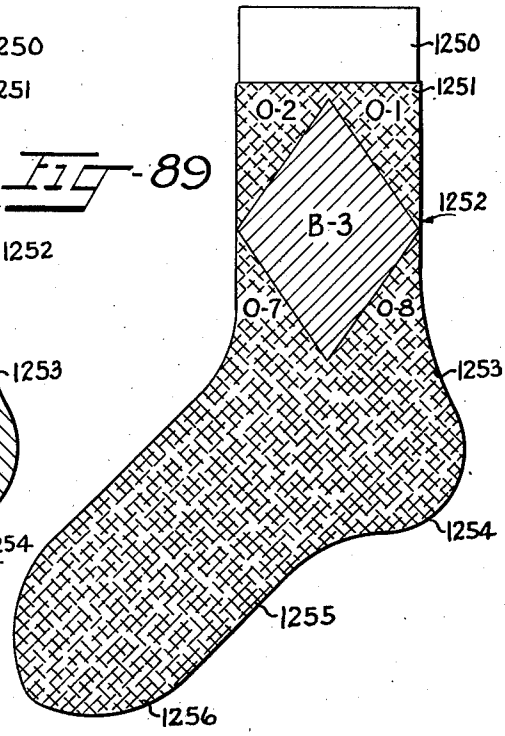


Fig-90

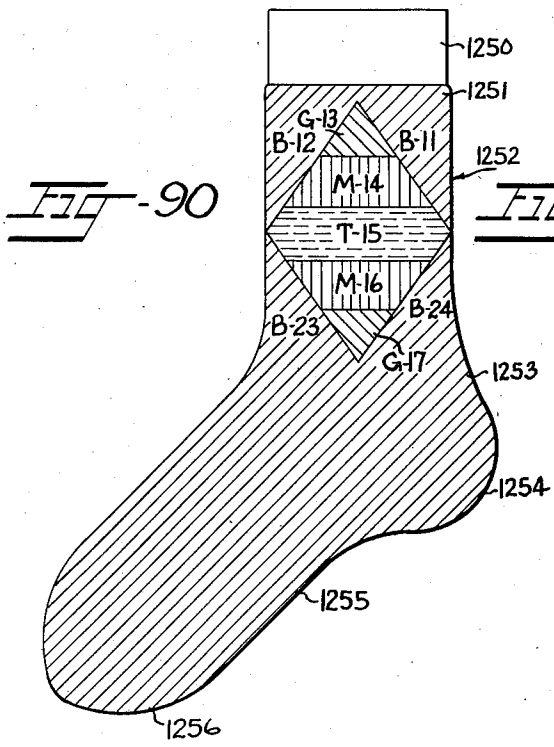
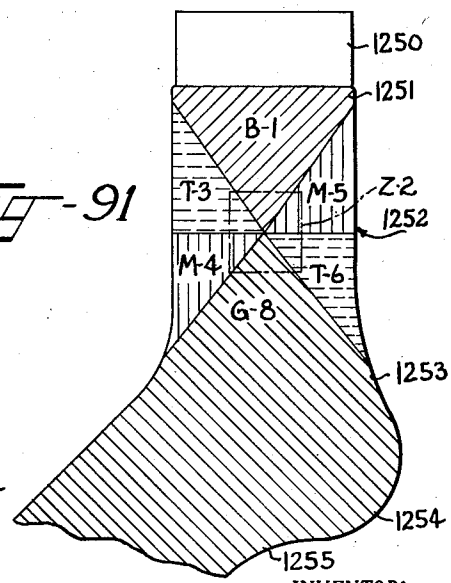


Fig-91



INVENTOR:
HERMAN E. CRAWFORD.
BY
ATTORNEY.

Nov. 18, 1958 H. E. CRAWFORD 2,860,500

KNITTING MACHINE FOR KNITTING HOSIERY AND OTHER FABRICS

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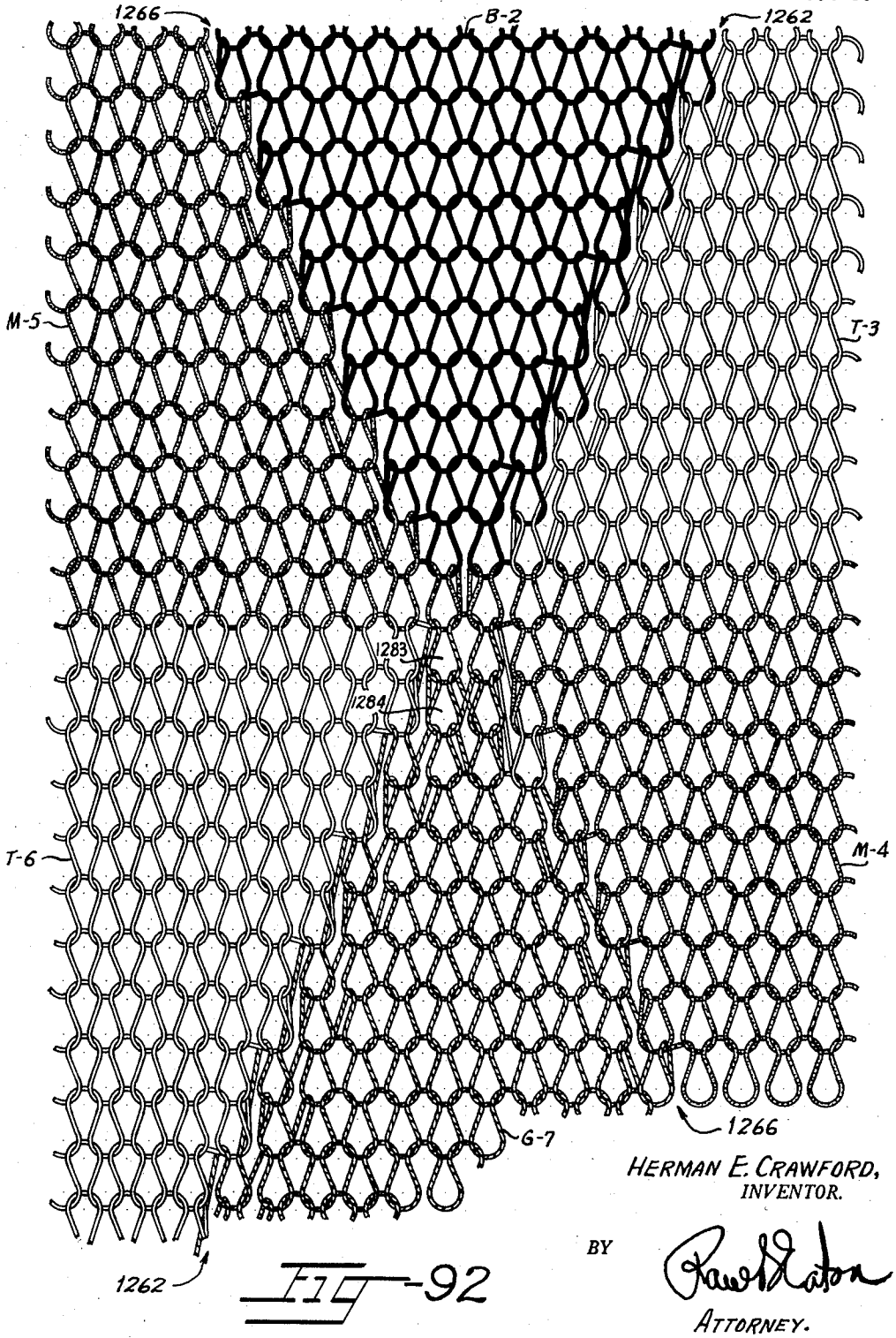


Fig -92

HERMAN E. CRAWFORD,
INVENTOR.

BY

ATTORNEY.

Nov. 18, 1958 H. E. CRAWFORD 2,860,500

KNITTING MACHINE FOR KNITTING HOSIERY AND OTHER FABRICS

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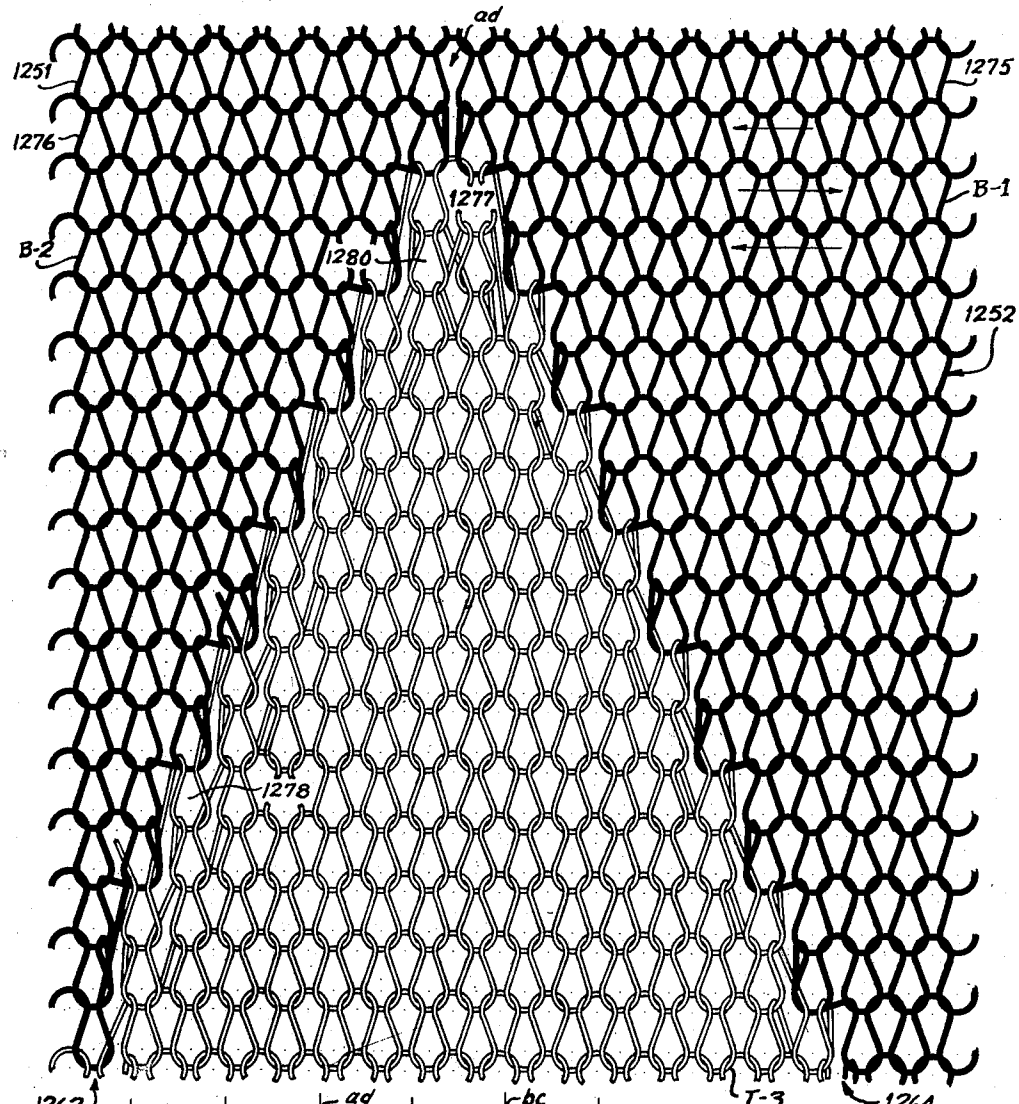


FIG-93

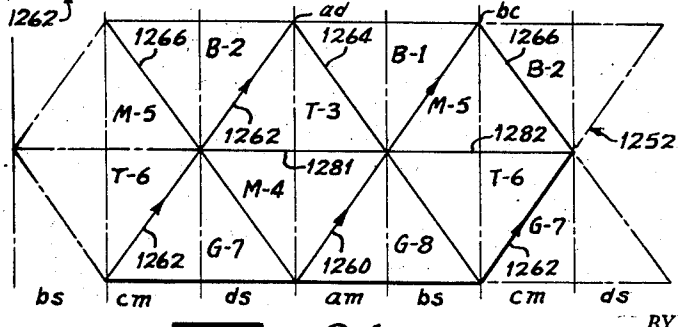


FIG-94

HERMAN E. CRAWFORD,
INVENTOR.

BY Paul E. Eaton

ATTORNEY.

Nov. 18, 1958 H. E. CRAWFORD 2,860,500

KNITTING MACHINE FOR KNITTING HOSIERY AND OTHER FABRICS

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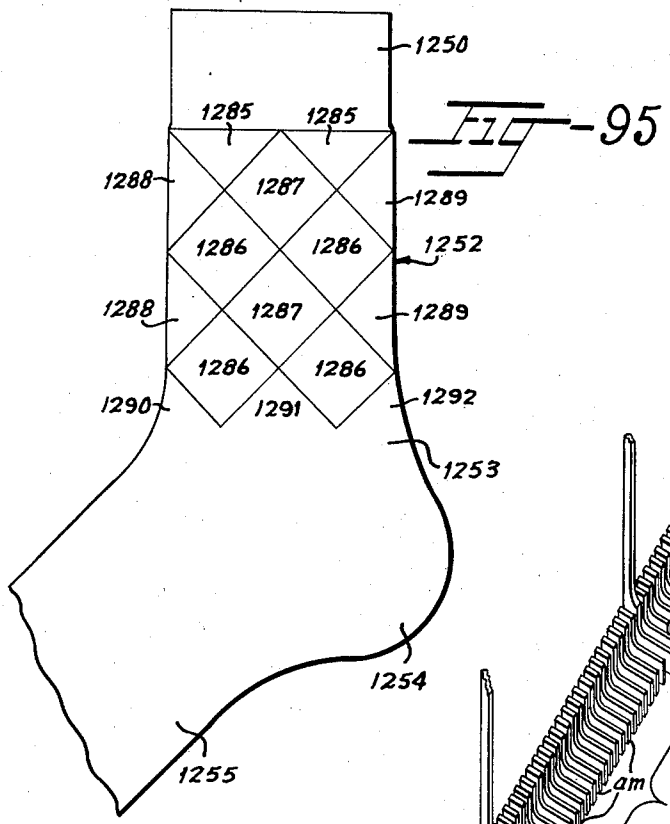


Fig-95

Fig-96

HERMAN E. CRAWFORD,
INVENTOR

BY

ATTORNEY

Nov. 18, 1958 H. E. CRAWFORD 2,860,500

KNITTING MACHINE FOR KNITTING HOSIERY AND OTHER FABRICS

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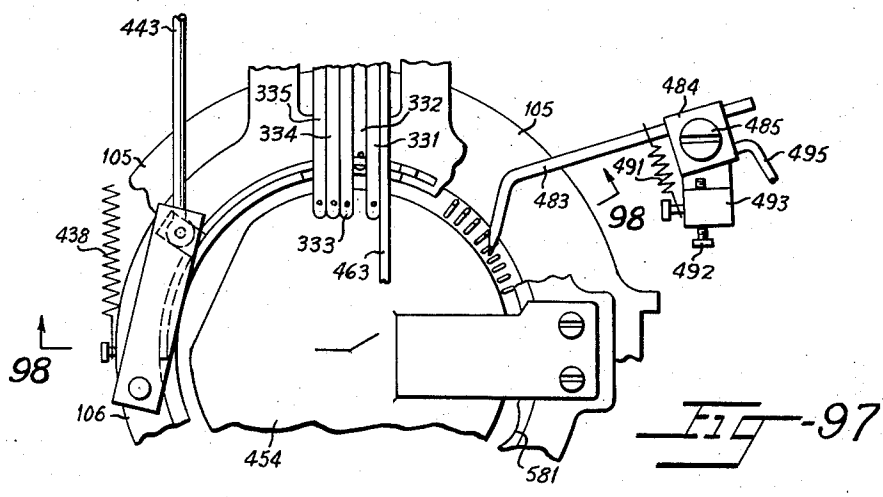


Fig-97

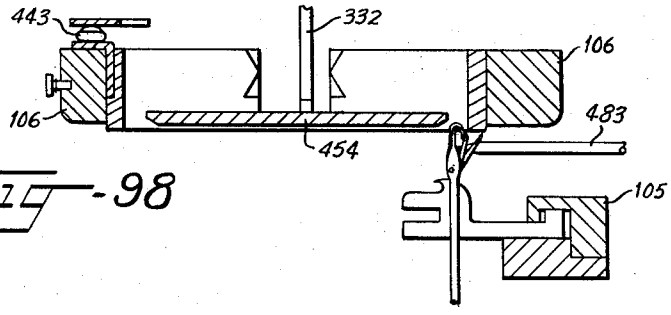


Fig-98

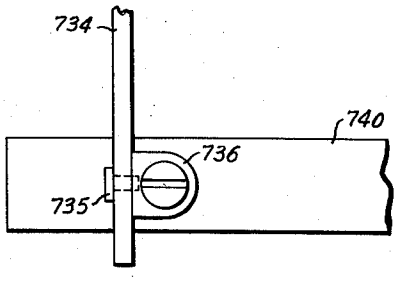


Fig-99

HERMAN E. CRAWFORD,
INVENTOR.

BY

ATTORNEY

United States Patent Office 2,860,500
Patented Nov. 18, 1958

2,860,500

KNITTING MACHINE FOR KNITTING HOSIERY AND OTHER FABRICS

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This invention relates to an improved circular knitting machine especially designed for producing variegated triangular designs in tubular fabrics such as the "Argyle" patch in men's hosiery.

Heretofore the formation of "Argyle" or other triangular patterns in stocking has either been accomplished by floating a particular color of yarn back of another color during the circular knitting operation, or it has required the commonly known reverse plating method or, in order to produce a pattern in which neither of the above methods are employed, it has been necessary to either make the stockings by hand or on hand machines.

It is an object of this invention to provide a knitting machine having means for producing tubular knit fabrics or stockings having diamond shaped or triangularly shaped patterns of varying sizes and colors and wherein the yarns forming the colors of the designs are connected to the initially knitted portion of the stocking in such a manner as to produce the effect of a single yarn being used in both the portions covered by the ornamental pattern and the initially knit portion of the stocking. That is, the yarns forming the designs in the stocking are interknitted with the yarn forming the initially knitted portion of the stocking by looping the yarns together in much the same manner as to form a continuous wale in knitting from one portion to another of a stocking.

In order to produce the triangular or diamond-shaped patterns, the top portion is knitted by conventional rotary knitting, with or without an elastic strand being incorporated hereinto. The top portion may be knitted on another machine and transferred to my machine or knitted on my machine as hereafter outlined. Then a few ring top courses are knitted in the conventional manner of rotary knitting, then a plurality of triangular portions connected to the ring courses are knitted by reciprocatory knitting. Then the yarns from which the triangular portions have been knitted are retained on the needles while the yarns for knitting triangular portions interposed between the already knitted triangular portions are introduced to the needles.

Means are provided for shogging the needle cylinder after the first triangular portion has been knitted a distance which is equal to approximately the greatest number of wales employed in knitting the first triangular portion, and the second triangular portion is knitted. If these triangular portions at their widest point cover approximately half the distance around the stocking, then the needle cylinder would be shogged after the second triangular portion has been knitted to a distance approximately one half of the greatest number of wales in the previously knit triangular portion for knitting a third triangular portion which is preferably continued to knit a lower or fourth triangular portion joined to the third triangular portion to complete a rectilinear patch of knitting, then, of course the needle cylinder would be shogged approximately a half revolution to perform the same operation on the other side of the stocking. However, if a

greater number of triangular portions and rectilinear portions should be desired in a design then the needles would not be shogged to as great an amount as for knitting the type of stocking shown in Figure 88.

However, if smaller patches are desired to be knitted, then, of course, after the knitting of the first triangular portion the needle cylinder would be shogged a distance equivalent to the greatest number of needles employed in the previously knit triangular portion to knit the second triangular portion and so on around the stocking until the first set of triangular portions has been knitted, after which the needle cylinder would be shogged to a point where the beginning of a second series of triangular portions would be knitted. These triangular portions would be knitted, not only down to the lowermost part of the first triangular portion, but would be continued until a complete rectilinear portion has been knitted and then the needle cylinder would be shogged a sufficient number of needles until where knitting will commence at the juncture point at the lower edges of two adjacent triangular portions and an additional complete patch composed of upper and lower triangular portions would be knitted and it would be carried out throughout the knitting of the leg portion of the stocking. If desired, the above described operations could be carried out through the foot portions of the stocking either completely around the foot portion of the stocking or only the top portion of the stocking could have the pattern placed therein with a conventional sole portion unornamented incorporated in the stocking, by certain changes in the controls, such as by increasing the number of notches in the clutch for shogging the needle cylinder.

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

Figure 1 is a front elevation of the improved knitting machine, some of the parts being shown schematically;

Figure 2 is an 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, omitting the lower portion of Figure 1 and showing many of the parts schematically;

Figure 4 is an enlarged rear elevation of the improved knitting machine with part of the auxiliary pattern drum support plate in cross section and looking substantially along the line 4—4 in Figure 2;

Figure 5 is an enlarged top plan view taken substantially along the line 5—5 in Figure 1, but omitting the needle cams and also omitting all of the parts disposed below the upper bed plate of the machine;

Figure 6 is an enlarged top plan view taken substantially along the line 6—6 in Figure 1 and showing the conventional stitch cams and the various movable needle cams associated with the needle cylinder, the needle cylinder being shown in section as a circle and omitting the grooves and needles on the periphery thereof and various of the parts being shown in cross section, including the top auxiliary pattern drum;

Figure 7 is an enlarged sectional plan view taken substantially along the line 7—7 in Figure 1 showing the conventional means for driving the needle cylinder and the clutch means associated therewith for effecting reciprocatory or rotary knitting as well as my novel clutch means for shogging the needle cylinder after finishing one portion of a pattern and upon starting on a succeeding portion thereof;

Figure 8 is an enlarged top plan view, with parts broken away, looking substantially along the line 8—8 in

Figure 4 and showing the means for effecting step-by-step rotation of the top auxiliary pattern drum:

Figure 9 is a vertical sectional view taken substantially along the line **9—9** in Figure 8 and showing a friction mechanism associated with the lower portion of the top auxiliary pattern drum;

Figure 10 is an enlarged elevation with parts in section taken substantially along the line **10—10** in Figure 7 and showing the shogging clutch for the needle cylinder;

Figure 11 is a vertical sectional view taken substantially along the line **11—11** in Figure 8 and showing the ratchet mechanism for effecting step-by-step movement of the auxiliary pattern chain shown in Figure 2;

Figure 12 is a fragmentary elevation with parts in section and is taken substantially along the line **12—12** in Figure 6;

Figure 13 is an enlarged fragmentary isometric view taken from the point indicated by the arrow **13** in Figure 3 and showing the structure relating to the yarn feed fingers and the manner in which they are mounted in the cap piece of the latch ring **106**;

Figure 14 is a fragmentary elevation with parts in section and is taken substantially along the line **14—14** in Figure 13, and showing the manner in which one of the yarn feed fingers is raised by the conventional thrust rod associated therewith;

Figure 15 is an enlarged fragmentary elevation with parts in section taken substantially along the line **15—15** in Figure 5 and showing the conventional clamp and cutter means associated with the latch ring;

Figure 16 is a fragmentary elevation taken substantially along the line **16—16** in Figure 10 but showing the cam ring **745** in a different position relative to the follower key **742** from that shown in Figure 10;

Figure 17 is an enlarged isometric view looking in the direction of the arrow **17** in Figure 5;

Figure 18 is a fragmentary elevation taken looking substantially along the line **18—18** in Figure 12;

Figure 19 is an enlarged fragmentary elevation of the upper central portion of Figure 3;

Figure 20 is an enlarged fragmentary isometric view taken substantially along the line **20—20** in Figure 3;

Figure 21 is a fragmentary elevation taken substantially along the line **21—21** in Figure 20;

Figure 22 is an enlarged schematic top plan view, with parts in section, and is taken substantially along the line **22—22** in Figure 1;

Figure 23 is a fragmentary elevation taken substantially along the line **23—23** in Figure 22 with parts broken away for purposes of clarity;

Figure 24 is a fragmentary elevation with parts in section taken substantially along the line **24—24** in Figure 6;

Figure 25 is a fragmentary elevation taken looking substantially along the line **25—25** in Figure 6;

Figure 26 is an elevation with parts in section taken substantially along the line **26—26** in Figure 6 and showing a supporting and controlling means for three of the needle cams;

Figure 27 is an elevation with parts in section looking at the right-hand side of the cam supporting means shown in Figure 26, and omitting the support therefor shown in Figure 26;

Figure 28 is an elevation, with parts in section, taken substantially along the line **28—28** in Figure 6 and showing the means for supporting and controlling the movable needle raising cam for preventing certain of the needles from being passed through the stitch cams;

Figure 29 is an elevation with a part in section looking at the right-hand side of the cam supporting means shown in Figure 28;

Figure 30 is an enlarged vertical sectional view taken substantially along the line **30—30** in Figure 26;

Figure 31 is an elevation with parts in section taken substantially along the line **31—31** in Figure 6 and

showing means for controlling one of the two cams associated therewith;

Figure 32 is a view looking at the right-hand side of Figure 31;

Figure 33 is an elevation with parts in section taken substantially along the line **33—33** in Figure 6 and showing means for supporting and controlling a needle lowering cam;

Figure 34 is an elevation with parts in section looking substantially along the line **34—34** in Figure 33;

Figure 35 is a view looking at the right-hand side of the cam supporting means shown in Figure 34, or at the opposite side from that shown in Figure 33;

Figure 36 is an elevation with parts in section taken substantially along the line **36—36** in Figure 6 and showing the means for supporting and controlling the cam for lowering the needles during the knitting of the elastic top of a stocking;

Figure 37 is an elevation with parts broken away looking at the right-hand side of Figure 36;

Figure 38 is an elevation with parts in section taken substantially along the line **38—38** in Figure 6 and showing a means for supporting and controlling one of the pick cams and one of the cams for lowering certain of the needles when the needle circle is moving in a clockwise direction in Figures 5 and 6;

Figure 39 is an elevation, with parts broken away, looking at the right-hand side of Figure 38;

Figure 40 is an elevation, with parts in section, looking at the right-hand side of Figure 39 or at the back side of Figure 38;

Figure 41 is an elevation, with parts in section, and is taken substantially along the line **41—41** in Figure 6, and showing means for supporting a stationary cam and a movable cam, the movable cam being provided to lower certain of the needles when the needle cylinder moves in a clockwise direction in Figure 6 and the fixed cam being provided to raise certain of the needles upon movement of the needle cylinder in either direction;

Figure 42 is an elevation looking at the left-hand side of Figure 41;

Figure 43 is an elevation, with parts in section, and is taken substantially along the line **43—43** in Figure 6 and showing means for supporting and controlling another cam for raising certain of the needles upon clockwise rotation of the needle cylinder in Figure 6 so as to prevent these needles from passing through the stitch cams;

Figure 44 is an elevation, with parts in section, taken substantially along the line **44—44** in Figure 43;

Figure 45 is a vertical sectional view taken along the line **45—45** in Figure 44;

Figure 46 is a developed view of the cams on the top auxiliary pattern drum;

Figure 47 is a developed view of the cams on the lower auxiliary pattern drum shown in the lower central portion of Figure 1;

Figure 48 is a developed view of the lower right-hand portion of the main pattern drum shown in Figure 4, that portion being embraced by the line **48—48** in Figure 4;

Figure 49 is a schematic top plan view of the needle circle showing the arrangement of the butts and illustrating the varying lengths of the butts on the needles for making the type of stocking shown in Figures 88 to 94, inclusive;

Figure 50 is an elevation with parts in section taken substantially along the line **50—50** in Figure 5;

Figures 51 to 66, inclusive, show the arrangement of the cams on the top auxiliary pattern drum starting from the second set of cams from the top in Figure 1 and extending to the bottom of the top auxiliary pattern drum and also showing the ends of the control fingers actuated thereby;

Figures 67 to 69, inclusive, are details showing the

arrangement of the cam members on the lower auxiliary pattern drum **830**, successively, from left to right in Figure 1 and also showing the corresponding fingers actuated thereby;

Figure 70 is an enlarged schematic view of the right-hand end of the main pattern drum in Figure 4 and showing some of the control members associated therewith and looking substantially along the line **70—70** in Figure 4;

Figures 71 to 79, inclusive, are vertical sectional views taken successively adjacent the cams on the main pattern drum in Figure 4 from right to left, and are also successive detail views of the cam members shown in Figure 48 starting from the second cam member from the top and extending to the bottom of Figure 48;

Figure 80 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 needles during rotary knitting, that is, while forming the rib top and the ring top immediately therebelow of a stocking;

Figure 81 is a view similar to Figure 80 and shows the arrangement of only those cams which are actuated at the needle cylinder immediately following the forming of the ring top of a stocking, that is, during the latter portion of the last revolution of the needle cylinder in rotary knitting and prior to the needle cylinder going into reciprocatory knitting;

Figures 82 and 83 are diagrammatic views showing some of the needle control cams adjacent the needle cylinder and showing the paths of the needle butts while narrowing and during reciprocatory knitting in opposite directions;

Figure 84 is an other diagrammatic view of the cams adjacent the needle cylinder showing the path of travel of the butts of the needles during the process of changing from knitting on one half of the needles to knitting on the other half of the needles, as in the forming of a gusset opposite from a previously formed gusset;

Figures 85 and 86 are diagrammatic views showing the arrangement of the cams adjacent the needle cylinder and the path of travel of the butts of the needles during a widening operation, as in forming the upper half of a diamond at one side of a stocking between two previously formed gussets during reciprocatory knitting;

Figure 87 is a diagrammatic view showing the arrangement of the pertinent cams adjacent the needle cylinder and the path of travel of the butts of the needles during various intermediate stages in the knitting of a pattern in a stocking;

Figure 88 is an elevation showing the stocking with one particular ornamental pattern knitted in solid colors, this pattern being the particular one described herein with respect to the operation of the machine;

Figure 89 is a view similar to Figure 88 but showing another arrangement of the colors in the stocking which may be made without any changes in the arrangement of the cams in the machine as described;

Figure 90 is an elevation of a stocking showing still another arrangement of colors in the pattern formed in the stocking which would require minor changes in the arrangement of the cams on the top auxiliary pattern drum which controls the yarn tension and yarn feed fingers;

Figure 91 is an elevation of the uper portion of the leg and heel portion of a stocking showing an arrangement of colors and patterning which may be formed by merely shogging the needle cylinder 90 degrees from the position in which it started the knitting of the pattern shown in Figure 88;

Figure 92 is a greatly enlarged elevation looking at the front central portion of the leg portion of the stocking shown in Figure 88 substantially along the line **92—92** in Figure 88 or at the portion **2—2** defined in dotted lines in Figure 91 and showing the manner in which the proximate ends of the upper and lower gusset portions of a stocking are joined to the proximate side portions of adjacent diamonds;

Figure 93 is a greatly enlarged view of the fabric at the upper central portion of Figure 88 as outlined by the dotted rectangle Z–1 and showing the manner in which the loops from adjacent gusset portions of the stockings are joined to the loops from the upper portion of a diamond;

Figure 94 is a diagrammatic layout of the leg or ornamental pattern portion of the stocking shown in Figure 88;

Figure 95 is an elevation of one side of the upper portion of a stocking in which the number of triangular portions is greater than that shown in the other figures and which can be made on the present machine by a re-arrangement of the needle cams and needle butts and the clutch mechanism shown in Figure 10;

Figure 96 is a schematic developed view of the needles in the needle circle;

Figure 97 is a top plan fragmentary view showing the latch opener more fully;

Figure 98 is a vertical sectional view taken substantially along the line **98—98** in Figure 97;

Figure 99 is a fragmentary view looking from the right-hand lower side of Figure 3 and showing the connection between parts **734** and **740**.

BRIEF SYNOPSIS OF THE MACHINE

The present machine 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 and Williams under their model No. B–5, and shown in the patent to R. W. Scott, No. 1,152,850, of September 7, 1915. Among the conventional parts used in the present machine is a frame which employs much of the conventional type of driving and clutch mechanisms for shifting from rotary to reciprocatory knitting and vice versa and also a main cam shaft having the usual pattern chain and pattern drum thereon for controlling the clutch mechanism. A conventional type of needle cylinder having the usual latch needles therein is driven at times to rotate and at other times to reciprocate and the usual type of sinker head is employed having conventional sinkers therein which are controlled by conventional cams in a sinker cap associated therewith.

Broadly, the present invention comprises the addition of a top auxiliary pattern drum and a lower auxiliary pattern drum, which are referred to in these terms since the conventional type of main pattern drum is also employed in this machine. An additional pattern chain is provided for controlling means for intermittently transmitting step-by-step rotation to the top auxiliary pattern drum. This top auxiliary pattern drum controls the cams which surround the needle cylinder and which, in turn, control actuation of the needles. The top auxiliary pattern drum also controls the movement of yarn feed fingers and suitable yarn feed tension devices for presenting certain colors of yarn to the needles according to the desired pattern. A clutch mechanism disposed on one end of the main drive shaft of the machine is also controlled by the top auxiliary pattern drum for determining the needle or needles which effect a shogging effect in the needle cylinder to take the patterning yarn during reciprocatory knitting. Due to a limited range in the patterning of the top auxiliary pattern drum, the lower auxiliary pattern drum is also provided to operate in conjunction with the main pattern drum to permit the lower auxiliary pattern drum and/or the main pattern drum to activate certain of the elements which are at other times controlled by the top auxiliary pattern drum as well as some other elements which are not controlled by the top auxiliary pattern drum.

The conventional main pattern drum of the machine

also has special cam members thereon to, at times, effect movement of the yarn tension devices and the yarn feed fingers and to also control the movement of a conventional gap closer as well as the cutting means for severing certain of the yarns in a predetermined order as the use of these yarns is not required during certain periods in the forming of a particular pattern.

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 same will be made.

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 frames **100** and **102** are similar to a frame shown in U. S. Patent No. 1,723,881, of August 6, 1929. The machine has a conventional needle cylinder **103** which is rotatable, as will be later described, and carries therein a plurality of vertically movable latch needles, not shown in these figures but illustrated in some figures to be later described. These latch needles are of a conventional type and every other one of the latch needles has a conventional jack, not shown, (Figure 96) disposed therebelow which is employed in the forming of the rib top portion or welt of a stocking and all needles cooperate in drawing stitches with the usual sinkers.

The conventional sinkers are mounted in the usual sinker head, such as indicated at **295** in Patent No. 1,152,850 and are controlled by suitable cams disposed in a sinker cap **105**. A conventional latch ring **106** is mounted at the upper end of the needle cylinder **103** and is pivoted on a post **107** to swing upwardly at the rear of the machine. The needle cylinder **103** extends through a conventional bed or cam plate **110** secured to the upper surface of the cast frame **102**, as by screws **111** (Figure 26). This circular bed plate **110** supports the various needle cams, to be later described, and also supports the post **107** to which the latch ring **106** is connected.

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

This vertical movement of the socket horn **113** is effected by a crank arm **115** having conventional adjustment scraws therein which are adapted to bear against cam members **120** fixed on a conventional main pattern drum **121** (Figure 4). This crank arm **115** is oscillatably mounted on a shaft **122**, the left-hand end, in Figure 4, being imbedded in the vertically disposed cast frame **102**. Since the adjustment screws on the crank arm **115** and the manner of their adjustment is well known to those familiar with the art a further description and illustration of the same is deemed unnecessary.

Driving means for needle cylinder, etc.

Now, referring to Figures 1, 2, 3 and 7, the vertically disposed standard portion **102***a*, in Figure 7, has a sleeve bearing **126** therein which projects outwardly and to the right and has a pulley **127** rotatably mounted thereon having a pinion **128** integral therewith. This pinion **128** meshes with a gear to be later described, for imparting a normal rate of speed to the needle cylinder. A tubular shaft **131** is rotatably mounted in the bearing **126** and extends beyond opposite ends of the bearing **126**, and its right-hand end, in Figure 7, has a conventional manually operable crank handle **132** secured thereto as by a screw **133**.

This manually operable handle **132** also has a key **134** thereon (Figure 7) which is imbedded in a suitable keyway in the right-hand end of the tubular shaft **131** and also extends outwardly beyond the diameter of the shaft **131** and is mounted in a suitable keyway in the end of a hub portion **135** of a conventional slow speed pulley **136** rotatably mounted on the tubular shaft **131** but keyed thereto by the key **134**.

A conventional idler pulley **137** is rotatably mounted on the hub portion **135** of the slow speed pulley **136** and is driven by a constantly moving belt **140** driven by conventional means not shown. The belt **140** passes between a forked shifting member **141** having a handle thereon for manipulation by an operator and this member **141** is mounted for longitudinal sliding movement on a shaft **143** (Figure 1) fixedly mounted in suitable bearing portions projecting from the front vertical surfaces of the standard portions **102***a* and **102***b* of the upper cast frame **102**.

In order to transmit rotation to the tubular shaft **131** at a normal rate of speed, the handle member **142** on the yoke **141** is grasped by an operator and the belt **140** is moved into engagement with the pulley **127**. Now, the gear **128** integral with the pulley **127** meshes with a larger gear **145** fixed on a stub shaft **146** rotatably mounted in a suitable sleeve bearing **147** fixedly mounted in the vertical standard portion **102***a* of the upper cast frame **102**.

The left-hand end of the shaft **146** in Figure 7 has a gear **150** of slightly larger diameter than the gear **145**, fixedly mounted thereon and keyed thereto, which meshes with a pinion **151** which is slightly smaller than the pinion **128** and is keyed to the left-hand end of the tubular shaft **131**, and it is thus seen that the pulley **127** will transmit rotation to the shaft **131** through the gears **145** and **150** and the pinion **151**.

Now, when it is desired to transmit a slower than normal rate of speed to the tubular shaft **131**, the belt **140** is shifted into engagement with the pulley **136** and this pulley, being keyed to the shaft **131** by the key **134**, will transmit rotation directly to the shaft **131**. However, in this instance, the pulley **127** is caused to idle due to the intermeshing pinion and gear **150** and **151** and the intermeshing gear **145** and the pinion **128**.

A restricted end portion **152** of a main 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 slidably mounted for movement along the shaft **153**, but must rotate therewith, since it is keyed to the shaft by a sliding key **155**. The clutch **154** is movable along the shaft **153** by a shifting member **156**, the lower end (Figure 1) of which is mounted for longitudinal sliding movement along the shaft **143**. This shifting member **156** has a cam follower depending therefrom and secured thereto by a screw **160** (Figures 1 and 7). The cam follower is adapted to move in sliding engagement with suitable cam members on a clutch control cam drum **162**, all of which is clearly shown in said Patent No. 1,152,850.

The clutch control cam drum **162** is fixedly mounted on a shaft **163** rotatably mounted in the standard portions **102***a* and **102***b* of the upper cast frame **102**. A ratchet wheel **164** is fixedly mounted on the hub of the clutch control cam drum **162**, and step-by-step rotation is imparted to the same for driving the clutch control cam drum **162** by means, not shown in the present drawings, but clearly shown in the patent to R. W. Scott, No. 1,152,850.

The means in said patent for transmitting step-by-step rotation to the ratchet wheel **164** is controlled by a conventional pawl controller **165** (Figure 7) which is oscillatably mounted on the shaft **143** and within the lower

portion of the clutch shifting member **156**. This pawl controller **165** is actuated by a conventional pattern chain **166** having suitable projections thereon, such as are shown in said patent, and the upper portion of this pattern chain **166** is mounted on a conventional sprocket wheel **167**, only the hub of which is visible in Figure 1.

The sprocket wheel **167** is also rotatably mounted on the shaft **163** and has a ratchet wheel **170** integral therewith (Figure 1) which is also driven in a conventional manner as shown in Figure 5 of said patent. The pattern chain **166** is also mounted on sprocket wheels **171**, **172**, **173** and **174** rotatably mounted on suitable studs **175**, all of which are identical, and each of which has a restricted threaded end portion, not shown, which penetrates a slot **176**, there being a plurality of these slots in a main pattern chain bracket **180** suitably secured to the frame **100** of the machine. These threaded ends of the studs **175** are secured in said slots **176** by lock nuts **181**. The pattern chain **166** transmits step-by-step rotation to the clutch control cam drum **162** so as to cause the shifting member **156** to move the slidable clutch **154** longitudinally of the shaft **153** in one direction or the other according to the desired pattern, to thus cause either reciprocatory or rotary motion to be imparted to the shaft **153** and thus to the needle cylinder **103** as will be later described.

When the clutch **154** is moved into engagement with the gear **151**, rotary motion is transmitted to the shaft **153**, assuming the belt **140** to be in engagement with one or the other of the pulleys **127** or **136**. Now, when the clutch **154** is moved to the left in Figure 7 into engagement with a pinion **183** rotatably mounted on the shaft **153** (Figure 7), reciprocatory motion will be transmitted to the shaft **153** from the pinion **183** which is driven reciprocatorily in the following manner: A quadrant or segmental gear **184** is oscillatably mounted on a rear shaft **185** fixedly mounted in the standard portions **102***a* and **102***b* of the cast upper frame **102**. This quadrant **184** is continuously oscillated by a link **186** connected, as at **187**, to the gear **150** and, as at **190**, to the quadrant substantially midway of its tooth portion and the rear shaft **185**, all of which is clearly shown in said patent.

The shaft **153** has a conventional beveled gear **191** rotatably mounted thereon which, at times, is driven in fixed relation to the shaft **153** by an improved clutch or shogging mechanism which is a part of the present invention and will be later described in detail. This beveled gear **191** drives the needle cylinder **103** and engages a conventional beveled gear **192** (Figure 26), which is a usual part of the needle cylinder **103** and which is clearly shown in Figure 12 of said Patent No. 1,152,850.

Top auxiliary pattern drum

The parts thus far described are conventional. Referring to Figures 1, 2, 4, 5, 7, 8 and 9, there is shown a top auxiliary pattern drum broadly designated at **195**, which is a part of my invention. This pattern drum **195** is an open top drum having a vertical axis and its bottom is closed by a bottom plate **196**. The plate **196** is rotatably mounted on a vertically disposed shaft **197** having an enlarged lower portion **198** (Figure 9) against which the lower surface of the plate **196** is urged by a friction means, to be presently described, to restrain movement of the top auxiliary pattern drum **195** on the shaft **197** but to permit the drum to be rotated on the shaft **197** either by automatic means to be later described or manually. The shaft **197** also has a restricted threaded portion **201** on the lower end thereof which is engaged by a nut **202** for securing the shaft **197** to the upper surface of a substantially rectangular horizontally disposed auxiliary bed plate **203** suitably secured to the upper end of the upper cast frame **102**.

The vertically disposed shaft **197** projects upwardly from the bottom plate **196** of the top auxiliary pattern drum **195** and may terminate in a horizontal plane slightly below the upper edge of the top auxiliary pattern drum **195** and has secured on the restricted upper end thereof an indicating pointer **193** which is secured on the restricted upper end of the shaft **197** by a suitable lock nut **194** threadably mounted on the upper end of the shaft **197** (Figure 5). The purpose of this indicating pointer **193** is to assist an operator in setting up the machine for operation since the inner surface of the drum **195** will be provided with a series of numbers to also assist in positioning the drum **195** in proper relation to the position of the shaft **197**. The arrangement of the numbers and their purpose will be later described.

The friction means for the top auxiliary pattern drum **195** comprises a sleeve **204** (Figure 9) fixedly mounted on the shaft **197**, as by screws **204***a* (Figure 8) and having a flange **205** on the lower end thereof on which the lower ends of a plurality of internally threaded tubular members **206** are secured, as by welding. The flange **205** of the sleeve **204** has bores therein coinciding with the tubular members **206**. Suitable friction pins **207** are mounted for vertical sliding movement in the flange **205** of the sleeve **204** and are urged downwardly by compression springs **210** which are adjusted by suitable set screws **211** imbedded in the internally threaded tubular members **206** (Figures 8 and 9).

The lower surface of the plate **196** has a thickened circular portion forming an annular shoulder **212** on which is fitted a ratchet wheel **213** secured to the plate **196**, as by screws **214**. Intermittent step-by-step rotation is transmitted to the ratchet wheel **213** and, of course, to the pattern drum **195**, by a spring loaded ratchet pawl **215** oscillatably mounted, as at **216** (Figure 8), on an arm **217** of a crank lever **218** (Figures 1 and 8). The crank lever **218** is oscillatably mounted intermediate its ends, as at **220**, on the auxiliary bed plate **203**. A tension spring **221** is connected at opposed ends thereof to the ratchet pawl **215** and the arm **217** to normally urge the ratchet pawl **215** into engagement with the teeth in the ratchet wheel **213**.

The free end of an arm **219** of the crank lever **218** has a cam follower **224** rotatably mounted thereon, as at **226**, which is successively normally urged against a plurality of circularly spaced irregularly-shaped cam members **227** by a tension spring **231**, the left-hand end of which (Figure 8) is connected, as at **232**, to a medial portion of the arm **219**, and at its other end, as at **234**, to the upper surface of a bearing bracket **235** secured, as by screws **236**, to the upper surface of the auxiliary bed plate **203**.

The irregular cam members **227** are suitably secured on the outer periphery of a cam cylinder **237** (Figures 2 and 8) which is rotatably mounted on a shaft **240** fixedly mounted in the bearing bracket **235** (Figures 8 and 11). Continuous rotation is imparted to the cam cylinder **237** by means of a gear wheel **241** suitably secured to the right-hand end of the cam cylinder **237** in Figures 4 and 8. This gear wheel **241** engages the gear **145** (Figure 7) which is driven, in the manner heretofore described, by the pinion **128** on the pulley **127**.

Auxiliary pattern chain and driving means therefor

Spaced approximately 90 degrees apart from each other are a plurality of lugs or cam members **242** (Figures 2 and 7) which are secured to the outer vertical surface of the gear **145**. As the gear **145** rotates in a counterclockwise direction in Figure 2, the cam members **242** successively move into engagement with the angularly disposed upper end portion of an arm **243** of a bell crank oscillatably mounted, as at **244**, on the vertically disposed standard 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

163 in Figure 1. This cam wheel 246 has a notch 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 the ornamental pattern portion of a stocking.

However, each time the upper end of the bell crank arm 243, in Figure 2, is engaged by one of the lugs or cam members 242, the bell crank having arms 243 and 245 is moved in a clockwise direction in Figure 2 and, upon any one of the cam members 242 passing by the arm 243, the arms 243 and 245 are moved in a partial counterclockwise direction 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 243. It is thus seen that during the knitting of the ornamental pattern portion of a stocking, to be later described, intermittent oscillation is transmitted to the bell crank arm 243.

Now, the bell crank arm 243 has the front end of a link 251 connected thereto, as at 252 in Figure 4. This link 251 extends rearwardly, and then is bent at right angles in Figure 4, and then is bent again to extend rearwardly, and is pivotally connected as at 253 to a pawl carrying arm 254. The upper end of the pawl carrying arm 254 (Figure 11) is oscillatably mounted on the shaft 240 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, the lower end of which is connected, as at 261, to the ratchet pawl 256 and the upper end of which is connected to a suitable spring anchor 262 projecting from the bearing bracket 235. The ratchet wheel 257 has a sprocket wheel 263 integral therewith (Figure 4), and the ratchet wheel 257, with the sprocket wheel 263, is mounted for rotation on the shaft 240. A suitable friction device 264 is provided on the right-hand end of the shaft 240, as will be observed in Figure 4, and this friction device 264 is identical to the friction device, shown in Figures 8 and 9 associated with the top auxiliary pattern drum 195, to thus prevent the sprocket wheel 257 from rotating freely on the shaft 240.

It is thus seen that, upon each movement of the upper end of the bell crank arm 243 (Figure 2) in a clockwise direction, the link 251 (Figures 2, 4 and 11) will transmit movement in a counterclockwise 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 11) during knitting of the ornamental pattern portion of a stocking. The sprocket wheel 263 has an endless auxiliary pattern chain 265 mounted thereon. This endless pattern chain 265 extends downwardly from the front side of the sprocket wheel 263, which is disposed rearwardly of the cylinder 237 in Figure 2, and then passes beneath a sprocket wheel 266 and over another sprocket wheel 267 and then downwardly and upwardly in engagement with a plurality of sprocket wheels 90 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 then extends downwardly and passes in engagement with another sprocket wheel 278 and then again over the sprocket wheel 263. There may be more or less of the sprocket wheels 90, 276, 277 and 278, all of which are idler sprocket wheels, according to the desired length of the auxiliary pattern chain 265. 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 forming of the heel and toe pockets of a stocking.

All of the sprocket wheels 266, 267, 90 and 276 to 278, inclusive, are identical and are also the same as the sprocket wheel 174 and are mounted in the same manner as the sprocket wheels 171 to 174 in Figure 2. A suitable skeleton frame 281 is disposed rearwardly of the machine and may be of any desired shape for supporting the sprocket wheels 266 to 278, inclusive, the size of the frame also being determined by the required length of the endless auxiliary pattern chain 265. This skeleton frame 281 has a pair of spaced forwardly projecting portions 282 and 283 integral therewith both of which are secured to the main pattern chain bracket 180 as by bolts 284. The bracket 180 has heretofore been described as supporting the sprocket wheels for the conventional pattern chain 156.

The auxiliary pattern chain 265 has a series of variably spaced pattern lugs 285 thereon, each of the links of this auxiliary pattern chain 265, in some instances, being divided into three of the lugs 285 for purposes of decreasing the required length of the auxiliary pattern chain 265. As any one of these lugs 285 passes over the upper surface of the sprocket wheel 263, they are adapted to engage and raise an auxiliary pawl controller 286 (Figures 4 and 8).

This auxiliary pawl controller 286 is secured, as by screws 287, to a crank arm 290 which extends forwardly and is fixedly mounted on a shaft 291 (Figure 8) oscillatably mounted in bearing members 292 and 293 suitably secured to the auxiliary bed plate 203. A latch lifting finger 295 is fixedly mounted on the left-hand end of the shaft 291 in Figure 8 and extends rearwardly and has a restricted rounded portion which slidably penetrates a pivoted latch 296. The latch 296 normally engages the arm 219 of the crank lever 218 and has a shoulder 297 (Figure 4) adjacent the free end thereof.

The pivoted latch 296 is pivotally connected, as at 300, to the bearing bracket 235 (Figures 8 and 11). The arm 219 has a notch 301 therein (Figure 8) which is normally engaged by the shoulder 297 on the latch 296 and it is thus seen that the latch 296 normally prevents the free end of the arm 219, in Figure 8, from being moved in a counterclockwise direction by the tension spring 231 and thereby prevents the crank 218 from being actuated by the cam members 227 for transmitting rotation to the ratchet wheel 213 and the top auxiliary pattern drum 195.

Now, upon any one or more of the lugs 285 on the auxiliary pattern chain 265 engaging the auxiliary pawl controller 286, it is obvious (Figure 8) that the latch lifting finger 295 would be caused to move toward the observer at its lower end, in Figure 8, to thus move the shoulder 297 of the latch 296 out of engagement with the notch 301 in the arm 219. This will permit the tension spring 231 to pull the lower end of the arm 219 to the right, in Figure 8, as the high point of any one of the cam members 227 moves out of engagement with the cam follower 224. This will, of course, cause the ratchet pawl 215, in Figure 8, to move from right to left and upon the next succeeding of the cam members 227 engaging the cam follower 224, the arm 219 will again be projected outwardly at its lower end and will, of course, cause the ratchet pawl 215 to transmit partial rotation to the ratchet wheel 213 and thus to the pattern drum 195.

It is thus seen that step-by-step rotation is transmitted to the top auxiliary pattern drum 195 only when one of the lugs 285 on the auxiliary pattern chain 265 is in engagement with the auxiliary pawl controller 286. At all other times, the auxiliary pattern drum 195 remains in a fixed position.

Yarn feeding means controlled by the top auxiliary pattern drum

In the drawings there is shown means for admitting five different colors to the needle cylinder as well as means for admitting rubber yarn to the cylinder. However, it is to be understood that a greater or lesser number of colors of yarn may be admitted to the needle cylinder if desired by making changes in controls and by adding additional yarn feed fingers. In the present in-

stance, only four colors of yarn are admitted to the needle cylinder as in knitting the stocking shown in Figure 88.

Referring to Figures 2, 3 and 4, there are shown a plurality of spindles or stands **304**, the lower ends of which are secured to a suitable frame **305** secured, as by screws **306** (Figures 2 and 3) to a rearwardly extending portion **307** of the auxiliary plate **203**. The stands **304** may be of any desired construction and are adapted to support the usual cones **310** from which yarn Y is withdrawn. The yarn Y passes upwardly through suitable eyes, not shown, in a horizontally disposed bar **312**. This bar **312** is secured at opposed ends thereof to forwardly extending bars **313** and **314** (Figure 4), the front ends of which are secured to a bar **315** disposed in parallel spaced relation to the bar **312**. The bar **315** is, in turn, secured to a horizontally disposed bar **316** which is secured intermediate its ends to the rear end of an angle bar **317**.

The angle bar **317** extends forwardly and then is bent downwardly, in Figure 3, to form a vertically disposed portion **320**, the lower end of which is secured as by a screw **321** (Figures 3 and 5) to the upper surface of the rearwardly extending portion **307** of the auxiliary bed plate **203**.

The yarn Y extends forwardly, after passing through the eyes, not shown, in the horizontally disposed bar **312**, and passes through suitable yarn tension devices broadly designated at **322**. Since there are five of these yarn tension devices they will bear the reference characters **322—1**, **322—2**, **322—3**, **322—4** and **322—5**, respectively. These yard tension devices **322** may be of any desired structure, it being well known that there are many types of yarn tension devices now available which may be mounted on the bar **316** for retaining tension in the yarn as it extends from the yarn tension devices to the needle cylinder. The main requisite of the yarn tension devices **322** is that they each be provided with an arm **324** which is normally urged upwardly and has a suitable opening at the free end thereof through which the yarn passes.

In order to facilitate the relaxing of the tension in the yarn during reciprocatory knitting, the yarn tension devices should each have a suitable clamping means, generally indicated at **325** in Figure 3, for clamping the yarn Y as it passes through the yarn tension device **322** to prevent the arm **324** from taking up the tension in the yarn disposed between the clamping device **325** and the cone **310**, instead of taking up the tension in the yarn between the end of the finger **324** and the corresponding yarn feed finger to be later described.

Since there are five yarn tension devices **322** mounted on the bar **316**, there are provided five yarn feed fingers **331** to **335**, inclusive, in the latch ring **106**. In this instance, the yarn feed finger **334** is not used since only four different colors of yarn are used in knitting a stocking such as is shown in Figure 88. Each of the yarn feed fingers **331** to **335**, inclusive, is oscillatably mounted as at **340**, in a conventional cap piece **341** (Figures 3, 5, 13 and 14) integral with the latch ring **106**. Each of the yarn feed fingers **331** to **335**, inclusive, has an upwardlly extending arm **342** integral therewith (Figures 13 and 14) which, in the event that yarn feed fingers are used such as are shown in said Patent Number 1,152,850, may be welded to the upper rear ends of the yarn feed fingers.

Pivotally connected to the upper ends of the arms **342** are the front ends of connecting rods **344** to **348**, inclusive, which are connected to the respective yarn feed fingers **331** to **335**, inclusive (Figure 4). The rear ends of the rods **344** to **348**, inclusive, slidably penetrate downwardly bent ears (Figure 5) integral with the left-hand ends of yarn feed control fingers **351** to **355**, inclusive, respectively, and have suitable collars **350** fixedly mounted on the rear ends thereof so that rearward movement of the yarn feed control fingers **351** to **355** will impart like movement to the rods **344** to **348** and will cause the corresponding yarn feed fingers **331** to **335**, inclusive, to be moved upwardly at their free ends and thus out of operation position.

Since the control fingers **351** to **355**, inclusive, are controlled by the top auxiliary pattern drum **195**, in a manner to be presently described, during the knitting of the ornamental pattern portion of a stocking, during the knitting of all other portions of the stocking, that is, all portions other than the ornamental pattern portion, it is necessary that yarn feed fingers, which feed different colors of yarn to the portions of the stocking not involved in the ornamental pattern, be controlled by means other than the top auxiliary pattern drum. Therefore the left-hand ends of certain of the control fingers **351** to **355**, inclusive (Figure 5), assume a forward position during the knitting of parts of the stocking other than the ornamental pattern portion to permit the feeding ends of any corresponding yarn feed fingers **331** to **335**, inclusive, to be raised and to move the corresponding connecting rods **344** to **348** rearwardly independently of the corresponding control fingers **351** to **355**, inclusive. The yarn feed fingers **331** to **335** are normally urged against the conventional throat plate as by springs **359** (Figures 13 and 14). The control fingers **351** to **355**, inclusive, are oscillatably mounted intermediate their ends on a common post **357** having suitable spacers **358** thereon (Figures 4, 5 and 17) for spacing the fingers **351** to **355**, inclusive, slightly apart from each other. The lower end of the post **357** has one end of a link **360** fixedly connected thereto (Figures 2, 4 and 17). This link **360** extends rearwardly and is fixedly mounted on the lower end of a post **361**. The post **361** extends upwardly and has spaced yarn tension control fingers **363** to **367**, inclusive, oscillatably mounted thereon, which are spaced apart from each other by suitable spacing sleeves **368** (Figure 17).

The upper end of the post **357** is mounted in a strap iron member **370** which extends rearwardly and is secured, as by screws **371**, to the vertically disposed portion **320** of the angle bar **317**. The lower portion of the vertically disposed post **357** is also fixedly mounted in a bracket **372** which extends to the right in Figure 4, and is mounted on a standard **373** secured, as by screws **374** (Figures 3 and 17), to the upper surface of the rearwardly projecting portion **307** of the auxiliary bed plate **203**.

Connected to the yarn feed control fingers **351** to **355**, inclusive, adjacent the left-hand end of each of the same (Figure 5) is a tension spring **375** which extends rearwardly and each of these tension springs **375** is connected to a common strap iron member **376** (Figures 4 and 5) which extends downwardly and is then bent inwardly and is secured, as by screws **377**, to the rearwardly extending portion **307** of the auxiliary bed plate **203**. These tension springs **375** normally urge the free ends of the yarn feed control fingers **351** to **355**, inclusive, in engagement with the periphery of the top auxiliary pattern drum **195**.

The front edges of the yarn tension control fingers **363** to **367**, inclusive, are engaged by substantially vertically disposed portions of L-shaped bell cranks **380** to **384**, inclusive, respectively (Figures 3, 4, 5, 20 and 21). These bell cranks **380** to **384**, inclusive, are oscillatably mounted, as at **385**, in Figures 3 and 21, on a stepped block **386** secured to the upper surface of a horizontally disposed angle bar **390**. The angle bar **390** extends inwardly and the upper flange thereof is cut away adjacent the vertically disposed portion **320** of the angle bar **317** (Figure 5). The vertical flange of the angle bar then passes in engagement with the rear surface of the portion **320** of the angle bar **317** and is secured thereto, as by screws **387**.

The rear ends of the L-shaped bell cranks **380** to **384**,

inclusive, are pivotally connected to the lower ends of yarn tension connecting rods **391** to **395**, respectively, each of which has means intermediate its ends, indicated at **396**, to provide for telescopic adjustment of the same. The upper end of each of the connecting rods **391** to **395**, inclusive, is bent laterally or is hooked so as to form a portion for engaging the upper surface of the tension arm **324** of each of the yarn tension devices **322**.

The rear end of each of the L-shaped bell cranks **380** to **384**, inclusive, has a suitable tension spring **400** (Figure 21) connected thereto which extends downwardly and forwardly at an angle, in Figure 3, and the other end of which is connected to the lower edge of the vertical flange of the angle bar **390**. In order to insure that the right-hand ends of the control fingers **351** to **355**, inclusive, and **380** to **384**, inclusive (Figure 5) may be properly spaced adjacent the top auxiliary pattern drum **195**, there is provided a slotted block or comb **401** (Figures 2 and 5) having a plurality of vertically spaced slots therein, the slots of the block **401** being slidably penetrated by the free ends of the fingers **351** to **355**, inclusive, and **363** to **367**, inclusive. This comb block **401** (Figures 2 and 5) is secured, as by screws **404**, to a plate **405** which extends inwardly, as shown in Figures 4 and 5, and is secured as by screws **406** to the vertically disposed portion **320** of the angle bar **317**.

Cams on top auxiliary pattern drum for yarn tension and yarn feed control

It might be stated that the relative positions of the various parts of the machine, and particularly the cams on the top auxiliary pattern drum **195**, are in the positions they will assume during the knitting of the upper portions of a diamond in a stocking, such as is shown in Figure 88. The cam members disposed in the same horizontal plane as the control fingers **351** to **355**, inclusive, and **363** to **367**, inclusive, are shown in Figures 57, 56, 55, 54, and 53, respectively.

Referring to Figure 46 it will be noted that the periphery of the top auxiliary pattern drum **195** is divided into seventeen equal spaces which are designated by the numerals 1 to 17 inclusive, from top to bottom of the pattern drum **195**. The matter shown in Figures 53 to 57, inclusive, is the same as that shown in the spaces 4 to 8, inclusive, in Figure 46, there being no cam members shown in Figure 54, since the yarn feed finger **334** in Figure 5 is not used in forming the stocking shown in Figure 88, and, therefore, it would be unnecessary for the control fingers **354** and **366** to oscillate.

It will be noted in Figures 46 and 53 that a cam member **410** is suitably secured to the pattern drum **195** and is disposed in the same horizontal plane as the space designated at 4 in Figure 46, and in the same horizontal planes as the free ends of the control fingers **355** and **367**, and since the free ends of the control fingers **355** and **367**, are spaced circumferentially slightly apart from each other in closely adjacent horizontal planes, as shown in Figure 53, the leading end of the cam member **410** is notched at **411** so that both of the control fingers **355** and **367** will be actuated simultaneously.

Disposed in the same horizontal plane as the numeral 6 in Figure 46, and in the same horizontal planes as the free ends of the control fingers **373** and **365** (Figure 55) is a cam member **413** which is suitably secured to the periphery of the pattern drum **195** and the leading end of which is also provided with a notch **414** for the same purpose that the notch **411** is provided at the leading end of the cam member **410**. Disposed in the same horizontal plane as the numeral 7 in Figure 46 and in the same horizontal planes as the free ends of the control fingers **352** and **364**, in Figure 56, are cam members **415** and **416** which are spaced apart from each other and each of them is also notched at the leading end thereof, as at **417** to provide for the spaced ends of the control fingers **352** and **364** to engage these cams at the same time.

Disposed in the same horizontal plane as the numeral 8 in Figure 46, and in the same horizontal planes as the free ends of the control fingers **351** and **363** (Figure 57) is a cam member **420** suitably secured to the auxiliary pattern drum **195** and which is also notched at the leading end thereof as at **420*a***, to provide for the spacing of the free ends of the fingers **351** and **363**. Since the function of the yarn feed control fingers **351** to **355**, inclusive, and the yarn tension control fingers **363** to **367**, inclusive, is very similar, except that they are actuated at different times according to the desired pattern, only the function of the control fingers **352** and **364** will be described, since these are the only two which are in operating position in the drawings, which position they will assume during the knitting of the top portion of a diamond such as that shown in Figure 88.

When the reading end of the yarn feed control finger **352** is moved outwardly, as shown in Figures 5 and 56, the connecting rod **345** at the left-hand end of the yarn feed control finger **352**, in Figure 5, is released and permits the front end of the yarn feed finger **332** to move downwardly while the rest of the yarn feed fingers **331**, **333**, **334** and **335** remain in a raised or inoperative position as shown in Figures 13 and 14. At the same time that the yarn feed finger **332** moves to a lowered or operative position, the yarn tension control finger **364** causes the L-shaped bell crank **381** to move upwardly at its rear end so the hooked portion at the upper end of the connecting rod **392** will be moved so as to not restrict upward movement of the tension arm **324** while the rest of the connecting rods **391** and **393** to **395**, inclusive, remain in a lowered position. When the rods **391** to **395** are in a lowered position, this causes the corresponding tension arms **324** to remain locked in a lowered position to thus relax the tension on the yarn Y between the free ends of the tension arms **324** and the corresponding yarn feed fingers **331** and **333** to **335** inclusive. It might be stated that the usual type of clamping means, indicated at **325** in Figure 3, is opened when the free end of the corresponding tension arm **324** is moved downwardly by any one of the connecting rods **391** to **395**, inclusive, which is essential when the yarn Y is being drawn from the free end of any one of the tension arms **324** so as to permit the yarn Y to be withdrawn from the cone **310** as it passes through the free end of the tension arm **324** and to the corresponding yarn feed finger.

When the left-hand end of any one of the control fingers **351** to **355**, inclusive, is moved forwardly in Figure 5, by virtue of the corresponding cam members on the pattern drum **195**, each corresponding yarn feed finger is caused to move downwardly at its front end by its associated tension spring **359** (Figures 13 and 14) which is conventional and this structure is also similar to that shown in Figure 12 of said Patent Number 1,152,850.

Control means for gap closer

Referring to Figures 3, 5, 46 and 97, there is shown means for controlling a conventional type of gap closer, not shown, but disposed within the latch ring and which is adapted to move during reciprocatory knitting to cause one of its ends to close the upper part of the gap in the latch ring **106** formed by the yarn feed throat to insure that any one of the yarn feed fingers which may have previously been lowered, or from which the yarn is being taken by the needles during reciprocatory knitting will remain fixed in a lower position. This gap closer is of a type such as is shown in U. S. Patent Nos. 1,859,137 of May 17, 1932, and 1,152,850 of September 7, 1915. During the knitting of the courses forming the ornamental pattern portion of a stocking, the position of the throat gap closer is controlled by spaced cam members **421** to **425**, inclusive (Figure 5), suitably secured to the

top auxiliary pattern drum 195 and disposed in the space designated by the numeral 1 in Figure 46.

It will be noted, in Figure 5, that there is a space between proximate ends of the cam members 421 to 425, inclusive, into which a control finger 426 is moved by means to be presently described for moving the gap closer, not shown, away from the throat in the latch ring 106 while changing from one color of yarn to another, that is, to permit the yarn finger which has been feeding yarn to the needles to be moved upwardly while another yarn finger is lowered to operative position, and the cam members 421 to 425, inclusive, on the pattern drum 195, control the position of the gap closer during the knitting of those courses which are a part of the ornamental pattern portion of a stocking.

The control finger 426 extends rearwardly and is oscillatably mounted on a vertically disposed post 427, the restricted lower end of which slidably penetrates the upper portion of a bracket 430 and is secured therein as by a nut 431 (Figure 50) threadably mounted on the restricted lower end of the post 427. The bracket 430 is secured to the auxiliary bed plate 203 by any suitable means such as screws 432. It will be noted, in Figure 50, that the control finger 426 has a downwardly extending portion 433 which is bent laterally at the lower end thereof and is also oscillatably mounted on the post 427. This laterally bent portion at the lower end of the vertically disposed portion 433 of the control finger 426 has the right-hand end of a link member 435 welded thereto, this link 435 also being oscillatably mounted on the post 427.

The link 435 extends rearwardly and to the left, from the post 427 in Figure 5, and is then bent spirally and this spirally bent portion is slidably penetrated by a relatively short rod 437 having a collar 440 fixedly mounted on the rear end thereof in Figure 5. This collar 440 is urged against the free end of the link 435 by means to be later described. The rod 437 extends forwardly and its front end is pivotally connected adjacent the upper end of a conventional bell crank 441 oscillatably mounted, as at 442, on the post 107 (Figures 3 and 5). The upper end of the bell crank 441 is normally urged forwardly by a tension spring 438 (Figure 5) connected at its rear end to the bell crank 441 and at its front end to a suitable spring anchor on the latch ring 106.

Pivotally connected to the upper end of the bell crank 441, as shown in Figure 3, is the rear end of a connecting rod 443, the front end of which is connected in a conventional manner to the gap closer disposed within the latch ring 106. This gap closer is conventional, its structure being well known to those familiar with the art, and a further disclosure of the same is deemed unnecessary.

The manner in which the gap closer is controlled by the top auxiliary pattern drum 195 during the knitting of an ornamental pattern portion of a stocking, has been described. Now, during the knitting of the heel and toe pockets of a stocking, the gap closer is moved to operative or closing position by a conventional thrust rod 444 (Figure 3) having a projection 445 thereon which is adapted to engage an arm 446 of the bell crank 441 when the thrust rod 444 is projected upwardly by spaced cam members 447, 448 and 449 (Figure 72) suitably secured to the conventional main pattern drum 121 which is, in turn, rotatably mounted on the rear shaft 185. The driving means for the main pattern drum 121 will be later described.

The shaft 122 has a conventional comb 453 secured thereto which is slidably penetrated by the lower portion of the thrust rod 444 as well as other thrust rods to be later described. Upon the lower end of the thrust rod 444 being engaged by any one of the spaced cam members 447, 448 or 449, the thrust rod 444 will be projected upwardly to thus move its projection 445 into engagement with the arm 446 of the bell crank 441 to thus transmit partial counterclockwise rotation thereto. This will, of course, cause the connecting rod 443 to move the gap closer to closing position.

Clamping and cutting mechanism and control means therefor

Referring to Figures 5 and 15, there is shown a conventional clamp and cutter plate 454 which is disposed within the needle circle and is suitably secured to the lower surface of a bracket 455 secured, in a conventional manner, to the latch ring 106. This clamp and cutter plate 454 has the usual conventional clamp 456 and cutter 457 mounted thereon, the structure of which may be identical to, and is shown to be very similar to, the structure of the clamp and cutter mechanism shown in said Patent Number 1,152,850. The structure of the clamp and cutter plate and associated parts is also similar to that shown in U. S. Patent Nos. 1,788,514, of January 31, 1931, and 1,919,123, of July 18, 1933.

The clamp and cutter means is controlled for clamping and cutting the various yarns fed to the needle circle by the yarn feed fingers 333 and 335 in a conventional manner as shown in said patents.

The means in said patents also include a thrust rod 460 (Figures 15 and 76) which is mounted for vertical sliding movement in the comb 453 and the lower end of which also engages the main pattern drum 121. The main pattern drum 121 has a cam member 461 suitably secured thereto, which is stepped as shown in Figure 76 so as to cause the thrust rod 460 to be moved upwardly, in Figure 76, in two steps so as to cause the clamping member 456 to operate slightly ahead of the cutting means 457. The upper end of the thrust rod 460 is adapted, as shown in Figure 15, to engage and move the rear free end of an operating lever 463 (Figures 5 and 15) downwardly in a clamping and cutting operation. In so doing the operating lever 463 has a pin 464 on the front end thereof which engages a lever 465 for moving the same downwardly in Figure 15 to move the clamp member 456 into engagement with the clamp and cutter plate 454 and to actuate the cutter means 457. The lever arm 465 is a part of the present invention and extends rearwardly, or upwardly in Figure 5, and is oscillatably mounted intermediate its ends, as at 459, on the cap piece 341 (Figure 15) and then extends rearwardly and its lower surface is normally engaged by a horizontally disposed arm 470 of a bell crank (Figure 50). The bell crank having arm 470 is oscillatably mounted, as at 471, on the bracket 430 and has a substantially vertically disposed arm 472 integral therewith. Pivotally connected to the upper end of the arm 472 is the left-hand end of a connecting rod 473 which slidably penetrates the free end of a strap iron member 474 secured, as by screws 475 (Figures 5 and 50), to the left-hand end of a control finger 476 (Figure 5).

The control finger 476 is oscillatably mounted intermediate its ends on the post 357 previously described and its free right-hand end in Figure 5 is disposed in the same horizontal plane as the lateral space indicated by the numeral 2 on the pattern drum 195 in Figure 46, and also in the same horizontal plane as cam members 477 to 480, inclusive (Figures 46 and 51). The top auxiliary pattern drum 195 is provided with the four cam members 477 to 480, inclusive, so as to activate the clamp and cutter members 456 and 457 immediately following the knitting of any one of the four different sections of a stocking as shown in Figure 88 and in which sections three different colors of yarn are employed. In other words, the clamp and cutter members 456 and 457, respectively, are actuated by the top auxiliary pattern drum 195 each time a change is made from one color of yarn to another during the forming of the ornamental pattern portion of a stocking.

The reading end of the control finger 476 is normally urged against the pattern drum 195 by a tension spring

481 connected to the bell crank arm 470 (Figure 50) at one end and connected to the bracket 430 at its other end to urge a collar 482, fixed on the end of the connecting rod 473, against the strap iron member 474 (Figures 5 and 45).

The yarns fed by the yarn feed fingers 333 and 335 are clamped and cut, during the knitting of the courses in a stocking which are not involved in the ornamental pattern, by the conventional means heretofore described since the means controlled by the main pattern drum 121 and the auxiliary pattern drum 195 may override each other.

Latch means for clamp and cutter

In order to preserve the particular manner in which the various cam members are arranged on the top auxiliary pattern drum 195, there is provided a latch member 466 (Figure 5) which is oscillatably mounted, as at 467, on the comb block 401 and the free end of which normally rests on the upper surface of the control finger 476. Now, as the control finger 476 is moved outwardly by the cam members 477 to 480, inclusive, the free end of the latch member 466 will be caused to move downwardly in Figure 2, by means of a tension spring 458, to thus engage and hold the free end of the control finger 476 out of the path of the cam members 477 to 480, inclusive, although any one of the cam members may have moved out of engagement with the reading end of the control finger 476.

This will prolong the period during which the clamping and cutting means are held in open position, which is necessary during the changing from one color yarn to another during the knitting of the ornamental pattern portion of a stocking such as that shown in Figures 88 to 91, inclusive. In order to release the latch member 466 from engagement with the control finger 476 and to thereby permit the control finger 476 to again move into engagement with the periphery of the top auxiliary pattern drum 195, a plate 468 is secured, as by screws 469, to the upper surface of the latch member 466, this plate 468 projecting a substantial distance to one side of the vertical plane of the latch member 466.

The lower surface of the plate 468 is adapted to be slidably engaged by the upper end of a bell crank 488 (Figure 2) which is oscillatably mounted intermediate its ends, as at 489, on the comb block 401. The bell crank 488 extends downwardly and is then bent rearwardly and its reading end rests, by gravity, on the periphery of the cam cylinder 237. The cam cylinder 237 has a relatively short cam member 496 (Figure 8) which upon moving in engagement with the lower end of the bell crank 488, will cause the bell crank 488 to rotate slightly in a counterclockwise direction, in Figure 2, to cause the upper end thereof to engage the lower surface of the plate 468 and to raise the free end of the latch member 466 out of engagement with the control finger 476.

It might be stated that the cam cylinder 237 rotates at one-fourth the speed as that of the needle cylinder. The purpose of this is that at the end of each counterclockwise travel of the needle cylinder the cam 496 will ride under the lower end of the bell crank 488 regardless of whether the cylinder is being shogged or is engaged in reciprocatory knitting.

Control means for latch opener

The latch opener, to be presently described, when used in forming a pattern such as that shown in Figure 88, is usually employed in opening the latch on the two long butt needles *lb* at the junction of the two groups of needles *bs* and *cm* which go into operation immediately upon starting to knit the apex of the diamond disposed on the opposite side of the stocking from the diamond shown in the central portion thereof in Figure 88 or at the point *bc* in Figure 94. The latch opener is of a type similar to that shown in U. S. Patent No. 1,574,703 of February 23, 1926, and comprises a latch opener finger 483 (Figure 5) the left-hand end of which is bent forwardly immediately adjacent the needle cylinder 103 so as to, at times, be disposed in the line of the path of travel of the upper ends of the long butt needles *lb* which at this point have their latches at a lower elevation than the other needles, said latches being in closed position as a result of their having been lowered to a level which has closed their latches, as will be later explained. The front end of the latch opener finger is pointed in a manner well known to those familiar with the art, so as to move the latch of these needles to open position. This latch opener finger 483 is fixed in a block 484 oscillatably mounted, as at 485, on the upper end of a standard 486 (Figures 5, 28 and 29). The lower end of the standard 486 is secured, as by screws 487, to a second elevating switch cam block broadly designated at 490, which will be later described in detail.

The latch opener finger 483 is normally urged, by a tension spring 491, against the free end of an adjustment screw 492 mounted in an off-set upwardly projecting portion 493 of the standard 486. The tension spring 491 is connected at one end to the finger 483 and at its other end to a suitable spring anchor 494 projecting from the upwardly projecting portion 493 of the standard 486. The rear end of a feeler finger or wire 495 is imbedded in the block 484 and is then bent forwardly and is adapted to be slidably engaged by a downwardly projecting portion of a strap iron member 497 (Figure 5) which extends forwardly and is secured, as by screws 500, to one end of a latch opener control finger 501. The latch opener control finger 501 is oscillatably mounted, on a post 502, the restricted lower end of which slidable penetrates the auxiliary bed plate 203 and is secured therein by a lock nut 502*a* threadably mounted on the lower end thereof (Figure 12). The post 502 also has the rear end of a horizontally disposed bar 503 fixedly mounted thereon and which is fixedly mounted at its front end on a post 504 (Figures 1, 5 and 12).

The post 504 is disposed in a vertical plane closely adjacent the top auxiliary pattern drum 195 and extends downwardly and its restricted lower end slidable penetrates a block 505 secured, as by screws 506, to the front face of the auxiliary bed plate 203 (Figures 1, 5 and 12). The post 504 is secured in the block 505 by a nut 507 threadably mounted on the restricted lower end thereof.

It will be noted, in Figure 1, that the latch opener control finger 501 extends to the right from the bar 503 and is then bent upwardly at an angle and then horizontally so that its free end is disposed in the same horizontal plane as the space defined by the numeral 3 on the auxiliary pattern drum 195 in Figure 46. It will be noted in Figures 1, 46 and 52, that the reading end of the latch opener control finger 501 is disposed in the same horizontal plane as a cam member 510 suitably secured to the periphery of the top auxiliary pattern drum 195. A tension spring 511 is connected, at its front end in Figure 5, to the post 504 and, at its rear end, to the left-hand end of the control finger 501 to thus normally urge the reading end thereof against the pattern drum 195 and its cam member 510 (Figures 5 and 46).

It is thus seen that, upon the free end of the control finger 501 being engaged by the cam member 510 on the top auxiliary pattern drum 195, the control finger 501 will be partially rotated in a clockwise direction, in Figure 5, to thus allow the latch opener finger 483 to move slightly in a counterclockwise direction in Figure 5 and to move block 484 against the rear end of the adjustment screw 492, in which position the free end of the latch opener finger 483 will be positioned for opening the latch on any needle which may be projected into its path. Now, upon the cam member 510 moving out of engagement with the reading end of the control finger 501, the tension spring 511 will transmit partial counterclockwise

rotation to the finger **501** and its arm **497**, in Figure 5, to thus again move the free end of the latch opener finger **483** out of the path of the needle circle. This action is shown more clearly in Figures 97 and 98.

Shogging means for needle cylinder and arrangement of needle butts

A particularly important feature of the present invention is the means for shogging the needle cylinder to cause a group of needles to knit in a narrowing operation with one color of yarn and then, by shogging the needle cylinder a predetermined amount so as to change the range of movement of the needles past the knitting point, the needles which were narrowed may take a different colored yarn in a widening operation, the two yarns being interknitted so as to produce a fabric wherein any reasonable number of different colored yarns may be knitted into a single wale although the yarn in the wale to one side or the other of said single wale may be a different color than the yarn in said single wale, and although both colors of yarn appear to be knitted into the same course. In other words, a fabric is produced in which it will appear that a different color of yarn had been knitted in the same courses and the same wales as previous colors of yarn in the knitting of patterns in which one or more lines forming the juncture of two adjacent areas knit of different colors of yarn extend at an angle substantially bisecting the vertical plane of the wales and the horizontal plane of the course of a stocking. This line shall be hereinafter referred to as a suture line. This will be more fully described in the method of operation hereinafter following.

The needle cams, to be later described, are so arranged and designed as to act upon certain needles while not acting upon other needles due to the arrangement of the needle butts. Referring to Figures 49 and 96, it will be observed that the butts of the needles are divided into three lengths, namely, short butt needles, medium butt needles and long butt needles *lb*. For purposes of description and for determining the cooperating influence between the shogging mechanism, to be presently described, and the needle cylinder, the needles are divided into four groups which, as shown in Figure 49, are defined as group *am*, group *bs*, group *cm*, and group *ds*. The needles are collectively referred to by the reference character N.

The needles *bs*, except the two endmost needles thereof, as well as the needles *ds*, except the two endmost needles thereof, are all provided with relatively short butts and shall be hereinafter referred to as short butt needles. The needles *am* and *cm* are medium butt needles, except for the two endmost needles in each of the groups *am* and *cm* while the endmost needles in each of the groups *am*, *bs*, *cm* and *ds* are long butt needles. The relative length of the short, medium and long butts on the needles is clearly shown in Figure 49. The purpose of the various lengths of butts on the needles will be later described.

It will be noted by referring to Figure 49 that there are 25 *am* needles and 29 *bs* needles, 26 *cm* needles and 28 *ds* needles. The reason for this division is to properly aline the point of connection between certain of the triangular areas such as the juncture point of section B–1 and G–8 and B–2 and G–7 in Figure 88. It is of course understood that the numbers may be varied as desired to secure the necessary and proper point to point alinement of these areas.

It has already been stated how the beveled gear **191**, in Figure 7, is engaged by a beveled gear **192** associated with the needle cylinder **103** for transmitting rotation thereto from the shaft **153**. However, since the beveled gear **191** is rotatably mounted on the shaft **153**, shogging clutch means, comprising a locking disk **520**, are provided for locking the beveled gear **191** relative to the shaft **153** in varying radial positions to, at times, produce a shogging effect in the needle cylinder **103** during the forming of a suture between two adjacent differently colored pattern portions of a stocking. After a triangular portion B–1, for example, has been knitted and the next step is to knit another triangular portion B–2, the clutch mechanism is to become operative to rotate the needle cylinder approximately one and one-half revolutions to cause its cylinder to be so disposed that knitting can then be commenced at the point *bc* in Figure 94 to knit the triangular portion B–2.

The disk **520** is secured as by screws **521** to the left-hand or outer face of the beveled gear **191** (Figures 7 and 10), and the diameter of this disk **520** is substantially less than the diameter of the beveled gear **191**. The locking disk **520** is provided with notches **522** to **525**, inclusive, the notches **522** and **523** being disposed diametrically opposite from each other and the notches **524** and **525** also being disposed diametrically opposite each other but transversely of the notches **522** and **523** for purposes to be later described. The locking disk **520** is provided with lead-in slots **526**, there being one of these slots associated with each of the notches **522** to **525**, inclusive.

Mounted to, at times, have rotational sliding movement against the outer surface of the disk **520** is a shogging disk **527** (Figure 7), of substantially the same diameter as the locking disk **520**, which is fixed on the left-hand end of the shaft **153** in Figure 7, as by a key **530** and a lock screw **531**. The shogging disk **527** has a notch **532** cut in its periphery in which a portion of a locking finger **533** has radial sliding movement. This locking finger **533** is oscillatably mounted as at **534** in the slot **532** of the shogging disk **527** and has a tail **535** integral therewith which projects inwardly and the inner free end of which is engaged by a spring pressed pin **536** slidably mounted in a bore or cavity **537** in the end of the shaft **153**. A compression spring **540** is mounted in the cavity **537** to normally urge the pin **536** outwardly against the proximate surface of the tail portion **535**.

When the tail **535** of the locking finger **533** is urged outwardly by the pin **536**, the free end of the finger **533** is adapted to engage the outer periphery of the locking disk **520** (Figures 7 and 10). In the event the free end of the finger **533** is not alined with any one of the notches **522** to **525**, inclusive, the finger **533** will ride against the outer surface of the disk **520** and, in the event the shaft **153** (Figure 10) is moving in a counterclockwise direction, the finger **533** will merely jump over any one of the notches **522** to **525** past which it may be moved, until the shaft **153** is moved in the reverse direction, presuming the shaft to be reciprocating, and when the shaft **153** moves in the opposite or clockwise direction in Figure 10, the free end of the finger **533** will then be led into the next adjacent notch **522** to **525**, inclusive, by virtue of the lead-in slots **526**, to thus lock the shogging disk **527** in engagement with the locking disk **520** to cause like rotation or reciprocation, as the case may be, to be transmitted from the shaft **153** to the beveled gear **191**.

In order to produce a shogging effect between the shogging disk **527** and the locking disk **520** of the shogging clutch, which will, in turn, be transmitted to the needle cylinder **103**, automatic means are provided, to be presently described, for disengaging the locking finger **533** from engagement with any one of the notches **522** to **525**, inclusive, and for causing the locking finger **533** to be moved into engagement with another of the notches **522** to **525**, inclusive.

Urged against the outer surface of the free end of the tail portion **535**, by means to be later described, is an adjustment screw **541** which is threadably imbedded in the free end of a shogging crank arm **542** (Figure 7). It will be noted, in Figure 7, that the sock horn **113** has an opening **543** therein into which the free end of the crank arm **542** projects and, in order to prevent the free end of the arm **542** from interfering with a sock being knitted and disposed within the sock horn **113**, a suitable shield plate

544 is secured to the inner wall of the sock horn 113 by suitable bolts 546.

The crank arm 542 is cut away intermediate its ends, as at 547, so as to clear certain thrust rods, to be later described, which extend upwardly from the conventional main pattern drum 121. The rearmost end of the crank arm 542 is fixedly secured on the lower end of a vertically disposed shaft 550 which is oscillatably mounted in a tubular bracket 551 (Figures 4 and 7) which has an inwardly projecting portion 552 integral therewith which is also disposed intermediate the upper and lower ends of the tubular bracket 551. This portion 552 is secured, as by screws 553 (Figure 6) to the upper surface of the auxiliary bed plate 203.

Fixedly mounted on a medial portion of the vertically disposed shaft 550, and in sliding rotational engagement with the upper end of the tubular bracket 551, is one end of a shogging control finger 554, the reading end of which is urged against the periphery of the top auxiliary pattern drum 195 by the compression spring 540 in the left-hand end of the shaft 155 in Figure 7. It is thus seen that the adjustment screw 541 is held against the free end of the tail 535 of the finger 533 by the reading end of the finger 554 bearing against the periphery of the top auxiliary pattern drum 195.

The control finger 554 is disposed in the same horizontal plane as the bottom space identified by the numeral 17 in Figure 46 and as is clearly shown in Figure 4, on the top auxiliary pattern drum 195. This control finger 554 is also disposed in the same horizontal plane as radially spaced cam members 555 to 559, inclusive (Figures 46 and 66), suitably secured to the periphery of the top auxiliary pattern drum 195. These cam members 555 to 559, inclusive, are spaced a predetermined distance apart from each other according to the desired pattern so as to produce a shogging effect in the needle cylinder after predetermined periods of rotary and/or reciprocatory knitting.

It is evident that when the shogging control finger 554 is out of engagement with any one of the cam members 555 to 559 inclusive (Figure 66) the finger 533 (Figure 7) will remain in locked position, that is, will remain in engagement with any one of the notches 522 to 525 (Figure 10) in the locking disk 520. Now, upon any one of the cam members 555 to 559, inclusive, moving into engagement with the reading end of the shogging control finger 554, in Figure 66, the finger 554 will, of course, partially rotate in a counterclockwise direction, in Figures 6 and 66, to thus cause the shaft 550 and the crank arm 542 in Figure 7 to move in a corresponding manner. This will move the tail portion 535 of the finger 533 inwardly, along with the pin 536, against the compression spring 540 and will move the locking end of the locking finger 533 out of engagement with a notch in the locking disk 520. The cams 555 to 559 are so positioned, on the top auxiliary pattern drum 195, as to cause the finger 533 to be moved out of engagement with a particular notch in the locking drum 520 when the end of a clockwise stroke of the shaft 153 and the shogging disk 527 in Figure 10 has been reached.

Assuming the free end of the finger 533 to have been in engagement with the notch 524, as shown in Figure 10, upon the finger 533 being moved out of the notch 524, the shaft 153, with the shogging disk 527, will then move one revolution in a counterclockwise direction in Figure 10. Now, although all of the cam members 555 to 559 are of substantially the same length, movement of the auxiliary pattern chain 265 and the position of certain of the lugs 285 on the auxiliary pattern chain 265 are such as to vary the period during which the locking finger 533 is in a raised or inoperative position and during which the locking finger 533 will move in a path of slightly greater radius than the radius of the locking disk 520 according to a desired pattern.

In order to produce a shogging effect in the needle cylinder 103, the locking finger 533 is moved out of engagement with the corresponding notch 522, 523, 524 or 525 immediately following the end of a clockwise revolution of the shaft 153, the shogging disk 527 and the locking disk 520 in Figure 10. The shaft 153, with the shogging disk 527, then moves in a counterclockwise direction in Figure 10 for a complete revolution while the locking finger 533 remains disposed so as to move in a path of greater radius than the disk 520 and then, upon the shaft 153, with the shogging disk 527, again moving in a clockwise direction, the locking finger 533 is released so as to bear, under pressure of the spring 540 (Figure 7), against the periphery of the locking disk 520. According to the desired pattern, the locking finger 533 may be caused to bear against the periphery of the locking disk 520 between any one of the four notches 522 to 525, inclusive, and will then be led into the next succeeding notch by means of the corresponding lead-in slot or notch 526.

Now, presuming the locking pin 533 to have been released so as to engage the periphery of the locking disk 520 at a point between the notches 523 and 525, by virtue of the pattern chain 265, during clockwise movement of the shaft 153 and the shogging disk 527, the locking finger 533 will move into engagement with the notch 525 to thus transmit a half revolution to the locking disk 520 which will, of course, impart a half revolution to the needle cylinder 103.

Now, we will presume that we had been knitting on the needles in groups *am* and *ds*, since these groups *am* and *ds* correspond to the notch 524 in the locking disk 520 (Figures 10 and 49). This means that the needles in groups *am* and *ds* had been moving equal distances from each side of the yarn feed fingers or from their knitting point upon each revolution of the needle cylinder 103 in opposite directions during reciprocatory knitting. When the locking finger 533 has move into engagement with the notch 525, in the manner previously described, this will shog the needle cylinder in such a manner as to cause the needles in groups *bs* and *cm* to assume the arc of action previously travelled by the needles in groups *am* and *ds* and the needles in groups *am* and *ds* will assume the previous position and arc of omvement of the needles in groups *bs* and *cm*. It is thus seen that, with the shogging of the needle cylinder a half revolution in the manner described, the needles in the groups *bs* and *cm* will then move equal distances past the knitting point upon each revolution of the needle cylinder during reciprocatory knitting.

The same is substantially true in the event that, say, following the positioning of the locking finger 533 in engagement with the notch 525, it is moved into engagement with the notch 523, except, in this instance, the needle cylinder will be shogged a quarter revolution instead of a half revolution and, presuming that the needles in groups *bs* and *cm* had been moving equal distances past the knitting point, the shogging of the needle cylinder a quarter revolution would then cause the needles in groups *cm* and *ds* to change their arc of movement so as to assume the former arc of action of the needles in groups *bs* and *cm*. In other words, the needles in groups *cm* and *ds* will then move equal distances past the knitting point during each revolution of the needle cylinder during reciprocatory knitting.

It might be stated 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 knitting cylinder 103, takes place when the locking finger 533 is in engagement with the notch 522 (Figure 10) in the disk 520. When the machine goes into reciprocatory knitting, the needles in groups *am* and *bs* in Figure 49, are moved past the knitting point, or in other words, past the yarn feed fingers, when the locking finger 533 is still in engagement with the notch 522. The locking finger 533 next moves into engagement with the notch 523, in the manner previously described, and the needles in groups

ds and *cm* then reciprocate past the knitting point. The locking finger **533** is next moved into engagement with the notch **524**, as shown in Figure 10, and causes the needles in groups *am* and *ds* in Figure 49, to reciprocate past the knitting point. The locking finger **533** next moves into the notch **525**, in Figure 10, and causes reciprocatory movement of the needles in groups *bs* and *cm* in Figure 49, past the knitting point. The ornamental pattern effected by shogging the needle cylinder in this manner will be later described in detail.

During the shogging of the needle cylinder, that is, during the time that the locking finger **533** is moving past the disk **520**, and is not in engagement with any one of the notches **522** to **525**, inclusive, the beveled gear **191** is prevented from rotating due to the friction of the beveled gear **192** at the lower end of the needle cylinder **103** against the upper surface of the upper bed plate **203**.

Driving means for conventional main pattern drum

By referring to Figures 1, 3, 4 and 7, it will be observed that the conventional main pattern drum **121** is constructed, mounted and driven in a manner very similar to that shown in said Patent No. 1,152,850. The main pattern drum **121** is rotatably mounted on the shaft **185** and has a gear **563** secured thereto as by screws **564** (Figure 3). The gear **563** meshes with a gear **565** rotatably mounted, as at **566**, on the vertically disposed standard portion **102***b* of the cast upper frame **102**. The gear **565**, in turn, meshes with a gear **570** fixedly mounted on the shaft **163** (Figure 1).

This gear **570** has a lower auxiliary pattern drum, which is a part of the present invention, suitably secured thereto and which will be later described in detail. It has already been described how intermittent step-by-step rotation is imparted to the shaft **163** and it is evident that such intermitent step-by-step rotation will be imparted from the shaft **163** through the gears **570**, **565** and **563** to the main pattern drum **121**.

The main pattern drum **121** controls the yarn feed fingers **333** and **335**, the conventional gap closer disposed in the latch ring **106**, and the clamp and cutter mechanisms **456** and **457** (Figure 5) during the knitting of all courses not involved in the forming of an ornamental pattern and including the top, the ring courses, the heel pocket, the foot portion and the toe pocket of a stocking in a manner identical to that shown and described in said Patent No. 1,152,850. The main pattern drum **121** also controls the rubber yarn feed finger and the cutter and clamp means for the rubber yarn in the usual manner. Since the rubber yarn is not employed in forming any part of a stocking wherein the ornamental pattern is involved, the cams on the main pattern drum **121** for controlling the feeding of the rubber yarn and for controlling the clamping and cutting means therefor are arranged in a conventional manner such as that shown in Figures 77 and 78.

However, the cam members on the pattern drum **121**, for controlling the yarn feed fingers **333** and **335**, the gap closer and the conventional yarn clamp and cutter members **456** and **457**, have been modified somewhat from that shown in said Patent No. 1,152,850 so that the control means responsive to the corresponding cam members on the top auxiliary pattern drum **195** may override the control means responsive to the cam members on the main pattern drum **121** and relating to the yarn fingers **333** and **335**, the gap closer and the clamp and cutter members **456** and **457** during reciprocatory knitting, that is, during the knitting of the courses defining the ornamental pattern portion of the stocking.

Rubber yarn control mechanism

Although the rubber yarn is controlled in a conventional manner, a brief description of the control means therefor is believed to be in order. The rubber yarn, indicated at R in Figure 2 is taken from one of the cones **310** which is mounted on one of the spindles or stands **304** and then extends upwardly, in Figure 2, and passes through a suitable tension device **571** which comprises the usual type of stationary and spring pressed disks between which the yarn R passes and which are suitably mounted on a bracket **575** secured, as by screws **576**, to the angle bar **317**. The yarn R then passes forwardly and downwardly, in Figure 2, and, by referring to Figures 5 and 15, it will be observed that there is provided a yarn feed finger **577** oscillatably mounted, as at **580**, on the cap piece **341**. The rubber yarn feed finger **577** and associated parts are similar to that shown in U. S. Patent No. 1,373,676 of April 5, 1921.

Now, the latch ring **106** has a notch **581**, in Figure 5, which identifies the point adjacent the rubber yarn feed finger **577** at which the rubber yarn is introduced to the needles in the needle cylinder. The yarn feed finger **577** for the rubber yarn, as shown in Figures 5 and 15, is of a conventional type which is engaged by a suitable torsion spring **578** for normally urging the free end of the yarn feed finger **577** to a position closely adjacent the notch **581** in the latch ring **106**. This spring means, being conventional, will not be further described. The rubber yarn feed finger **577** has a set screw **583** threadably imbedded therein which is urged against a thrust rod **584** by the torsion spring **578** (Figure 15). The thrust rod **584** then extends rearwardly and curves downwardly and it will be observed, in Figure 78, that the lower end of the thrust rod **584** engages the periphery of the main pattern drum **121** when the rubber yarn R is being fed to the needles.

The main pattern drum **121** has a cam member **585** suitably secured thereto which urges the thrust rod **584** upwardly, in Figure 78, to thus move the free end of the yarn feed finger **577**, for the rubber yarn R to inoperative position, or, to a position further away from the upper end of the needle cylinder. The lower end of the thrust rod **584** is also guided in the comb **453** heretofore described.

A conventional clamp and cutter device, broadly designated at K in Figure 5, for clamping and cutting the rubber yarn R after the forming of the rib or welt top of a stocking, is controlled by a cam member **586** suitably secured to the conventional main pattern drum **121**. This clamp and cutter means K may be of the same type as is employed in cutting the yarn Y, as heretofore described, and also of the type shown in said Patent No. 1,373,676.

The clamp and cutter mechanism K has a conventional spring means, not shown, for normally urging a thrust rod **587**, of which the lower end is shown in Figure 77, downwardly against the periphery of the main pattern drum **121** when the yarn R is being clamped by the clamping means included in the structure indicated at K. Now, when the rubber yarn R is being fed to the needles, the cam member **586** is moved into engagement with the lower end of the thrust rod **587** to thus open the clamping means as well as the cutting means to allow the rubber yarn to be carried along by the needles after the needles have engaged the rubber yarn.

Upon the cam member **586** again moving out of engagement with the lower end of the thrust rod **587**, the clamp and cutter are both rendered operable for clamping the free end of the yarn R as well as cutting the same simultaneously, in a manner well known to those familiar with the art.

In the knitting of a stocking of the type shown in Figure 88, two body yarns of different colors are fed to the needle circle, each at a different period in the knitting of the stocking. These body yarns are fed through the yarn feed fingers **333** and **335** and are controlled in a manner identical to that shown in said Patent No. 1,152,850, this showing including thrust rods **591** and **596**, the lower ends of which are visible in Figures 73 and 74, respectively, of this invention. The conventional

springs 359 normally urge the yarn fingers 333 and 335 downwardly (Figures 13 and 14) to cause their corresponding thrust rods 596 and 591 to be urged against the periphery of the main pattern drum 121, at different times, during the feeding of the corresponding yarns to the needle circle.

The main pattern drum 121 has cam members 592 and 593 suitably secured thereto which are adapted to engage the lower ends of the thrust rods 590 and 591, respectively, at different times for raising the corresponding yarn feed fingers 333 and 335 to inoperative position. It is obvious that neither of the cam members 592 or 593 need be in engagement with the corresponding thrust rods 596 and 591 during the knitting of the ornamental pattern portion of the stocking. However, assuming that the yarn fed by the yarn feed finger 335 is employed in knitting the rib portion or welt of a stocking while the yarn fed by the yarn feed finger 333 is employed in knitting the foot, heel and toe portion of a stocking, it is necessary that one of the yarn feed fingers 333 or 335 be in a raised posiiton while the other of the yarn feed fingers 333 or 335 is in a lowered or operative position, depending upon what portion of the stocking is being knitted.

Since, let us assume, the yarn fed through the yarn feed finger 335 is the first yarn that is used in the knitting of a stocking, that is, in forming the welt of a stocking, the connecting rod 395 (Figures 3 and 4) will be in a raised position due to the fact that the top auxiliary pattern drum 195 will have ceased rotation, upon knitting the ornamental pattern portion of a previously knitted stocking, with the leading end of the cam member 410 on the top auxiliary pattern drum 195 in engagement with the reading ends of the control fingers 367 and 355.

This will, of course, move the yarn feed fingers 335 o operative position and will move the connecting rod 395 upwardly (Figures 3 and 4) to where the tension in the yarn will be controlled by the tension arm 324 associated with the yarn tension device 322–5.

It will be noted in Figure 46 that the top auxiliary pattern drum 195 has been divided into 36 equal spaces designated by the numerals 21 to 56 and each of these spaces being representative of an arc at the periphery of the top auxiliary pattern drum 195 formed by a sector having a 10 degree angle. These spaces coincide with 36 teeth in the ratchet wheel 213 (Figure 8).

The numeral 56 in Figure 46 indicates substantially the vertical plane on the auxiliary pattern drum 195 at which the reading ends of the yarn feed control fingers 351 to 355, for the yarn feed fingers 331 to 335, respectively, and the yarn tension control fingers 363 to 367 for the yarn tension devices 322—1 to 322—5, respectively, engage the periphery of the top auxiliary pattern drum 195 when the top auxiliary pattern drum 195 has ceased intermittent step-by-step rotation in the forming of an ornamental pattern portion of a stocking and during the knitting of the ring courses below the ornamental pattern portion of the stocking and the heel pocket, the foot portion, the toe pocket and the rib top as well as the ring courses preceding the starting of knitting of a succeeding ornamental pattern portion of a stocking. At this point, the top auxiliairy pattern drum 195 is again caused to move at least one step in its rotation, say, from left to right in Figure 46, to condition the various parts controlled thereby for knitting the ornamental portions of the stocking.

It is evident, in Figure 46, that the yarn feed control finger 353 and the yarn tension control finger 365, for the yarn feed finger 333 and the yarn tension device 322—3, respectively (Figures 4 and 5), thus remain in engagement with the cam member 413 on the top auxiliary pattern drum 195 (Figures 46 and 55), so the yarn feed finger 333 and the corresponding tension arm 324, on the yarn tension device 322—3, may normally be in an operative position so as to be controlled by the main pattern drum 121 during the knitting of those portions of a stocking other than an ornamental pattern portion, for moving the same from operative to inoperative position or vice versa.

Referring to Figures 5, 6 and 51 to 66, inclusive, it is evident that the reading ends of the various control fingers which engage the periphery of the top auxiliary pattern drum 195 are not disposed in the same vertical plane. Therefore, by referring to Figure 46 it will be noted that there is a series of circular dots applied to the auxiliary pattern drum in the horizontal spaces defined by the numerals 1 to 17, inclusive, to denote the relative positions of the reading ends of the various control fingers corresponding to the cam members appearing in these particular spaces. The reading ends of the control fingers associated with the top auxiliary pattern drum 195 remain in a position relative to each other, as indicated by the dots in Figure 46, at all times.

In Figure 75 there is shown the lower end of a thrust rod 594 for controlling the position of the yarn tension arm 324 of tension device 322–3 during conventional knitting and which is adapted to be engaged by a cam portion 595 suitably secured to the periphery of the main pattern drum 121, for raising the right-hand end of a lever arm 600 (Figures 3 and 20) to which the upper end of the thrust rod 594 is pivotally connected, as at 601, in Figures 3 and 20. This lever arm 600 is oscillatably mounted, as at 602, on the stepped block 386, heretofore described. The left-hand end of the lever arm 600, in Figure 3, has a vertically disposed connecting rod 604 pivotally connected thereto, which extends upwardly and the upper end of which is shaped very much the same as the connecting rods 391 to 395, inclusive, and which is adapted to pass above the tension arm 324 of the tension device 322–3 in Figure 4.

When the cam member 595, in Figure 75, moves out of engagement with the lower end of the thrust rod 594, the thrust rod is urged downwardly against the periphery of the main pattern drum 121 by a tension spring 606 (Figure 3) the upper end of which is connected to a medial portion of the thrust rod 594 and the lower end of which is connected to the comb 453 in which the lower portion of the thrust rod 594 has vertical sliding movement.

This completes the description of the parts of the machine which are controlled in a conventional manner by the conventional main pattern drum 121. The manner in which the yarn tension device 322–3 is controlled by the main pattern drum 121, however, is not conventional, and, of course, it has been clearly stated how the various cams on the main pattern drum 121 are arranged so as to cooperate with the top auxiliary pattern drum 195. There are, however, three additional sets of cams on the main pattern drum 121 which will be later described, due to the fact that these latter cams are involved in the operation of the various radially movable needle cams and the three remaining sets of cams on the main pattern drum 121 will be described at the time the description is given relating to the needle cams.

Needle cams and how controlled by the top and lower auxiliary pattern drums and the main pattern drum

A description will now be given relating to the cams which control the actuation of needles and other mechanism associated therewith. Referring to Figures 80 to 87, 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 the patent to R. W. Scott, No. 1,152,850. A brief description will be given of the conventional cams in order that their relation with the cams of the present invention may be clearly understood.

As is also clearly shown in said patent, the needle cylinder 103 is surrounded at its lower end by a conven-

tional cam cylinder or ring **620**, a portion of which is shown in Figures 26 and 28, which is spaced apart from the needle cylinder **103** so that the cam members, to be presently described, may be secured to the inner surface thereof with the proximate surfaces of said cam members being disposed in close relation to the needle cylinder **103**.

Suitably secured to the inner face of the cam cylinder or ring **620** is a jack guide ring **621**, the lower edge of which is disposed a substantial distance upwardly from the lower edge of the cam cylinder or ring **620** so as to provide a slot through which the butts of conventional needle jacks, not shown, may pass. These needle jacks may be substantially of the type shown in said Patent No. 1,152,850. This jack guide ring **621** is cut away at one side thereof and has a conventional jack lowering cam and a needle guide cam **623** and **624**, respectively, mounted in the space defined by the cut away portion of the jack guide ring **621**. The jack guide ring, as well as the cams **623** and **624**, serve to maintain a vertical attitude of the jacks and to prevent the jacks 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.

The lower proximate portions of the cams **623** and **624** are cut away to form an inverted V-shaped opening. An advancing jack cam **619** is disposed in the V-shaped opening defined by the cams **623** and **624** for raising the needle jacks, alternate needles having a conventional jack disposed in the same vertical plane for raising them for taking the rubber yarn R during the knitting of the rib top of a stocking.

A segmental needle support ring **625** is mounted atop the jack guide ring **621** and terminates at one end thereof in engagement with the cam **624**. The upper surfaces of the cam **624** and the segmental support ring **625** are disposed at the same level.

Conventional hardened cams **626** and **627** are disposed at a point at the rear of the knitting machine and which together form a broad V-shaped opening from which the sloping surfaces **630** and **631** of the hardened cams **626** and **627** lead in opposite directions to return the butts of any needles, which may be passed into said opening during a knitting operation, to a mean horizontal plane. Mounted on the cam plate **110** in a conventional manner, and disposed centrally of the opening defined by the surfaces **630** and **631** on the hardened cams **626** and **627** is a conventional bottom center cam **634** and a conventional top center cam **635** which are spaced slightly apart from each other to permit the butts of the needles to pass therebetween during a knitting operation. A conventional left-hand stitch cam **636** and a conventional right-hand stitch cam **637** are disposed adjacent opposed sides of the top and bottom center cams **635** and **634**, respectively.

Conventional narrowing or lifting pickers, generally referred to as picks, **640** and **641** are provided in association with the conventional stitch cams **636** and **637**, these picks **640** and **641** being clearly shown in said Patent No. 1,152,850. The picks **640** and **641** are employed for engaging and elevating the leading needle in a particular group (Figure 49), one at a time, at each stroke of the reciprocating needle cylinder **103**. The narrowing picks **640** and **641** are mounted to oscillate in opposite directions with respect to each other in a manner identical to that shown in Figures 9, 10 and 11, of said Patent No. 1,152,850, and as is clearly shown in Figure 6 of the present invention and therefore a further showing or description of the same is deemed unnecessary. These narrowing picks **640** and **641** operate in a conventional manner during reciprocatory knitting of the heel and toe portions of a stocking and are also operated in a conventional manner during the knitting of the ornamental pattern portion of the stocking and wherein reciprocatory knitting is involved.

Widening cams

It will be noted, in Figure 80, that the narrowing picks **640** and **641** are each provided with a notch which is of such depth as to accommodate the butt of but a single needle at a time. Disposed at the front of the machine is a pair of lowering widening picks **644** and **645**, the notches of which are of such depth as to receive and lower the butts of two needles at a time. These widening picks **644** and **645** function in a conventional manner during the knitting of the heel and toe pockets of a stocking. However, the widening picks **644** and **645** are mounted in a manner entirely different from any widening picks heretofore known to be in use so their use may be selectively controlled by either the top auxiliary pattern drum **195** or a lower auxiliary pattern drum to be later described. The directing of the needles to the widening picks **644** and **645** is determined by other cams, to be later described, and which are controlled by the top auxiliary pattern drum **195**, the lower auxiliary pattern drum, to be later described, and also the main pattern drum **121**.

The widening picks **644** and **645**, which are of symmetrically-like form, are spaced equi-distant from the center of the stitch cams and, when the widening picks **644** and/or **645** are disposed in operating position closely adjacent the needle cylinder, the working ends of these widening picks **644** and **645** are disposed closely adjacent the proximate lower edges of left-hand and right-hand widening pick feed cams **646** and **647**, respectively. These widening pick feed cams **646** and **647** are provided to alternately lower certain groups of selected needles (Figure 49), these groups being selected by the shogging means earlier described (Figures 1, 7 and 10) for alternately lowering these needles so that the leading two needles in each group will move into engagement with the widening picks **644** and **645**, respectively, and will then be projected to a substantially lower elevation, as is clearly shown in Figures 85 and 86, so these first two needles, along with any other needles previously lowered to this elevation in the same manner, will pass through the stitch cams for knitting on these particular needles while the remaining needles continue to move in substantially the same horizontal plane as they had previously been moving, above the top center cam **635**.

Figures 6, 38, 39 and 40 clearly show the manner in which the left-hand widening pick feed cam **646** and the widening pick **644** are mounted, while Figures 6, 33, 34 and 35 clearly show the manner in which the right-hand widening pick feed cam **647** and its associated widening pick **645** are mounted.

The left-hand widening pick feed cam **646** is mounted for radial sliding movement on the inclined upper surface of a cam block **650** secured, as by screws **651**, to the upper bed or cam plate **110**. The widening pick feed cam **646** has radially extending slots **652** therein which are slidably penetrated by shoulder screws **654** threadably imbedded in the upper surface of the cam block **650** to thus hold the widening pick feed cam **646** in sliding engagement with the upper surface of the cam block **650**.

The cam block **650** has a bearing block **655** secured thereto, as by screws **656** (Figures 38 and 39). A vertically disposed stub shaft **657** is oscillatably mounted in the bearing block **655** and has a universal joint **660** at the upper end thereof, in Figure 38, to which is universally connected a medial portion of the widening pick **644**. The widening pick **644** extends outwardly or to the right, in Figure 38, from the universal joint **660** and is held in engagement with the upper cam surface of a cam plate **661** by a suitable tension spring **662** connected at its upper end to the widening pick **644** and at its lower end to a medial portion of the stub shaft **657**. The control means for the left-hand widening pick feed cam **642** will be later described.

The widening pick **644** is actuated by the butts of the needles which are moved into engagement with the same so as to cause the widening pick **644** to move downwardly

as indicated in the left-hand portion of Figure 85 when the needles are moving from left to right in Figures 80 and 85.

Now, in order to insure, that the other of the widening picks **645** is automatically moved into operative position as the butts of the needles move from left to right in Figures 80 and 85, so as to be engaged by and lower the leading two of any needles directed to the same by the cam **647** upon reverse movement of the needle cylinder, the outer proximate portions of the picks **644** and **645** are, at times, slidably engaged by the opposed downwardly bent ends of a swing arm **663** which is oscillatably mounted intermediate its ends in Figure 6, as at **664**, on an angle clip **665** secured, as by welding, to a medial portion of an L-shaped standard **666** which is secured, as by screws **667**, to the upper surface of the bed or cam plate **110**.

When the left-hand widening pick feed cam **646** directs the butts of any of the needles to the widening pick **644**, the widening pick **644** moves downwardly and outwardly away from the cylinder to substantially the position shown in Figure 6. The opposed ends of the arm **663** are also formed at an angle to provide a cam surface so that, upon movement of the inner end of the widening pick **644** outwardly to the position shown in Figure 6, the swing arm **663** will be caused to rotate slightly in a counterclockwise direction in Figure 6. The right-hand end of the arm **663**, being in engagement with the outer end portion of the widening pick **645**, wil cause the pick **645** to move inwardly toward the needle cylinder **103** and toward the cam **647** so that the two leading needles in the needle circle, upon a reverse movement of the needle cylinder, will engage the widening pick **645** and will cause the same to move outwardly to thereby reverse the position of the inner ends of the picks **644** and **645** from that shown in Figure 6.

The movement of the picks **644** and **645**, as transmitted thereto by the butts of the needles, is very sudden and, in order to prevent the swing arm **663** from rebounding to thus change the position of the inner ends of the picks **644** and **645** unintentionally, there is provided a friction member, **670** preferably of rubber or other friction material, which is secured, as by a screw **671**, to the upper end of a spacer block **672** which is slidably penetrated by the screw **671** and is, in turn, secured to the upper end of a first elevating switch cam block **673**. The cam block **673** is secured by screws **674** to the upper surface of the cam plate **110**. The cam mounted in the block **673** and the mechanism associated therewith will be later described. It is clearly shown in Figures 31 and 32 how the upper surface of the swing arm **663** slides against the lower surface of the friction member **670** for the purpose heretofore stated.

The right-hand widening pick **645**, in Figures 6 and 80, is universally mounted intermediate its ends on a universal joint member **675** which is integral with the upper end of a stub shaft **676** (Figure 35). The stub shaft **676** is oscillatably mounted in bearing portions of a bearing block **677** fixedly secured, as by screws **680**, to a right-hand widening pick feed cam block **681**.

Secured to the surface of the bearing block **677** remote from the needle cylinder **103**, as by screws **683***a*, is a cam plate **683**. A medial portion of the widening pick **645** is urged against the upper cam surface of the plate **683** by a suitable tension spring **688** (Figure 35), the upper end of which is secured to the widening pick **645** and the lower end of which is suitably connected to a medial portion of the stub shaft **676**. Each of the cam plates **661** and **683**, associated with the picks **644** and **645**, respectively, has an upwardly projecting stop portion **689** at the remote ends of the plates **661** and **683** and these portions **689** are alternately engaged by the widening picks **644** and **645** to restrict outward movement thereof.

The right-hand widening pick feed cam block **681** is secured, as by screws **682**, to the upper surface of the cam plate **110** (Figures 33, 34 and 35). The right-hand widening pick feed cam **647** is mounted for radial sliding movement on the inclined upper surface of the cam block **681**, in Figures 33 and 35 and is held against the upper surface of the block **681** by a guide plate **684** secured to the upper surface of the cam block **681** by a shoulder screw **685**. The widening pick feed cam **647** has a suitable radially extending slot therein which is slidably penetrated by the screw **685** so the screw **685** will serve as a guide member during radial movement of the widening pick feed cam **647**. Also, to assist in guiding the widening pick feed cam **647** during its radial movement, the guide plate **684** has a radially extending slot **686** therein (Figure 6) which is slidably penetrated by a pin **687** projecting from the upper surface of the widening pick feed cam **647**.

Now, referring to Figure 40, it will be observed that the widening pick cam block **650** has a radially extending bore **695** therein which is closed at its end nearest the needle cylinder and has a compression spring **696** therein which is engaged by a spring loaded pin **700**, the outer end of which engages an angle clip **701** secured to the lower outer surface of the left-hand widening pick feed cam **646** to thus normally urge the left-hand widening pick feed cam **646** outwardly with respect to the needle cylinder. The right-hand cam **647** is also urged outwardly in a manner very similar to that of the left-hand cam **646**. Referring to Figure 33, it will be observed that the right-hand cam block **681** has a radially extending bore **705** therein which is closed at its end nearest the needle cylinder and which has a compression spring **706** mounted therein. The spring **706** urges a spring-loaded pin **707** outwardly against an angle clip **710** welded to the outer lower surface of the right-hand widening pick feed cam **647** to thus urge the same outwardly with respect to the needle cylinder.

Widening pick control mechanism

Adjustably secured to the proximate upper surfaces of cams **646** and **647**, as by screws **712** (Figure 6), are angle clips **713** and **714**, respectively. The angle clips **713** and **714** are adapted to be alternately engaged by the free ends of L-shaped dogs **715** and **716**, respectively, oscillatably mounted, as at **720**, on opposed ends of a substantially V-shaped driven oscillatable arm **721**. This substantially V-shaped oscillatable arm **721** is secured, as by screws **722**, to the upper surface of a cuff member **723** suitably secured to the upper end of a vertically disposed shaft **724** (Figures 1 and 6).

The shaft **724** is oscillatably mounted in a tubular bearing member **725** having wing portions secured thereto, and secured, in turn, to the front surface of the circular bed plate **110** as by screws **727**. The shaft **724** extends beyond the lower end of the bearing member **725** and has secured thereto the front end of a crank arm **730** which extends rearwardly in Figure 22 and is pivotally connected to the left-hand end of a link **731**, the other end of the link being pivotally connected, as at **733**, to the upper end of a substantially vertically disposed switch bar **734** (Figures 10 and 22). The lower end of the switch bar **734** is pivotally connected, as at **735**, to a horizontally disposed bar **740** suitably secured to the front face of the vertically disposed standard portion **102***a* of the upper cast frame **102** (Figures 1 and 3).

By referring to Figures 1, 3, and 99, it will be seen that the lower end of the switch rod **734** is oscillatably mounted, as at **735**, on a block **736** which is, in turn, oscillatably mounted on the front surface of the bar **740** to thus permit oscillation of the upper end of the switch rod **734** in a forwardly and rearwardly as well as an outwardly and inwardly manner.

The switch bar **734** has a follower key portion **742** integral therewith (Figures 10 and 16) the upper and lower edges of which are beveled or cut at an angle so

as to lead the follower key portion 742 of the bar 734 to opposed sides of a substantially circular cam member 743 projecting from a widening pick cam ring 745 which is fitted onto the shogging disk 527 and is secured thereto, as by screws 746, only one of which is shown in Figure 7. It will be noted, in Figure 7, that the inner face of the pick cam ring 745 has a notch 747 therein which coincides with the notch 532 in the shogging disk 527, and in which the locking finger 533 is oscillatably mounted, so as to provide space for movement of the free end of the locking finger 533 out of engagement with any one of the notches 522 and 525, inclusive, in the locking disk 520. The cam portion 743 integral with the widening pick cam ring 745 is cut away, as at 750 in Figure 10, to thus provide a space between the proximate ends of the cam portion 743 substantially larger than the vertical length of the follower key 742 on the switch bar 734 (Figure 16).

Owing to the fact that the compression springs 696 and 706 in the widening pick feed cam blocks 650 and 681, respectively, normally urge the corresponding cams 646 and 647 outwardly, the follower key portion 742 on the bar 734 is alternately urged in opposite directions and is thus caused to alternately bear against opposed surfaces of the cam member 743 on the cam ring 745, since the angle clips 713 and 714 associated with the feed cams 646 and 647 alternately bear against the dogs 715 and 716 on opposed ends of the arm 721.

It is thus seen that the follower key 742 is urged to a point centrally of the opening 750, as shown in Figure 16, and the beveled ends of the key 742 will lead the key to opposite sides of the cam member 743 as it reciprocates past the key.

The proximate ends of the cam portion 743, which define the notch 750 in Figure 10 are also beveled, as at 751 and 752, to assist in leading the key 742 to cause the same to alternately engage opposed faces of the cam portion 743 of the cam ring 745 (Figures 10 and 16). It might be stated that the switching of the key portion 742 on the switch bar 734 takes place about midway of each reciprocatory stroke of the notch 750 in the cam member 743. The key portion 742 on the bar 734 is held out of engagement, by means to be presently described, with the cam ring 745 and its cam member 743 during rotary knitting, that is, during continuous rotation of the shaft 153.

During reciprocatory knitting, the follower key 742 on the bar 734 is held against the periphery of the cam ring 745 by a tension spring 753 which is clearly shown in Figure 3. The right-hand end of the tension spring 753, in Figure 3, is connected intermediate the ends of the rod 734 at one end thereof and its left-hand end is connected to the bell crank 115.

It is thus seen that as long as the key portion 742 of the switch bar 734 remains in engagement with the cam ring 745 and during reciprocatory motion of the shaft 153, oscillation will be transmitted through the link 731 and crank arm 730 to the shaft 724 which will, in turn, cause oscillatory motion to be transmitted to the substantially V-shaped driven oscillatable arm 721.

As a safety feature, the proximate ends of the L-shaped dogs 715 and 716 are connected to opposed ends of a tension spring 754 (Figure 6) to thus normally urge the proximate ends of the L-shaped dogs 715 and 716 inwardly against suitable stop pins 755 projecting from the upper surface of the driven oscillatable arm 721. The tension in the spring 754 is substantially greater than the pressure exerted by the compression springs 696 and 706 in Figures 40 and 43, respectively, so the remote ends of the L-shaped dogs 715 and 716, in Figure 6, will cause the corresponding cams 646 and 647 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 715 and 716 is to allow either one of the cams 646 and 647 to move outwardly in the event that some of the butts on the needles may not be properly positioned, or in the event that some type of foreign matter becomes lodged between the inner ends of the cams 646 or 647 and the outer surface of the needle cylinder 103. If the spring means, exemplified by the tension spring 754, were not provided, the cam 646 and 647 or the needles may become badly damaged or broken under the conditions heretofore set forth.

It is obvious that during the knitting of an ordinary type of stocking in which no ornamental pattern is included in the leg portion thereof, it is necessary that the widening pick feed cams 646 and 647 remain withdrawn from the path of travel of the butts of the needles and, at times, the widening pick feed cam 646 will remain disposed in the path of travel of the butts of the needles for a prolonged period while the other widening pick feed cam 647 will remain out of the path of travel of the butts on the needles.

This is necessary due to the fact that, during ordinary rotary knitting the needle cylinder 103 moves in a counterclockwise direction, in Figure 6, to cause all of the needles to move along a path indicated at P–1 in Figure 80. The alternate needles will move along the path of the arrows indicated at P–3, in Figure 80, when knitting the rib top or rib and elastic top portion of a stocking. During this rotary knitting, both of the cams 646 and 647 must be disposed out of the path of travel of the butts of the needles.

However, during reciprocatory knitting, as in forming the heel and the toe pockets of a stocking, and during the widening at the heel and toe of the stocking, the follower key portion 742 on the switch bar 734 is moved rearwardly, into engagement with the corresponding cam member 743 and the widening pick cam ring 745, to thus cause alternate movement of the cam members 646 and 647 into engagement with the needle cylinder. During the narrowing operations, in the forming of the heel and toe pockets of the stocking, the key portion 742 of the switch bar 734 is again moved out of engagement with the cam 743 and the ring 745, in Figure 10, to again render the widening pick feed cams 646 and 647 inoperative. During this time, the narrowing picks 640 and 641 will effect the narrowing operation in a conventional manner as is clearly shown in said Patent No. 1,152,850.

Widening pick knock-off mechanism

In order to control the position of the follower key portion 742 on the switch bar 734, relative to the cam member 743 and the ring 745, in Figure 10, during the knitting of the stocking as heretofore described, there is disposed rearwardly of the link 731, in Figure 22, a vertically disposed knock-off bar 760 which extends upwardly, in Figure 3, and is then bent forwardly and outwardly at an angle to form a horizontally disposed knock-off bar 761 which is oscillatably mounted intermediate its ends, as at 762, on the lower surface of the flange portion 112 of the circular bed or cam plate 110 (Figures 1 and 3).

Pivotally connected at the outer end of the horizontally disposed portion 761 of the bar 760 is the front end of an actuating rod 763. This rod 763 extends rearwardly, as shown in Figure 5, and slidably penetrates a pin 764 projecting from the upper end of a vertically disposed bell crank arm 765 (Figure 70).

The actuating rod 763 extends beyond the pin 764, after passing therethrough, and has a suitable collar 766 fixedly mounted thereon so that, upon the pin 764 being moved rearwardly or to the left in Figure 70, the actuating rod 763 will be caused to move rearwardly which will transmit partial counterclockwise movement to the horizontal portion 761 of the vertically disposed knock-off bar 760 (Figure 22) which will, in turn, cause

the knock-off bar **760** to move forwardly or in a clockwise direction in Figure 22 in engagement with the link **731** and to move the follower key portion **742** of the switch bar **734** out of engagement with the cam member **743** on the widening pick cam ring **745**.

During the knitting of the conventional portions of a stocking, that is, those portions of the stocking other than the leg portion in which the ornamental pattern is disposed, the pin **764** is moved rearwardly or in a counterclockwise direction in Figure 70, due to the bell crank arm **765** being oscillatable on the shaft **122**. The bell crank arm **765** has a reading arm **767** integral therewith the free end of which is normally urged against the periphery of the main pattern drum **121**.

The main pattern drum **121** has annularly spaced cam members **770**, **771** and **772** suitably secured thereon which are provided to transmit counterclockwise movement to the arm **765** and to move the pin **764** rearwardly to thus disengage the follower key portion **742** on the switch bar **734** from the cam member **743** on the cam ring **745**. The cam members **770** to **772** define notches **773**, **774** and **775** into which the reading end of the reading arm **767** is adapted to move during the knitting of the heel, toe and pattern portions of the stocking, respectively.

Since the follower key portion **742** of the switch bar **734** must be moved out of engagement with the cam portion **743** of the cam ring **745** at various times during the knitting of the ornamental pattern of a stocking such as that shown in Figure 88, there is provided a vertically disposed ear portion **776** (Figure 70) which extends upwardly and is then bent rearwardly at right angles and then upwardly again at right angles and which is a part of a horizontally disposed knock-off control finger **777** (Figure 5) which is oscillatably mounted, intermediate its ends, on the vertically disposed shaft **550** heretofore described (Figures 4, 5, and 6). By referring to Figures 5 and 62 it will be observed that the reading end of the knock-off control finger **777** is disposed in the same horizontal plane as spaced cam members **781** to **784**, inclusive, against which it is urged by a tension spring **768** (Figure 62) connected at its rear end to the finger **777** and at its front end to the bracket **430**. It will be noted that these cam members **781** to **784**, inclusive, are disposed in the lateral space on the auxiliary pattern drum **195** as is indicated by the numeral **13** in Figure 46.

Whenever the reading end of the knock-off control finger **777** is not raised by one of the cam members **781** to **784**, inclusive, the ear portion **776** of the knock-off control finger **777** is positioned slightly rearwardly of the position shown in Figure 70 to thus cause the follower key portion **742** of the switch bar **734** to be out of engagement with the cam member **743** on the widening pick cam ring **745** in Figures 10 and 16.

It is obvious that upon any one of the cam members **781** to **784**, in Figure 56, moving into engagement with the reading end of the knock-off control finger **777**, the ear portion **776** of the knock-off control finger **777** will be moved forwardly or to the position shown in Figure 70, which will, in turn, permit the tension spring **753** to pull the follower key **742** of the switch bar **734** into engagement with the cam member **743** and the cam ring **745** shown in Figure 10.

It is thus seen that the widening operation of the knitting needles will take place whenever one of the cam members **781** to **784** on the top auxiliary pattern drum **195** is in engagement with the reading end of the knock-off control finger, **777**, assuming that the reading end of the reading arm **767** is not being engaged by any one of the cam members **770** to **772**, inclusive, associated with the main pattern drum **121** (Figure 70).

It has already been described how the widening pick feed cams **646** and **647** are periodically alternately moved into engagement with the needle cylinder or, into the path of travel of certain groups of needle butts. During the knitting of an ornamental pattern, such as that shown in Figure 88, it is necessary that the needle cylinder be shogged a quarter of a revolution at four different times and a half revolution at another time as will be later described. Now, during this shogging of the needle cylinder, it is necessary that the right-hand widening pick feed cam **647** be moved into the path of travel of certain needle butts, as shown in Figure 84, to direct the needles downwardly to where they will pass through the stitch cams. This knits what is herein termed the suture of the ornamental pattern and which is the dividing line between adjacent ornamental pattern portions of a stocking as heretofore stated.

In order to move the right-hand widening pick feed cam **647** inwardly to operative position at intervals during which it cannot be moved to operative position by the oscillating mechanism shown in Figure 10, such as in the knitting along the suture of a stocking, cam members **791** to **794**, inclusive, are suitably secured to the top auxiliary pattern drum **195** (Figures 46 and 59), the cam members **791** and **792** being higher or thicker than the cam members **793** and **794** for purposes to be later described. It will be noted that these cam members **791** to **794** are disposed in the lateral space indicated by the numeral **10** in Figure 46. The reading end of a suture control finger **795** is disposed in the same horizontal plane as the cams **791** to **794**, on the drum **195**. This suture control finger **795** is oscillatably mounted on the post **502** and is then bent downwardly in Figure 12 and then inwardly as at **796**, this portion **796** also being oscillatably mounted in the post **502**. Suitable collars are provided to prevent vertical movement of the finger **797** on the shaft **502**.

Welded to the upper surface of the portion **796** of the suture control finger **795** is one end of an arm **797** which extends forwardly and to the left in Figure 6 as well as extending downwardly at an angle from the portion **796** of the suture control finger **795**. The free end of this arm **797** has adjustably secured thereto, as at **800**, a bunter **801** (Figures 6 and 33) the free end of which engages a substantially vertically disposed arm **802** of a suture bell crank broadly designated at **803**.

The suture bell crank **803** is oscillatably mounted at its juncture with an arm **804**, as at **805**, on the vertical leg of an angle clip **806** secured, as by screws **807**, to the lower surface of the auxiliary bed plate **203** (Figures 6 and 34.) A link **810** is pivotally connected, as at **811**, to the free end of the arm **804** of the bell crank **803**, the purpose of which will be later described.

Oscillatably mounted intermediate the ends of the vertical leg **802** of the suture bell crank **803**, as at **812** (Figures 33 and 34), is an auxiliary bell crank broadly designated at **813** and having arms **814** and **815** integral therewith. The arm **814** is normally urged against the free end of the angle clip **710**, welded to the lower surface of the right-hand widening pick feed cam **647**, by a tension spring **820** (Figure 33), the upper end of which is connected to the free end of the arm **815** and the lower end of which is connected intermediate the arm **804**. The substantially vertically disposed arm **802** also has a stop pin **821** thereon which is adapted to be engaged by the lower surface of the arm **815** of the bell crank **813** to restrict inward movement of the upper end of the arm **814**.

The purpose of this auxiliary bell crank **813** and the tension spring **820** associated therewith is to permit the right-hand widening pick feed cam **647** to be moved outwardly in the event that any foreign material passes between the inner edge of the same and the needle cylinder to thereby prevent breakage of the widening pick feed cam **647** and associated parts and, also, this will permit the cam **647** to be urged against the outer surface of the butts of the short butt needles in either group *bs* or *ds* (Figure 49) as they move past the same, so the cam **647**

may elevate the first long butt needles to pass the same, snapping into full operative position as it does so.

Now, it will be noted that when any one of the cam members **791** to **794**, inclusive (Figure 59), moves into engagement with the reading end of the suture control finger **795**, the suture control finger **795** will be caused to partially rotate in a clockwise direction, in Figure 6, to thus cause the bunter **801** to move the vertical arm **802** of the bell crank **803** (Figure 33) inwardly, which will result in the arm **814** of the bell crank **813** moving the right-hand widening pick feed cam **647** toward the needle cylinder to where the needle butts will engage the same.

Due to a limited range of the cam members **791** to **794**, inclusive, on the top auxiliary pattern drum **195**, there is provided cam members **824**, **825** and **826** which are spaced apart from each other and are suitably secured to the periphery of a lower auxiliary pattern drum broadly designated at **830** (Figures 3, 47 and 68). Their function will be presently described.

It will be noted in Figures 1, 3 and 33 that the link **810** extends downwardly from the arm **804** of the bell crank **803** and is adjustable as to overall length intermediate its end and the lower end thereof is pivotally connected, as at **831** (Figure 68), to a control arm **832** pivotally mounted at its left-hand end in Figure 3 on a stub shaft **833**. By referring to Figure 4, it will be observed that the stub shaft **833** projects outwardly from the standard **102***a* of the cast upper frame **102**. The right-hand end of the arm **832**, in Figure 68, extends through, and has vertical sliding movement in, a comb plate **837**, the lower end of which, in Figure 1, is secured, as by screws **840**, to the front surface of the base plate **100**.

The control arm **832** has a reading projection **841** integral therewith which projects upwardly and engages the periphery of the lower auxiliary pattern drum **830** (Figure 68). Now, when any one of the cam members **824** to **826**, inclusive, moves into engagement with the reading projection **841** on the control arm **832**, against which the reading finger **841** is urged by the springs **705** and **820** in Figure 33, the right-hand end of the control arm **832** along with the link **810** are moved downwardly to thus transmit partial counterclockwise rotation to the bell crank **803** (Figure 33) which will, in turn, cause the auxiliary bell crank **813** to move inwardly at its upper end and to again move the right-hand widening pick feed cam **647** into engagement with the needle cylinder. It is obvious that the control cams **824** to **826** inclusive, on the lower auxiliary pattern drum **830** are provided to cause the right-hand widening pick feed cam **647** to move inwardly at times when the cam members **791** to **794**, inclusive, on the top auxiliary pattern drum **195** are out of engagement with the reading end of the control finger **795** in Figure 4.

Lower auxiliary pattern drum and its function with respect to the needle cams

The lower auxiliary pattern drum **830** is clearly shown in Figures 1, 3, 47, 67, 68 and 69. It might be stated that the construction of the lower auxiliary pattern drum **830** may be varied considerably as desired. For example, the lower auxiliary pattern drum **830** may be of hollow construction and may be mounted on a hub portion of the gear **570** or may be an integral part of the gear **570** or may be welded or secured to the left-hand face of the gear **570**, in Figure 1, by any suitable means, or the lower auxiliary pattern drum **830** may be of a solid circular piece of material such as is shown in the drawings and which is suitably secured to the shaft **163** closely adjacent the gear **530**. The lower auxiliary pattern drum **830** has two additional sets of cams besides the set of cams **824** to **826**, inclusive (Figure 68), heretofore described and which will be later described in detail.

First and second elevating switch cams

Disposed in spaced relation to each other between the widening pick feed cams **646** and **647**, in Figure 80, are first elevating and first lowering switch cams **842** and **843**, respectively. The first elevating switch cam **842** is obscured, in Figure 6, by a leveling cam **844** disposed above and in the same vertical plane as the first elevating switch cam **842**. The first elevating switch cam **842** is clearly shown in Figures 6, 31, 32, 80, and 81. The first elevating switch cam **842** comprises a relatively thin plate member which has radial sliding movement in the switch cam block **673** heretofore described (Figures 31 and 32).

This first elevating switch cam **842** is mounted at an angle relative to the path of travel of the needle butts so as to elevate selected needles in the manner shown in Figure 81. The switch cam block **673** has an angularly disposed radially extending slot **845** therein for slidable reception of the first elevating switch cam. The lower edge of the slot **845** is closed by a plate **846** secured to the switch cam block **673** as by screws **847** (Figures 31 and 32). The leveling cam **844**, in Figure 31, is disposed above the horizontal plane of the first elevating switch cam **842** and is secured, as by screws **850**, to the upper surface of the switch cam block **673**.

Secured to the outer end of the first elevating switch cam **842** (Figures 31 and 32), as by screws **851**, is a pressure block **852**, against which the outer end of a spring pressed pin **853** is urged by a compression spring **854**, the block **673** having a bore **855** therein in which the compression spring **854** is mounted and also in which the pin **853** has sliding movement. The spring pressed pin **853** normally urges the switch cam **842** outwardly to substantially the position shown, in Figure 31, and urges the block **852** against the upper portion of a pivoted dog **856** and an eccentrically mounted disk **857** (Figure 6). The pivoted dog **856** is oscillatably mounted, as at **860** (Figures 31 and 32), on a plate member **861** secured, as by screws **862**, to an angle clip **863** which is, in turn, secured, as by screws **864**, to the lower surface of the cam or bed plate **110**.

The pivoted dog **856** is substantially L-shaped and the upper end of a substantially vertically disposed link **865** is pivotally connected thereto as at **866**. Referring to Figure 1 it will be noted that the link **865** is adjustable as to its overall length similar to link **810** and the lower end thereof in Figures 1 and 67 is pivotally connected, as at **867**, to the front end of a control arm **870**, which extends rearwardly and is oscillatably mounted on the stub shaft **833** heretofore described (Figures 3 and 4). This control arm **870** also penetrates and has vertical sliding movement in the comb plate **837** heretofore described.

The control arm **870** has a reading projection **871** thereon which is urged upwardly against the periphery of the lower auxiliary pattern drum **830** by the compression spring **854** disposed within the switch cam block **673** and through the intervening connections.

The lower auxiliary pattern drum **830** has cam members **872**, **873**, and **874** suitably secured thereto and which, upon moving into engagement with the reading projection **871** on the control arm **870**, will cause the right-hand end thereof, in Figure 2, to move downwardly to, in turn, transmit partial counterclockwise rotation to the pivoted dog **856** in Figure 31. This will cause the first elevating switch cam **842** to be moved inwardly toward the needle cylinder **103**.

The cam members **872**, **873** and **874** are each provided with a notch **875** at the leading end thereof so that, upon the lower auxiliary pattern drum being moved in a clockwise direction in Figure 67, the reading projection **871** on the control arm **870** will be moved downwardly a predetermined distance from the center of the lower auxiliary pattern drum **830** as a result of which the inner edge of the first elevating switch cam **842** will be moved to where it will engage the long butt and medium butt needles which are moved past the same in the needle cylinder.

After a predetermined period has elapsed, the cam members **872** and **874**, inclusive, will have moved to where the high point of the particular cam member in engagement with the reading projection **871** will then move the control arm **870** outwardly to its maximum distance from the lower auxiliary pattern drum **830** to thereby move the first elevating switch cam **842** inwardly to where all of the needles, that is, the long butt, medium butt and short butt needles will be engaged by the cam **842**.

In other words, the cam members **872** to **874**, inclusive, on the lower auxiliary pattern drum **830** will each affect the control bar **870** in such a manner as to cause the first elevating switch cam **842** to first move into a position to where, upon counterclockwise movement of the needles in Figure 49, say, the two long butt needles *lb* at the juncture of the groups *bs* and *cm* and all the medium butt needles in group *cm* would be raised by the first elevating switch cam **842** and during movement of the needles in group *cm* past the cam **842**, the cam **842** would proceed to move inwardly to where, not only the two long butt needles *lb* at the juncture of the groups *cm* and *bs* would be raised but the short butt needles in group *ds* would also be raised by the switch cam **842**.

This stepped movement of the switch cam **842** into engagement with the needle cylinder **103** is necessary due to the angular attitude of the butt engaging end of the switch cam **842** because, otherwise, the switch cam **842** may engage and break or bend some of the butts of the short butt needles in group *bs*.

Since the first elevating switch cam **842** is employed in raising the needles during some of the shogging operations of the needle cylinder **103** during the forming of the suture at the junction of ornamental pattern portions on a stocking, the first elevating switch cam **842** is not only controlled by the cam members **873** to **875**, inclusive, on the lower auxiliary pattern drum **830**, but is also controlled by cam members **880** and **881** on the top auxiliary pattern drum **195**.

A control finger **882** is disposed in the same horizontal plane as the cam members **880** and **881** and also in the same horizontal plane as the lateral space identified by the numeral **9** in Figure 46 on the top auxiliary pattern drum **195**. This control finger **882** extends to the left in Figure 5 and is oscillatably mounted on the post **504** heretofore described. The finger **882** is then bent downwardly to form a vertically disposed portion **883** (Figure 18), the lower end of which is welded to an operating arm **884** which is also oscillatably mounted on the post **504** and has an upwardly bent portion **885** integral therewith (Figure 18), the upper end of which is secured to the control finger **882**.

It will be noted in Figure 6, that this operating arm **884** extends to the left from the post **504** and has the eccentric disk **857**, heretofore described, secured thereon as by a screw **886**. This screw **886** is disposed off-center relative to the disk **857** so the disk may be adjustably rotated about the screw **886** for adjusting the relative distance between the block engaging surface of the disk **857** and the operating arm **884** (Figures 31 and 32). It has already been stated how the disk **857** engages the block **852** in Figures 31 and 32.

The reading end of the control finger **882** is urged against the periphery of the top auxiliary pattern drum **195** by the compression spring **855** disposed within the block **673** (Figure 31) and, upon either one of the cam members **880** or **881** in Figures 46 and 58 moving into engagement with the reading end of the control finger **882**, it is evident that the control finger **882** will be caused to move in a partial clockwise direction to thus move the left hand end of the operating arm **884**, in Figure 6, inwardly and to, in turn, move the first elevating switch cam **842** inwardly to engage the needle butts. The cam members **880** and **881**, in Figure 3, on the top auxiliary pattern drum **195** are not notched in the manner that the cam members **872** to **874**, inclusive, on the lower auxiliary pattern drum **830** are notched, since only approximately one fourth of the needles in the needle circle are raised by the switch cam **842** during a single stroke of the needle cylinder when controlled by the cam members **880** and **881** and, therefore, the switch cam **842** may be projected inwardly to the limit of its inward movement in a single stroke ahead of the particular group of needles to be engaged by the cam **842**.

Referring to Figures 3, 36, 37, 46, 48, 63, 71, 80 and 81, there is shown details of the first lowering switch cam **843** and the operating mechanism associated therewith. This first lowering switch cam **843** is employed in lowering all of the needles in the needle circle during rotary knitting of the welt portion of a stocking and, in which instance, the needles will be lowered as indicated by the arrows P–3 in the left-hand portion of Figure 80 and will be raised as indicated by the arrows P–2, at the right-hand portion of Figure 80, by means of the jacks raising alternate needles to the plane of the path of travel indicated at P–1 and the butts of the other needles will continue to move, as indicated at P–3 in Figure 80, past the vertical plane of the advancing jack cam **619** at the same elevation to which they had been projected downwardly by the first lowering cam **843** and will move upwardly on the hardened cam **627** so that all of the needles will pass through the stitch cams **637** and **636**. In other words, the alternate needles, which are projected upwardly at P–2, will take the rubber yarn, and the needles between these alternate needles will continue thereby along the path indicated by the arrows P–3, and it is seen that the rubber yarn will be laid into the loops of the stitches in the wales formed by the needles during the knitting of a rib top portion of a stocking. The structure of the stocking and the function of the cam **843** will be later described in detail.

The first lowering switch cam **843** is disposed at an angle relative to the path of travel of the needle butts and has radial sliding movement in a first lowering switch cam block **890** (Figures 6, 36 and 37), this block **890** having an angularly disposed slot **891** therein for slidable reception of the first lowering switch cam **843**. The slot **891** is closed at the lower edge thereof by a plate **892** secured, as by screws **893**, to the block **890**.

The block **890** is secured, as by screws **894**, to the upper surface of the cam or bed plate **110**. The first lowering switch cam **843** extends radially beyond the block **890** and has a pin **895** projecting therefrom to which one end of a tension spring **896** is connected. The cam block **890** has a longitudinally extending bore or hole **897** therein (Figure 36) which is loosely penetrated by the tension spring **896** and its end nearest the needle cylinder **103** is connected to a pin **900** bridging the open left-hand end of the hole **897** and it is thus seen that the tension spring **896** normally urges the first lowering switch cam **843** toward the needle cylinder.

Referring to Figure 37, it will be observed that the inner surface of the pin **895** is engaged by one end of an actuating finger **901** which projects to the left and then downwardly at an angle and is oscillatably mounted, as at **902**, intermediate its ends on an angle clip **903** secured, as by a screw **904**, to the front vertical face of the cam or bed plate **110** (Figures 6 and 37). The left-hand end of the actuating finger **901**, in Figures 6 and 37, has a connecting rod **905** pivotally connected thereto as at **906**. The connecting rod **905** extends rearwardly, in Figures 3 and 6, and is then bent inwardly at an angle and then again bent rearwardly, and by referring to Figures 3, 19 and 71, it will be observed that the rear end of the connecting rod **905** slidably penetrates a pin **907** projecting from the upper end of a substantially vertical leg **910** of a bell crank broadly designated at **911**. The bell crank **911** is oscillatably mounted on the stub shaft **122**. The leg **910** is urged forwardly at its upper end in Figures 3 and 71 by a tension spring **913** connected at its rear end

to a medial portion of the leg **910** and at its front end to the restricted portion **112** of the bed or cam plate **110** in Figure 3.

The rod **905** has a suitable collar **912** fixedly mounted on the left-hand end thereof in Figures 3, 19 and 71 which is normally engaged by the pin **907** so that counterclockwise movement of the bell crank **911** will cause the rod **905** to move from right to left in Figures 3 and 71 to thus move the actuating finger **901**, in Figure 6, in a clockwise direction. This will, of course, cause the upper end of the actuating finger **901** in Figures 36 and 37 to move the first lowering switch cam **843** outwardly away from the needle cylinder.

There are two cooperating means provided for moving the first lowering switch cam **843** outwardly through the medium of the connecting rod **905**. The first of these means includes a reading arm **915** on the bell crank **911** (Figure 71), the lower end of which is normally urged against the periphery of the main pattern drum **121** by the tension spring **913**. The main pattern drum has spaced cam members **920** to **923**, inclusive, of varying length, there being cams of lesser height disposed between the cam members **920** and **921** and between **921** and **922**, respectively for varying the positions of the butt engaging end of the first lowering switch cam **843** relative to the needle cylinder. The purpose of the cam members **924** and **925** on the main cam drum **121** is to effect movement of the first lowering switch cam **843** in the same manner that the cam members **872** to **874**, inclusive, on the lower auxiliary pattern drum **830** effect movement of the first elevating switch cams **842** and for the same reason as heretofore described.

Although the springs **896** (Figure 36) and **913** (Figure 71) normally urge the reading arm **915** against the cams **920** to **925**, on the periphery of the main pattern drum **121**, it is clearly shown in Figure 71 that the reading arm **915** of the bell crank **911** is, at times, held out of engagement with the periphery of the main pattern drum **121** by a switch cam lever arm **926**, the lower end of which engages the front surface of the pin **907** in Figures 3, 19 and 71. This switch cam lever arm **926** is oscillatably mounted intermediate its ends as at **927** on an angularly disposed bracket **930** which projects downwardly and is secured, as by a screw **931**, (Figure 19) to the upper surface of the cam or bed plate **110**. The rear surface of the upper end of the lever arm **926** (Figure 19) engages the front edge of a control finger **932** at the left-hand end thereof in Figure 5.

This control finger is oscillatably mounted intermediate its ends on the post **550** heretofore described (Figures 4, 5 and 6) and is disposed in the same horizontal plane as the lateral space on the top auxiliary pattern drum **195** indicated by the numeral **14** in Figure 46. The reading end of the control finger **932** is urged against the periphery of the top auxiliary pattern drum **195** or cam members **933** and **934** suitably secured to the top auxiliary pattern drum **195** by the spring **913** in Figure 71 and intervening connections.

It will be noted in Figure 63 that the cam member **934** extends substantially entirely around the top auxiliary pattern drum **195**, and is cut away to provide a space therebetween in which the cam member **933** is disposed, opposed ends of the cam member **934** being spaced a substantial distance apart from the cam member **933**.

Referring to Figures 6, 28, 29, 46, 64 and 80 there is shown a second elevating switch cam and the operating mechanism associated therewith. This switch cam is used for elevating certain needles to such an elevation that the butts thereof will pass above the top center cam, in Figure 80, and thus will not pass through the stitch cams.

The second elevating switch cam is indicated at **940** in Figures 6, 28 and 29 and is mounted for radial sliding movement in the second elevating switch cam block **490** heretofore described. The second elevating switch cam block **490** is secured, as by screws **941**, to the upper surface of the cam or bed plate **110**. The second elevating switch cam block **490** has an angularly disposed radially extending slot **943** therein in which the second elevating switch cam **940** has radial sliding movement. The left-hand side of this slot **943** is closed by a plate **944**, in Figure 29, secured as by screws **945**, to the block **490**.

The second elevating switch cam **940** extends radially beyond the outer end of the block **490** and has a pressure block **946** secured thereto as by screws **947** only one of which is shown in Figure 29. The cam block **490** has a radially extending bore **948** therein in which a spring pressed pin **950** has longitudinal sliding movement. The pin **950** is urged outwardly against the pressure block **946** by a compression spring **951** mounted in the bore **948**. The pin **950** normally urges the block **946** against one side of a vertically disposed pin **952** the restricted upper end of which is secured, as by a nut **953**, in a second elevating switch cam control finger **954** (Figures 6, 29 and 64). The manner in which the control finger **954** is mounted will be presently described.

The pressure block **946** on the second elevating switch cam **940** has secured thereto, as by screws **955**, a strap iron member **956** (Figures 6, 27 and 29). This strap iron member **956** extends upwardly at an angle from the pressure block **946** and then extends inwardly and downwardly at a lesser angle and has a substantially L-shaped finger **957** oscillatably mounted thereon as at **960**.

A tension spring **961** is connected to one of the legs of the L-shaped finger **957** at one end thereof and is connected at its other end to the strap iron member **956** to thus urge the corresponding leg of the L-shaped finger **957** against a stop pin **962** (Figures 6 and 29) projecting upwardly from the strap iron member **956**. The function of the L-shaped member **957** will be later described.

The control finger **954** is pivotally mounted on the restricted upper end of a vertically disposed post **963** (Figure 29), the restricted lower end of which is threadably imbedded in the auxiliary bed plate **203**. The depression spring **951**, in the second elevating switch cam block **490** (Figure 28), urges the reading end of the control finger **954**, through intervening connections, against the periphery of the top auxiliary pattern drum **195**. Referring to Figures 46 and 64, it will be observed that the control finger **954** is disposed in the same horizontal plane as cam members **964** and **965** suitably secured to the periphery of the top auxiliary pattern drum **195** and being disposed in the lateral space identified by the numeral **15** in Figure 46.

Referring to Figures 6, 28 and 64, it is evident that counterclockwise movement of the top auxiliary pattern drum **195**, in Figure 64, will cause the cam members **964** and **965** to successively engage the reading end of the control finger **954** which will, in turn, cause the control finger **954** to move from right to left in Figures 6 and 28 to thereby move the second elevating switch cam **940** into the path of travel of the needle butts in the needle cylinder. Since this cam **940** is employed during reciprocatory knitting of the pattern portion of a stocking only, no other means are necessary for operating the same other than that shown in Figure 64.

Referring to the right-hand central portion of Figure 80 there will be observed a cluster of three cam members, namely a double acting switch cam **970**, an upper oblique switch cam **971** and a lower oblique switch cam **972**, structural details of which appear in Figures 6, 26 and 27, the operating mechanisms therefor appearing in Figures 4, 6, 26, 27, 46, 64, 65 and 79, and functional members will be observed in Figures 80, 81, 84, 85 and 86.

The double acting switch cam **970** is used only during reciprocatory knitting for raising needles during the forming of an ornamental pattern portion of a stocking as well as the heel and toe pockets. The upper oblique switch cam **971** is employed in cooperation with the

right-hand widening pick feed cam, as the needle cylinder moves in a counter-clockwise direction in Figure 6, or from right to left in Figure 80, for lowering certain selected needles during the shogging of the needle cylinder while forming the suture of the stocking, which operation will be clearly described in the method of operation of the machine.

The lower oblique switch cam **972** is employed in lowering the needles which have been projected upwardly by the advancing jack cam **619**, and the corresponding jacks, during the taking of the rubber yarn by the needles as indicated by the path P–2 in Figure 80, after which these needles, which have been alternate needles, along with the needles therebetween are projected upwardly by the hardened cam **627** so that all of these needles in the needle circle are passed through the stitch cams.

Referring to Figures 6, 26 and 27, there will be observed a cluster cam block **973** which is secured to the cam or bed plate **110**, as by screws **974**, and in which the switch cams **970**, **971** and **972** are mounted for radial sliding movement. The double acting switch cam **970** has a radially extending stem **970***a* integral therewith which has sliding movement against the top surface of the cluster cam block **973** in Figure 26 and is held in sliding engagement therewith by a guide block **975** which is substantially L-shaped and is secured to one side of the block **973**, as by screws **976**. It will be noted, in Figures 6 and 26, that the guide block **975** is substantially shorter than the cluster cam block **973** and the stem **970***a* of the double acting switch cam **970** extends radially beyond the guide block **975** and has a spring anchor **977** thereon to which the iner end of a tension spring **980** is connected. The outer end of the tension spring **980** is connected to a suitable spring anchor **981** projecting from the upper surface of the cluster cam block **973**. This tension spring **980** normally urges the double acting switch cam **970** outwardly with respect to the needle cylinder **103** against an operating lever to be later described.

Referring to Figure 30 it will be observed that the cluster cam block **973** has radially extending angularly superposed slots **982** and **983** therein, the open right-hand sides of which are closed by a plate **984** secured, as by screws **985**, to the right-hand side of the cluster cam block **973** in Figure 30.

The upper oblique switch cam **971** has a restricted stem portion **971***a* integral therewith which has radial sliding movement in the slot **982** and which projects outwardly therefrom and has an eccentrically mounted disk **986** adjustably secured thereon as by a screw **987** (Figures 6 and 27).

Inasmuch as the upper oblique switch cam **971** is controlled as to movement toward the needle cylinder **103** by the same control finger **954** that controls the second elevating switch cam **940**, a description of this structure will be given before proceeding with the description of the means for operating the double acting switch cam **970** and the lower oblique switch cam **972**. Referring to Figures 6 and 27, it will be noted that upon either of the cam members **964** and **965**, in Figure 64, engaging the reading end of the control finger **954**, the control finger **954** will be caused to move in a partial counterclockwise direction, in Figure 6, to thus move the second elevating switch cam **940** inwardly in the manner heretofore described.

Now, upon the second elevating switch cam **940** moving inwardly, the strap iron member **956** along with the L-shaped finger **957** will also move inwardly and will cause the L-shaped member **957** to engage the eccentrically mounted disk **986** on the stem **971***a* of the upper oblique switch cam **971**, to thus cause the upper oblique switch cam **971** to also be moved inwardly slightly later than the time that the second elevating switch cam is moved inwardly. It is thus seen that the L-shaped finger **957** also serves as a safety device in the event any foreign matter, or the like, passes between the butt engaging end of the upper oblique switch cam **971** and the needle cylinder **103** when the upper oblique switch cam **971** has been moved to operating position.

Now, referring to Figures 26 and 27, it will be noted that the stem **972***a* of the lower oblique switch cam **972** extends outwardly beyond the outer vertical surface of the cluster cam block **973** and has a pressure block **990** secured to the lower surface thereof, which is urged outwardly by a spring loaded pin **991**.

The block **973** has a bore **992** therein in which the pin **991** has radial sliding movement. The pin **991** is urged outwardly by a compression spring **993** mounted in the bore **992**. The compression spring **993** urges the pin **991**, along with the block **990**, outwardly against an adjustment screw **994** which is held in adjustment in a crank arm **995** by a lock nut **996** (Figure 26).

The crank arm **995** is an integral part of a substantially Z-shaped crank member broadly designated at **997** and having an outwardly projecting arm **998** integral therewith. The substantially Z-shaped crank member **997** is oscillatably mounted at the juncture of its arms **995** and **998** on a vertically disposed shoulder screw **1000** (Figures 6 and 25). the lower end of which is threadably imbedded in a bracket **1001**. The substantially Z-shaped crank member **997** is also supported for oscillation on the bracket **1001**. The bracket **1001** is secured, as by screws **1002**, to the rear surface of the cam plate **110**.

The bracket **1001** has an outwardly projecting yoke member **1003** at the right-hand end thereof in Figure 25, in which the thrust rod **583** (Figure 78) which operates the rubber yarn feed finger **572** has vertical sliding movement and, also, in which the lower oblique switch cam thrust rod **1004** has vertical sliding movement. Referring to Figures 6 and 25, it will be noted that the arm **998** of the Z-shaped crank member **997** has a hook member **1005** secured thereto, as by screws **1006**, which projects inwardly and engages the rear surface of a cam plate **1007** secured, as by screws **1010** to one side of the thrust rod **1004**.

The thrust rod **1004** extends downwardly in Figures 4 and 25 from the yoke portion **1003** of the bracket **1001**, against which the lower surface of the cam plate **1007** normally rests, and its lower end, in Figure 79, rests by gravity against the upper surface of the main pattern drum **121** after passing through the comb **452**, heretofore described (Figure 79). The main pattern drum **121** has a cam member **1012** suitably secured thereto which is adapted to engage the lower end of the thrust rod **1004** for projecting the same upwardly so as to move the lower oblique switch cam **972** in a manner to be presently described, into the path of travel of the needle butts during the knitting of the rubber yarn R into the welt of a stocking.

When the thrust rod **1004** is moved upwardly by the cam member **1012**, it will be observed, in Figures 24 and 25, that the cam plate **1007** will move into engagement with the hook **1005** to thus move the same outwardly, which will, in turn, transmit partial clockwise movement to the substantially Z-shaped crank member **997** in Figure 6. This will, of course, cause the lower oblique switch cam **972** to be moved inwardly to engage the needle butts.

Now, in order to prevent the hook **1005** from being raised or moved upwardly by the rubbing action of the cam plate **1007**, as it is moved upwardly by the thrust rod **1004**, there is provided a disk-like guide member **1013** which is disposed on a vertical axis and this has a restricted threaded portion **1014** integral therewith (Figures 24 and 25) which threadably penetrates an arm **1015** and is secured in adjusted position therein by a lock nut **1016**. The arm **1015** is an integral part of a substantially Z-shaped strap iron bracket, broadly designated at **1017**, which extends downwardly and then outwardly and is secured to the lower surface of the cam

plate 203 by the same screws 432 which secure the bracket 430 to the upper surface of the auxiliary bed plate 203 (Figure 50).

Referring to Figures 6 and 26, it will be observed that the outer end of the stem portion 970*a* of the double acting switch cam 970 is urged against the angularly disposed inner end of an actuating lever 1025 by the tension spring 980 heretofore described. This actuating lever 1025 is oscillatably mounted, as at 1026, on the upper end of a strap iron bracket 1027 which projects downwardly and is secured, as by screws 1030, to the upper surface of the auxiliary bed plate 203 (Figures 26 and 27). A link 1031 (Figure 6) is pivotally connected at opposed ends thereof to a medial portion of the actuating lever 1025 and to the outer end of a control lever 1032. The control lever 1032 is oscillatably mounted intermediate its ends on the restricted upper portion of the vertically disposed post 963 (Figure 29) and its end remote from the link 1031 has a reading projection 1032*a* which is normally urged into engagement with the periphery of the top auxiliary pattern drum 195 or with spaced auxiliary cam members 1035 to 1039, inclusive, of varying length (Figures 46 and 65) disposed in the same horizontal plane as the reading projection 1032*a* of the control finger 1032, by means of the tension spring 980 associated with the double acting switch cam 970 (Figures 6 and 26). Referring to Figure 46, it will be noted that the cam members 1035 to 1039, inclusive, are disposed in the lateral space indicated by the numeral 16.

It is obvious that, upon any one of the cam members 1035 to 1039, inclusive, moving into engagement with the reading projection 1032*a* on the control arm 1032 in Figure 6, the control arm 1032 will partially rotate in a counterclockwise direction to thus cause the actuating lever 1025 to partially rotate in a counter-clockwise direction to where its free end, or upper end in Figure 6, will move the double acting switch cam 970 into the path of travel of the needle butts in the needle cylinder 103.

In order that there may be ample space between the various cams 1035 to 1039, inclusive, on the top auxiliary pattern drum 195 in Figure 65, for the reading projection 1032*a* of the control lever 1032 to properly engage the periphery of the top auxiliary pattern drum 195, the double acting switch cam 970 is also controlled by the lower auxiliary pattern drum 830. The actuating lever 1025 is disposed at an angle relative to its longitudinal axis, as heretofore stated, and its end remote from the end which engages the stem 970*a* of the double acting switch cam 970 is adapted to be engaged by the upper portion of a pivoted L-shaped dog 1040 (Figures 22 and 23) oscillatably mounted as at 1041 on the auxiliary bed plate 203. The auxiliary bed plate 203 has one of its corners cut away to form a notch 1042, on one of the walls of which the pivoted L-shaped dog 1040 is oscillatably mounted.

The L-shaped dog 1040 projects downwardly, beyond the point at which it is pivoted on the auxiliary bed plate 203, and then extends outwardly and has pivotally connected thereto, as at 1043, the upper end of a link 1044 (Figures 1 and 23). It will be noted, in Figure 1, that this link 1044 extends downwardly from the pivoted L-shaped dog 1040 and is then bent spirally and extends downwardly at an angle and terminates closely adjacent the lower auxiliary pattern drum 830.

The lower end of the link 1044, in Figure 69, is pivotally connected, as at 1050, to the front end of a control bar 1051. The control bar 1051 extends rearwardly and is pivotally mounted on the stub shaft 833 heretofore described (Figures 3 and 4).

The control bar 1051 has a reading projection 1052 integral therewith which is normally urged against the periphery of the lower auxiliary pattern drum 830 by a tension spring 1053, connected at its lower end to the link 1044 adjacent the pivoted dog 1040 and at its upper end to the lower surface of the auxiliary bed plate 203 as at 1054 (Figure 23). This reading projection 1052 is also guided in a vertical plane relative to spaced cam members 1060, 1061, 1062, suitably secured to the lower auxiliary pattern drum 830, by the comb 837 heretofore described, and in which the front end of the control bar 1051 has vertical sliding movement.

It is thus seen that upon any one of the cam members 1060, 1061, or 1062 moving into engagement with the reading projection 1052 on the control bar 1051 (Figure 69) the link 1044 will be moved downwardly to transmit partial clockwise rotation to the pivoted L-saped dog 1040 (Figure 23) as a result of which the upper end of the dog 1040 will move the actuating lever 1025 in a counterclockwise direction in Figure 6. This, of course, will move the double acting switch cam into engagement with the butts of the needles in the needle cylinder. This completes the structure and the operating mechanism of the switch cams 970, 971 and 972 associated with the cluster cam block 973.

Referring to Figure 80 there will be observed a reverse oblique switch cam 1070 and a fixed reverse leveling cam 1071 disposed thereabove. The reverse leveling cam 1071 is secured, as by screws 1072, to the upper surface of a reverse leveling cam block 1073 disposed to the left of the needle cylinder in Figure 6. Further structural details of the reverse leveling cam and the reverse oblique switch cam are shown in Figures 36 and 42 while the operating mechanism therefor is shown in Figures 5, 6, 41, 42 and 61, while functional diagrams relating to the mode of operation of these cam members 1070 and 1071 may be observed in Figures 80, 83, 85 and 87.

The reverse leveling cam block 1073 is secured as by screws 1074 to the upper surface of the cam or bed plate 110 (Figures 41 and 42). The reverse leveling cam block 1073 has a radially extending slot 1075 therein in which the reverse oblique switch cam 1070 has radial sliding movement. The bottom of the slot 1075 is closed by a plate 1076 secured, as by screws 1077, to the left-hand wall of the reverse leveling cam block 1073 in Figure 42.

The reverse oblique switch cam 1070 extends radially beyond the cam block 1073 and has a pressure block 1080 secured to the lower surface thereof, as by screw 1081, in Figure 42. The pressure block 1080 is urged outwardly against an eccentrically mounted disk 1082 (Figure 6) by a spring loaded pin 1083. The reverse leveling cam block 1073 has a bore 1084 therein in which the spring loaded pin 1083 has radial sliding movement (Figure 41) and in which a coil spring 1085 is mounted. This coil spring 1085 urges the pin 1083 against the block 1080 to thus normally urge the reverse oblique switch cam 1070 away from the needle cylinder 103.

The eccentrically mounted disk 1082 is a adjustably secured, as by a screw 1087, to the upper surface of a substantially L-shaped actuating finger 1088 oscillatably mounted as at 1091 on a strap iron bracket 1092 secured, as by screws 1093, to the upper surface of the cam or bed plate 110. The L-shaped actuating finger 1088 also has the front end of a link 1093 connected thereto through the medium of a post 1094, the restricted lower end of which penetrates the L-shaped actuating finger 1088 and is secured therein by a lock nut 1095 (Figure 41).

Suitable spacing collars 1096 are fixedly mounted on the post 1094 and the front end of the link 1093 is pivotally mounted on the post 1094 between the spaced collars 1096. Referring to Figure 42 it will be noted that this arrangement provides means whereby the link 1093 may be disposed at a higher elevation than the reverse leveling cam block 1073. The link 1093 extends rearwardly, in Figure 6, and has the front end of a tension spring 1097 connected thereto which also extends rearwardly in substantially parallel relation to the link 1093, and its rear end is mounted on a suitable spring anchor 1100 projecting upwardly from the upper sur-

face of a reverse elevating switch cam block **1101** to be later described.

The link **1093** extends rearwardly and is pivotally connected as at **1103**, to a downturned end portion of a control lever **1104**. The control lever **1104** is oscillatably mounted on the post **550**, heretofore described, and extends inwardly and the free end thereof is urged against the periphery of the top auxiliary pattern drum **195** (Figure 61) by the tension spring **1097** (Figure 6) heretofore described. This control lever is disposed in the same horizontal plane as the lateral space defined by the numeral **12**, in Figure 46, on the top auxiliary pattern drum **195**, and is also in the same horizontal plane as spaced cam members **1105** and **1106**.

It is thus seen that upon either one of the cam members **1105** and **1106**, in Figure 61, moving into engagement with the control lever **1104**, the control lever **1104** will partially rotate in a counterclockwise direction in Figures 6 and 61 which will, in turn, cause the link **1093** to move forwardly and to thereby transmit partial clockwise rotation to the L-shaped actuating finger **1088**. This will cause the eccentrically mounted disk **1082** to move the pressure block **1080**, along with its reverse oblique switch cam **1070**, inwardly to where the reverse oblique switch cam **1070** will be disposed in the path of travel of the long butt needles *lb* in the needle cylinder **103**. This completes the structure and operating mechanism associated with the reverse oblique switch cam **1070** and the reverse leveling cam **1071**.

Referring to Figures 6, 43, 44, and 45, it will be observed that the reverse elevating switch cam block **1101** has an angularly disposed radially extending slot **1110** in which a reverse elevating switch cam **1111** has radial sliding movement. The reverse elevating switch cam block **1101** is secured, as by screws **1113**, to the upper surface of the cam or bed plate **110**. The lower edge of the slot **1110**, in Figure 44, is closed by a vertically disposed plate **1114** secured, as by screws **1115**, to the right-hand side wall of the cam block **1101** in Figure 44. A pressure block **1116** is secured to a portion of the lower surface of the reverse elevating switch cam **1111** which extends a substantial distance outwardly beyond the block **1101**.

Referring to Figure 45, it will be observed that the switch cam block **1101** has a bore **1117** therein in which a compression spring **1120** is disposed, and in which a spring pressed pin **1121** also has longitudinal sliding movement. The pin **1121** is urged against the block **1116** by the compression spring **1120** to normally urge the reverse elevating switch cam **1111** outwardly with respect to the needle cylinder **103**. The compression spring **1120** also urges the pressure block **1116** into engagement with an eccentrically mounted disk **1122** adjustably secured, as by a screw **1123** (Figures 6, 43 and 44), to one corner of a substantially triangular plate **1124**. Another corner of the plate **1124** is pivotally mounted, as at **1125**, on a strap iron bracket **1126** secured, as by screws **1127**, to the upper surface of the cam or bed plate **110** (Figures 6, 43 and 44).

The remaining corner of the triangularly shaped plate **1124** has the front end of a strap iron link member **1130** pivotally connected thereto, as at **1131**. This strap iron link **1130** is twisted spirally and is then pivotally connected at its rear end, as at **1132**, to a downwardly bent portion of a reverse elevating switch cam control lever **1133** (Figures 5, 6 and 60). This control lever **1133** is very similar to the control levers **777** and **1104** heretofore described, and is also oscillatably mounted on the post **550**. The right-hand end of the control lever **1133**, in Figures 5 and 60, is normally urged into engagement with the periphery of the top auxiliary pattern drum **195** by the compression spring **1120** in the reverse elevating switch cam block **1101** and through intervening connections.

The control lever **1133** is disposed in the same horizontal plane as the lateral space indicated by the numeral **11** in Figure 46, on the top auxiliary pattern drum **195**, and is also disposed in the same horizontal plane as radially spaced cam members **1135** and **1136** suitably secured to the pattern drum **195** (Figure 60). It is obvious that, upon either one of the cam members **1135** or **1136** moving into engagement with the reading end of the control lever **1133**, the control lever **1133** will be caused to partially rotate in a counterclockwise direction, in Figures 5 and 60, and will thus cause the left-hand end thereof to move forwardly in Figure 6. This will transmit partial counterclockwise movement to the substantially triangular plate **1124**, through the link **1130**, to thus cause the eccentrically mounted disk **1122** to move the reverse elevating switch cam **1111** into the path of travel of the needle butts in the needle cylinder **103**.

Individual control for the widening pick 645

At three different times during the knitting of a stocking such as that shown in Figure 88, either all of the needles are lowered by the right-hand widening pick feed cam **647** to traverse pathways as shown in Figure 84 and to thereby pass through the stitch cams or, upon the needles moving from left to right in Figure 80, the left-hand widening pick feed cam **646** is in an inoperative position. Therefore, in the first instance, the needles, as they move from left to right in Figure 80 will be disposed in the plane of the pathway P–1 and will again pass through the stitch cams. In the second instance, although the butts of the needles would be disposed in the horizontal plane of the left-hand narrowing pick feed cam **646**, since this left-hand narrowing pick feed cam **646** is in an inoperative position, the needle butts would continue to traverse a pathway above the stitch cams.

In either event, the right-hand widening pick **645** will have been lowered as shown in Figure 84 by the last leading two of the needles upon the needle cylinder moving in a counterclockwise direction, or as the butts of the needles move from right to left in Figure 84 and, since the butts of the needles will have passed either above or below the left-hand widening pick **644**, in Figure 80, as the needle butts move from left to right, it is thus seen that the left-hand widening pick **644** will retain its elevated position and will therefore have failed to elevate the right-hand widening pick **645** to operative position.

However, it is necessary prior to going into a widening operation, to move the inner end of the right-hand widening pick **645** to elevated position or, in other words, to the position shown in Figure 6, preparatory to the next counterclockwise movement of the needle cylinder **103** in Figure 6, since the right-hand pick feed cam **647** is the first of the two widening pick feed cams **646** and **647** to be moved into operative position to start the widening operation, which occurs upon a counterclockwise revolution of the needle cylinder. The right-hand widening pick **645** must be in elevated or operative position upon this counterclockwise revolution of the needle cylinder **103** so as to be engaged by the butts of the first two needles in a particular group of needles to direct these needles downwardly so they will pass through the stitch cams and to initiate the movement of the widening picks **644** and **645** for a widening operation.

Now, in order to move the free end of the widening pick **645** from the position shown in Figure 86 to the position shown in Figures 6 and 80, a plurality of irregularly spaced pins **1140**, of which there are three shown in Figure 46, have their upper ends threadably imbedded in the bottom plate **196** of the top auxiliary pattern drum **195** and extend downwardly therefrom. Upon counterclockwise step by step movement of the top auxiliary pattern drum **195**, it will be observed that any one of the pins **1140**, in Figure 6, will engage an inwardly bent portion **1144** of a control lever **1145** to thus transmit partial clockwise rotation to the control lever **1145**.

The control lever **1145** is oscillatably mounted as at **1146** on the bed plate **203** (Figures 6 and 12) and is then bent upwardly and then spirally to form an end portion **1147** (Figure 6) which, upon clockwise movement of the control lever **1145**, will move into engagement with the outer end of the widening pick **645** to thus move the same to the position shown in Figure 6. This completes the description of the needle cams and the operating mechanism associated therewith.

Throughout the specification in referring to the top of the stocking, it has been referred to as a rib top or elastic top in many instances. It is to be understood that this invention is not limited to the use of a rib top or to an elastic top but can be employed in a stocking having any desired type of top whether the top be knitted on another machine and transferred to the machine which is the subject of this application or whether it is knitted by the machine in this application prior to going into reciprocatory knitting.

Throughout the specification the type of stocking knitted has been described and referred to largely as the type of stocking shown in Figures 88 to 94, inclusive, however, as is shown schematically in Figure 95, a stocking could be knitted having more than two triangular portions on opposed sides of the stocking but as many triangular portions can be provided around the periphery of the stocking as desired by a change of the cam mechanism and control mechanism of the machine and also a change in the arrangement of the needle butts and the number of notches in the clutch for shogging the needle cylinder.

Method of operation

Now, referring to Figures 88 to 91, inclusive, there is 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 especially arranged for knitting the stocking shown in Figure 88, the method of operation will be given with particular reference to the stocking shown in Figure 88 and to the fabric structure shown in Figures 92, 93, and 94. All of the stockings shown in Figures 88 to 91, inclusive, have the same characteristic parts typical of a half-hose and comprising a rib or elastic top **1250**, a ring top **1251**, a leg or ornamental pattern portion **1252**, a ring heel **1253**, a heel pocket **1254**, a foot **1255** and a toe pocket **1256**.

Briefly, the top **1250**, the ring courses **1251** and **1253** and the foot **1255** of the stockings shown in Figures 88 to 91, inclusive, are all knitted with continuous rotation of the needle cylinder **103**, while the leg **1252**, the heel pocket **1254** and the toe pocket **1256** are knitted with reciprocatory movement of the needle cylinder **103**.

Referring to Figure 94, there is shown a developed view of the leg or ornamental pattern portion **1252** of the stocking shown in Figure 88. After knitting the top **1250** and the ring courses **1251**, a detailed description of which will follow later in this specification, the knitting machine then goes into reciprocatory knitting, during which time a substantially triangular upper gusset B–1 is knitted starting with approximately half the needles and narrowing down to a maximum of four needles after which the needle cylinder **103** is shogged a half revolution during which the needles which have retained the terminal loops along the upper half of the suture line **1260** draw stitches along this line **1260** (Figure 94), and then a second upper gusset B–2 is knitted, similar to the gusset B–1, starting with the other half of the needles and narrowing down to two needles. These gussets B–1 and B–2 shall, for purposes of description, be considered as being knitted of a brown yarn.

The needle cylinder **103** is then shogged a quarter revolution, at which time the upper half of a second shogging suture line **1262** is formed. Then, starting with two needles, an upper triangular portion T–3 is knitted by widening up to a point including substantially half of the needles in the needle cylinder **103**.

This upper triangular portion T–3 is considered as being knitted of a tan yarn and, at the juncture of the upper triangular portion T–3 and a lower triangular portion M–4, the color of the yarn is changed from tan to maroon, and the needle cylinder **103** continues reciprocatory knitting starting with half of the needles and narrowing down to two needles. In each instance of narrowing or widening, herein referred to, the number of needles in a group is decreased or increased, as the case may be by a single needle with each succeeding course.

After knitting the diamond comprising the triangular portions T–3 and M–4, the needle cylinder **103** is shogged a half revolution during which the needles along the suture line **1260** do not draw stitches but merely lay the maroon yarn along this line so as to be surrounded by loops as a portion M–5 and a gusset G–8, to be later described, are knitted thereafter.

The needle cylinder then continues reciprocatory knitting starting with two needles and gradually widening to include half of the needles in the needle cylinder to thus knit the upper triangular portion M–5 which is also knitted with a maroon yarn. A triangular portion T–6 is then knitted of a tan yarn, the color of the yarn changing at the juncture of the triangular portions M–5 and T–6. This triangular portion T–6, is, of course, also knitted by narrowing, starting with half the needles and terminating at a single needle.

Upon knitting the triangular portion T–6, stitches are drawn along the lower half of the shogging suture line **1262** as the needle cylinder is again shogged a quarter of a revolution there being a change in the yarn during the latter shogging operation of the needle cylinder, from tan yarn to green yarn, to cause the needle cylinder to knit a green triangular portion G–7, starting with two needles and widening an additional needle at each succeeding course until the widest part of the triangular portion G–7 includes substantially half of the needles in the needle cylinder.

The shogging suture lines **1260** and **1262**, in Figure 94, have arrows thereon to indicate the direction in which the yarn is either laid along or knitted along the same and the number of arrows indicates the number of times that these suture lines are so affected by the yarn.

Without changing the color of the yarn, the needle cylinder is again shogged a half revolution, during which the yarn is floated along the lower half of the shogging suture line **1260** (Figure 94) in the manner heretofore described for the floating of the yarn for the full length of the shogging suture line **1260** after having knitted the triangle M–4. Then, starting with a single needle and gradually widening to include half of the needles in the needle cylinder **103**, a lower gusset G–8 is knitted on the opposite side of the stocking from the lower gusset G–7.

Now, since the lower gusset G–8 is in vertical alinement with the upper gusset B–1, it is not necessary to again shog the needle cylinder and therefore upon completion of the lower gusset G–8, the needle cylinder immediately goes into rotary knitting to knit the ring courses in the ring heel **1253** of the stocking shown in Figure 88. The heel pocket **1254** is then knitted by the usual widening and narrowing operations, after which the foot **1255** is knitted by rotary knitting and then the toe pocket **1256** is knitted by reciprocatory knitting and by the usual narrowing and widening operations.

For purposes of description, the suture lines **1260** and **1262** are herein referred to as shogging suture lines. The suture line at the juncture of the triangles B–1, T–3 and T–6, G–8 bears the reference character **1264** and the suture line between the triangular portions B–2, M–5 and M–4, G–7 bears the reference character **1266**. The suture line **1264** and **1266** shall be hereinafter referred

to as plain suture lines since no shogging of the needle cylinder is effected along these suture lines **1264** and **1266** although the loops in each course of adjacent portions are interknitted at these suture lines **1264** and **1266** (see Figures 92 and 93).

The manner in which the loops of adjacent triangular portions are interknitted is clearly shown in Figures 92 and 93. In Figure 93 there is shown that section of the fabric at the juncture of the triangular portions B–**1**, B–**2** and T–**3** including the bottom course in the ring top **1251**. In Figure 92 there is shown a section of the fabric at the front of the stocking shown in Figure 88 and at the juncture of the triangular portions B–**2**, M–**5**, T–**3**, T–**6**, M–**4** and G–**7**. The manner of interknitting these portions will be described as the method of operation proceeds, since the interknitting of these portions in the manner shown in Figures 88 and 94 is the result of individual automatic control of each of the movable needle cams in precisely timed relation to the shogging of the needle cylinder.

Rib or elastic top

The manner of introducing the various body yarns Y and the rubber yarn R to the needle circle for knitting the rib or elastic top **1250** and also the manner of elevating and lowering the needles during the knitting of the rib or elastic top is very similar to that shown in U. S. Patent Nos. 1,373,676, of April 5, 1921, and 2,139,606, of December 6, 1938. During all rotary knitting, the conventional gap closer disposed within the latch ring **106** remains in an opened or inoperative position. Upon completing the knitting of the ornamental pattern portion of the last preceding stocking being knitted on the machine, the top auxiliary pattern drum **195** will have stopped with the reading ends of the various control fingers occupying the positions indicated by the circular dots on the corresponding pattern drums **195**, **830** and **121** as shown in Figures 46, 47 and 48, respectively.

It will be noted that the reading end of the gap closer control finger **426** is engaging the periphery of the top auxiliary pattern drum **195**, in Figure 46, at a point between the cam members **421** and **425** which means that the left-hand end of the link member **435**, in Figure 5, will occupy a position forwardly of that shown and thus the tension spring **438** will have urged the connecting rod **443** forwardly in such a manner as to normally open the gap closer. Now, at this time the lower end of the thrust rod **444** (Figure 72) will be in engagement with the periphery of the main pattern drum **121** at a point between the cam members **447** and **449** (Figure 48) thus permitting the thrust rod **444** to remain in a lowered position so that the gap closer may still remain in an opened or inoperative position.

Referring again to Figure 46, it will be noted that the reading ends of the yarn tension control fingers **367** and **365** (Figures 53 and 55), for the brown yarn and the green yarn tension devices **322—5** and **322—3**, respectively (Figure 4), are engaged by their corresponding cam members **410** and **413**, while the reading ends of the yarn tension control fingers **366**, **364** and **363** (Figures 54, 56 and 57, respectively) are in a lowered position, that is, their reading ends are in direct engagement with the periphery of the top auxiliary pattern drum **195**. This means that the control rods **395** and **393** (Figure 4) will be disposed in a raised position while the remaining control rods **394**, **392** and **391** will remain in a lowered position to cause the free ends of the corresponding yarn tension arms **324** to assume a lowered position such as that shown in Figure 3.

It has already been described how the control rod **604** (Figure 3) which cooperates with the control rod **393** for controlling the position of the yarn tension arm **324** associated with the yarn tension device **322—3**, is moved to a lowered position by virtue of the cam member **595** (Figure 75) on the main pattern drum **121**. It is thus seen that during the knitting of the rib top of a stocking only the yarn tension arm **324** associated with the yarn tension device **322—5** (Figures 3 and 4) may be vertically movable and thus responsive to the pull or tension of the yarn as it passes therethrough.

Since the rib top **1250** of the stocking is of the same color as the ring top **1251** (Figure 88), a brown yarn is taken from one of the cones **310** and leads through the yarn tension device **322—5** and then moves downwardly through the corresponding yarn feed finger **335** to the needle circle.

Now, referring to Figures 6 and 46, it will be observed that the reading ends of the yarn feed control fingers **355** and **353** which correspond to the yarn tension control fingers **367** and **365**, respectively, are also engaged at their reading ends, at this time, by the cam members **410** and **413**, respectively, on the top auxiliary pattern drum **195** (Figures 53 and 55). The remaining yarn feed control fingers are, of course, in a lowered position at their reading ends. Ordinarily, this would mean that both of the yarn feed fingers **335** and **333** would be in a lowered or operating position (see Figures 13 and 14). However, the yarn feed finger **333** for the green yarn is, during the knitting of the rib or elastic top and ring top of the stocking, raised by the cam **592** on the main pattern drum **121** (Figures 48 and 74) engaging the lower end of the thrust rod **590** and it is thus seen how the brown yarn only is directed to the needles in the knitting of the rib or elastic top and ring top of a stocking.

Although the lower end of the thrust rod **591** is engaged by the cam member **593**, in Figure 48, which raises the brown yarn feed finger **335** to inoperative position, the main pattern drum **121** is moved a step in rotation upon starting the knitting of a sock to move the cam member **593** out of engagement with the thrust rod **591** (Figure 73). Referring to Figure 48, it will be observed that the reading arm **767** (Figure 70) for controlling the widening pick feed cams **646** and **647** (Figure 80) is in engagement with the cam member **772**, on the main pattern drum **121**, to thus render these widening pick feed cams **646** and **647** inoperative during the knitting of the rib or elastic top and ring top, their manner of operation being later described when they are brought into play.

It has already been stated how the rubber yarn R is directed to the rubber yarn feed finger **577**. Now, at the time of knitting the top of the stocking, the lower end of the thrust rod **584**, in Figure 78, will be in engagement with the periphery of the main pattern drum **121** in the space between the opposed ends of the cam member **585** (Figures 48 and 78). This will, of course, lower the curved upper portion thereof, in Figure 15, to permit the torsion spring **578** to move the free end of the rubber yarn feed finger **577** downwardly to operating position for laying in the elastic yarn R in knitting the top **1250**. Referring to Figure 48, it will also be noted that immediately after the rubber yarn feed finger **577** is permitted to move downwardly to operating position, the thrust rod **587** is engaged by the cam member **586** to open the rubber yarn clamping and cutting device K.

It has already been stated how alternate needles in the needle cylinder have corresponding jacks disposed therebelow. The butts of those needles between the needles having the jacks therebelow, as well as the butts of the alternate needles, both traverse the pathway P–**3** with the exception that upon said alternate needles (Figure 80) moving in the vertical plane of the advancing jack cam **619**, the jacks cause the butts on these alternate needles to traverse the pathway indicated at P–**2**. In order to lower the needles whose butts have been caused to traverse the pathway P–**2**, prior to the butts of these needles passing through the stitch cams and to also lower all of the needles, during the knitting of the top, after their butts have passed through the stitch cams upon entering and traversing a part of the pathway P–**1**, the lower oblique switch cam **972** and the first lowering switch cam **843** are moved into the path of travel of the needle butts during continuous rotation of the needle

cylinder 103. The remainder of the movable needle cams remain in an inoperative position so as to not interfere with the movement of the needle butts through the stitch cams during the knitting of the top of the stocking.

The reason for raising the alternate needles in the vertical plane of the advancing jack cam 619 is to cause these needles to take the rubber yarn R from the rubber yarn feed finger 577 at this point after which they are moved downwardly below the tops of the sinkers and the rubber yarn is then laid in the loops knit with the brown yarn as the needle butts pass through the stitch cams in the central portion of Figure 80. During this operation, the lower oblique switch cam 972 is moved inwardly by the cam member 1012, on the main pattern drum 121 (Figures 48 and 79), engaging the lower end of the thrust rod 1004 having the plate cam 1007 thereon (Figures 6, 24, and 25) which engages the hook member 1005 on the Z-shaped bracket 997 to cause the same to partially rotate in a clockwise direction in Figure 6. This will move the cam 972 into the path of travel of all of the needle butts.

The first lowering switch cam 843 is moved into the path of travel of the needle butts because of the cam 923 (Figures 48 and 71) on the main pattern drum 121 having previously moved out of engagement with the reading arm 915 of the bell crank 911, in Figure 71, and also because the cams 933 and 934 on the top pattern drum 195 (Figure 46) are out of engagement with the control finger 932 (Figure 63), as a result of which the tension spring 913 will cause the bell crank 911 to partially rotate in a clockwise direction, in Figure 71, to permit the connecting rod 905 to move forwardly, thereby permitting the tension spring 896 (Figure 36) to move the first lowering switch cam 843 into operative position.

Although throughout this description I have, at times, referred to a rib top, as a matter of fact a top knitted on this type of machine will not be a rib top but a mock-ribbed top due to the fact that the rubber yarn is laid in to produce this mock rib effect. It is also quite evident, as previously stated, that an ordinary plain top without elastic could be knitted by omitting the rubber yarn and also, as previously stated, a top of any desired type could be knitted on another machine and transferred to this machine if desired.

Ring top

After the top 1250 has been knit in the manner heretofore described, the lower oblique switch cam 972 and the first lowering switch cam 843 are withdrawn from the path of travel of the needle butts, by the cam member 1012 on the main pattern drum 121 moving out of engagement with the thrust rod 1004 and by the cam member 920 (Figures 48 and 71) engaging the reading arm 915 of the bell crank 911, after which a few rounds of circular knitting intervene to knit the usual ring top 1251 before starting pattern work in the leg 1252.

Upon going into the knitting of the ring top 1251, the rubber yarn feed finger 577 will again be moved to inoperative position by means of the corresponding cam member 585 on the main pattern drum 121 (Figures 48 and 78) and, immediately after the rubber yarn feed finger 577 is raised to inoperative position, the conventional clamp and cutter means K is caused to operate because of the cam 586 moving out of engagement with the lower end of the thrust rod 587 (Figure 77). During the knitting of the ring top 1251 of the stocking all needle butts traverse the pathway P–1 in Figure 80.

Since the same color yarn is knitted into the ring top 1251 as is knitted into the elastic top 1250, there is no change effected in the yarn tension devices 322 or the yarn feed fingers 331 to 335 upon going into the knitting of the ring top 1251, although it is obvious that the cams may easily be altered on the top auxiliary pattern drum and the main pattern drum 121 by those skilled in the art so that a different color yarn may be knitted into the ring top from any one of the yarn feed fingers 331 to 335 inclusive.

Knitting the pattern throughout the leg

Since, we will say, the needles in groups *am* and *bs* (Figures 49 and 81) constitute half of the needles in the needle circle that will be employed in knitting the first brown gusset B–1 (Figures 88 and 94), the needles in groups *cm* and *ds* will be raised by the first elevating switch cam 842 during the last complete normal revolution of the needle cylinder 103. Therefore, the first elevating switch cam 842 is moved inwardly so that its butt engaging end is spaced slightly apart from the periphery of the needle cylinder 103 by means of the low point or step 875 of the cam member 872, on the lower auxiliary pattern drum 830, engaging the reading projection 871 on the control arm 870 to thus move the link 865 downwardly in Figures 67 and 31, respectively. This causes the pivoted dog 856 to partially rotate in a counterclockwise direction, in Figure 31, to move the butt engaging end of the first elevating switch cam 842 inwardly in timed relation to the final revolution of the needle cylinder in a counterclockwise direction, in Figure 49, so the butt engaging end of the first elevating switch cam 842 will enter the path of travel of the long and medium butt needles in groups *bs* and *cm* at a point within the arc of the cylinder defined by the short butt needles *bs* (Figure 49).

This will cause all of the long butt needles *lb* and medium butt needles in group *cm*, Figure 49, to be elevated, along with the adjacent long butt needles *lb* in groups *bs* and *ds*. However, as the medium butt needles in group *cm* move past the first elevating switch cam 842, the cam member 872 is moved with the lower auxiliary pattern drum 830 (Figure 67) so the high point of the cam member 872 will engage the reading projection 871 on the control arm 870 to again project the first elevating switch cam 842 inwardly to where its butt engaging end will also be disposed within the path of travel of the short butt needles. Thus, with continued rotation of the needle cylinder 103 in a counterclockwise direction in Figures 6 and 46, all of the needles in groups *cm* and *ds* will successively be elevated by the first elevating switch cam 842, with the exception of the long butt needle *lb* in group *ds* nearest group *am* to traverse a pathway P–4 in Figure 81.

As the short butt needles in group *ds* are moving past the first lowering switch cam 843, during this last counterclockwise revolution of the needle cylinder, the cam member 920 (Figures 48 and 71) on the main pattern drum 121 moves out of engagement with the reading arm 915 of the bell crank 911 to permit the reading arm 915 to move into engagement with the cam member 924 which will in turn, permit the tension spring 896 (Figure 36) to move the first lowering switch cam 843 so its butt engaging end is disposed in slightly spaced relation to the needle cylinder 103, so as to miss the short butt needles but to engage the long butt needles *lb* at the juncture of groups *am* and *ds* and the medium butt needles in group *am*. Thus, the first lowering switch cam 843 directs the long butt needles *lb* at the juncture of groups *am* and *ds* and the medium butt needles in group *am* downwardly so they will pass beneath the lower edge of the first elevating switch cam 842, as the needles move from right to left in Figure 80. At this time, the first lowering cam 843 also lowers the two long butt needles *lb* at the juncture of groups *am* and *bs* in Figure 49. It might be stated that although the needles in groups *am* and *bs*, which were lowered by the first lowering switch cam 843, were not in an elevated position but were in an operative position and, therefore, they were merely lowered further as indicated by the arrows P–3 at the left-hand portion of Figure 80 so they would not be elevated by the first elevating switch cam 842. The first elevating switch cam 842 is then permitted to move to inoperative position because of the cam member 872 on the lower auxiliary pattern drum 830 (Figures 47

and 67) moving out of engagement with the reading projection **871** on the control arm **870** thereby permitting its associated compression spring **854** (Figure 31) to move the same to inoperative position.

Also, during this last counterclockwise revolution of the needle cylinder **103**, in knitting the ring top **1251**, a step in rotation is transmitted to the top auxiliary pattern drum **195**, for the first time in the knitting of a stocking, by means of the ratchet pawl **215** in Figure 8. This first step in movement is transmitted to the top auxiliary pattern drum **195**, causing the same to move in a counterclockwise direction in Figures 5, 6, and 8, the equivalent of one tooth in the ratchet wheel **213**, by one of the pattern lugs **285** on the auxiliary pattern chain **265** engaging the auxiliary pawl control **286** (Figure 8). This will remove the latch bar **296** from engagement with the notch **301** in the front arm **219** of the crank lever **218**. This will, in turn, permit the cam follower **224** to move to the right (Figure 8) against the next adjacent of the cams **227** to **230** by virtue of the tension spring **231**. The spring loaded ratchet pawl **213** will then be conditioned so that upon the next succeeding of the cam members **227** to **230**, inclusive, engaging the cam follower **224**, clockwise rotation will be transmitted to the crank lever **218** to thus impart a step in movement to the top auxiliary pattern drum **195**, in a counterclockwise direction in Figures 5, 6 and 8 and also from left to right in Figure 46.

This first step in rotation, by the top auxiliary pattern drum **195**, will cause the cam member **933** thereon to move into engagement with the reading end of the control finger **932** (Figures 46 and 53) causing the switch cam lever arm **926** in Figures 3, 19, and 71 to move in a clockwise direction, its lower portion bearing against the pin **907** to thus move the connecting rod **905** from right to left in Figures 19 and 71. This will also cause the connecting rod **905** to move rearwardly, in Figure 6, which will transmit partial clockwise rotation to the actuating finger **901** which will engage the pin **895** (Figure 36) to move the first lowering switch cam **843** to inoperative position.

Also, during this same final counterclockwise rotation of the needle cylinder in knitting the ring top **1251**, and with the first step in rotation by the top auxiliary pattern drum **195**, the main pattern drum **121** moves a step in rotation, which is transmitted thereto in a conventional manner, to move its cam member **772** out of engagement with the reading end of the reading arm **767** (Figures 48 and 70). However, at this time, the cam member **781** (Figures 46 and 62) on the top auxiliary pattern drum **195** also moves out of engagement with the reading end of the control finger **777** to thereby permit the tension spring **768** (Figure 6) to move the kick-off control finger **777** in a clockwise direction in Figures 6 and 62 thus moving its vertically disposed ear portion **776** from right to left in Figure 70.

This, of course, will move the bell crank having the arms **765** and **767** in a partial counterclockwise direction, in Figure 70, and will also move the connecting rod **763** rearwardly. This would ordinarily cause the vertically disposed kick-off bar **760** to move forwardly (Figure 22). However, it has already been stated that the cam **772** has just moved out of engagement with the reading end of the reading arm **767** in Figure 70 and, therefore, vertically disposed knockoff bar **760** will already be in a forward position and, therefore, the switch rod **734** and its associated key portion **742** remain out of engagement with the cam member **743** on the annular ring **745** (Figure 10).

Since the knitting machine is about to go into reciprocatory knitting, the first step in rotation of the top auxiliary pattern drum **195** will also cause the cam member **421** to move into engagement with the reading end of the gap closer control finger **426** (Figure 5) to transmit partial clockwise rotation to the arm **435**, in Figure 5, whereby its end portion will engage the collar **440** and move the connecting rod **437** rearwardly. This connecting rod **437** being connected to the bell crank **441** at its front end, will move the same rearwardly at its upper end in Figure 3 to move the conventional gap closer, not shown, disposed within the latch ring **106** to a closed or operative position.

This counterclockwise rotation of the needle cylinder **103** at the termination of the ring top **1251** actually knits the first course **1275** at the top of the gusset B–**1** which will terminate at point *bc* in Figures 88, 93 and 94 or 180 degrees from point *ad* in Figure 93.

After the needles in groups *cm* and *ds* are elevated in the manner heretofore described, by the first elevating switch cam **842**, they move along a pathway P–**4** in Figure 81. It is thus seen that at the final counterclockwise revolution of the needle cylinder **103**, upon completing the ring top **1251** of the stocking, in Figure 88, the needles in groups *am* and *bs* (Figure 49), other than the long butt needle *lb* in group *bs* nearest group *cm*, but including the long butt needle *lb* in group *ds* nearest group *am*, will remain in a lowered or operating position and their butts will traverse a pathway P–**5**, in Figure 81, while the remaining needles will pass above the stitch cams.

Now, upon the first clockwise revolution of the needle cylinder **103**, in reciprocatory knitting, during which the needles move from left to right in Figure 82, the short butt needle in group *bs*, nearest the needles in group *cm* (Figure 49) will engage and be carried upwardly by the left-hand narrowing pick **640**, in a conventional narrowing operation, to traverse a pathway P–**7**, in Figure 82, while the remaining needles in groups *am* and *bs*, plus the long butt needle in group *ds* nearest group *am*, will continue through the stitch cams traversing a pathway P–**6** in Figure 82. This will be repeated with each clockwise movement of the needle cylinder, the leading needle in group *bs* being elevated with each clockwise movement of the needle cylinder. All of the needles that are elevated, traversing the pathway P–**7** in Figure 82, will be elevated to traverse the pathway P–**12**.

It has already been described how the needles in group *am* will gradually be elevated and placed out of action with each counterclockwise revolution of the needle cylinder, during which the needles move from right to left in Figure 83, to cause the butt of the leading needle, which is the long butt needle *lb* in group *ds* nearest group *am* to be elevated by the right-hand narrowing pick **641** to traverse a pathway P–**11**, to be elevated to traverse the pathway P–**12**, while the remaining needles traverse a pathway P–**10** through the stitch cams. It is thus seen that upon each revolution of the needle cylinder in either direction and, incidentally, in the knitting of each additional course in the gusset B–**1** (Figures 88 and 94), another needle will be subtracted from those needles which pass through the stitch cams until, upon the last clockwise revolution of the needle cylinder **103**, in Figures 6 and 49, in knitting the gusset B–**1**, there are five needles remaining in a lowered or operative position.

The leading one of these five needles is elevated by the left-hand narrowing pick **640** to traverse the pathway P–**7** (Figure 82) thus leaving the two long butt needles *lb* at the juncture of groups *am* and *bs* as well as the two adjacent short butt needles in group *bs*, in a lowered operating position to thereby continue on through the stitch cams, traversing the pathway P–**6** in Figure 82 to thus complete the knitting of the gusset B–**1**.

Now, immediately upon the termination of this last lockwise revolution of the needle cylinder and immediately before going into the next succeeding counterclockwise revolution thereof, the right-hand widening pick feed cam **647** is, for the first time, moved into operative position. This is caused by the top auxiliary pattern drum **195** being moved a second step, by the means heretofore described, to move the cam member **791** into engage-

ment with the reading end of the control finger **795**, causing the same to move in a partial clockwise direction in Figure 6. This will move the bunter **801** into engagement with the upper portion of the vertical arm **802** (Figure 33) of the bell crank **803** thus causing the auxiliary bell crank **813** to move the right-hand widening pick feed cam **647** into engagement with the outer vertical surfaces of the butts on the medium butt needles in group *am*. This will cause the auxiliary bell crank **813** to partially rotate in a clockwise direction in Figure 33 to partially distend the tension spring **820**.

Now, the butts on the medium butt needles in group *am*, will move past the innermost end of the right-hand widening pick feed cam **647** in sliding engagement therewith and, since the two long butt needles *lb* at the junctures of groups *am* and *bs*, and the two short butt needles adjacent the same in group *bs*, are in a lowered position, the right-hand widening pick feed cam **647** will move into operative position through the opening caused thereby between the butts of the needles on opposite sides thereof. Now, with continued rotation of the needle cylinder **103**, in a counterclockwise direction, the butts on the leading two of the short butt needles in group *bs*, which have heretofore been in a raised position, will engage the lower surface of the right-hand widening pick feed cam **647** to be moved downwardly by the same whereupon they will engage the right-hand widening pick **645** to be moved downwardly a second time, as shown in Figure 84, and to thereby traverse a pathway **P–16**. The remaining needles in group *bs*, as well as all of the needles in groups *cm* and *ds*, and a few of the needles in group *am* adjacent group *ds*, say, five needles, will be lowered by the right-hand widening pick feed cam **647** so as to cause their butts to traverse a pathway **P–15** in Figure 84.

Now, since the long butt needle *lb* in group *am* nearest group *bs* is the leading needle of the lowered needles, the butt of this leading needle will traverse a pathway **P–14**, in Figure 84, due to the right-hand narrowing pick **641** elevating this first needle, as shown, to cause the first needle to pass above the stitch cams. Also, during the latter counterclockwise movement of the needle cylinder **103**, the top auxiliary pattern drum **195** is moved a third step so as to move the cam member **791** out of engagement with the control finger **795** to again release the right-hand widening pick feed cam **647** so that its compression spring **706** may move the same outwardly to inoperative position.

Since the gusset B–2, in Figures 88 and 94, is knitted of the same color yarn as the gusset B–1 there is no change in the position of the control means for the tension devices **322** and the yarn feed fingers **331** to **335**, inclusive.

First shogging of the needle cylinder

Immediately following the counterclockwise revolution of the needle cylinder **103** during which the right-hand widening pick feed cam **647** was moved into operative position, the right-hand widening pick feed cam **647** is moved to inoperative position in the manner heretofore described, and, at the time of the third step in movement by the pattern drum **195**, the cam member **555** moves into engagement with the shogging control finger **554** (Figures 46 and 66). This will impart partial counterclockwise rotation to the vertically disposed shaft **550**, in Figures 6 and 7, to thus cause the crank arm **542** to transmit partial clockwise rotation to the locking finger **533**, thereby moving the same out of engagement with the notch **522**, with which notch the locking finger **533** is in engagement during the knitting of the elastic top **1250**, ring top **1251** and gusset B–1 of the stocking shown in Figures 88 and 94.

When the locking finger **533** moves out of engagement with the notch **522** on the locking ring **520**, in Figure 10, the needle cylinder **103** is thus caused to cease rotation and, while the needle cylinder **103** is stationary, a fourth step in rotation is transmitted to the top auxiliary pattern drum **195** to move the cam member **964** on the top auxiliary pattern drum **195** (Figures 46 and 64) into engagement with the control finger **954** causing the same to move in a partial counterclockwise direction in Figure 6. Now, the vertically disposed pin **952** will then move the second elevating switch cam **940** into operative position so it will engage the medium and long butt needles but will miss any short butt needles which pass by the same because the needle cylinder will have again started to move in a counterclockwise direction as will be presently described. Thus, the second elevating switch cam **940** will engage the two long butt needles *lb* at the juncture of groups *am* and *ds*, as well as any other needles in group *am* which may have been lowered by the right-hand widening pick feed cam **647** before it was last moved to inoperative position.

Referring to Figure 6, it is obvious that the pin **952** on the control finger **954** will also cause the finger **957** to move inwardly so that immediately after the second elevating switch cam **940** has been moved into operative position, the upper oblique switch cam **971** will be moved into operative position, but being disposed in the radial plane of the long butt needles *lb* only. However, before this upper oblique switch cam **971** has moved into operative position, the two long butt needles *lb* at the juncture of groups *am* and *ds* will have passed by the same and will thus be moved upwardly by the second elevating switch cam **940** as heretofore stated.

At the same time that the cam member **964** moves into engagement with the control finger **954**, the cam member **880** (Figures 46 and 58) moves into engagement with the control finger **882**, causing the same to move in a partial clockwise direction in Figure 5 to move its associated arm **884** in the same direction. This will cause the eccentric cam member **857** to move the first elevating switch cam **842** into operative position. The first elevating switch cam **842** is moved into operative position as the needles in group *am* are moving past the same, as the result of the locking finger **533** having been moved into notch **523** as will be presently described, from right to left in Figures 80 and 81, as heretofore stated, these needles being in an elevated position so as to pass above the same. Thus, the first elevating switch cam **842** will engage the long butt needle *lb* in group *bs* nearest group *am*, moving it upwardly along with all of the short butt needles in group *bs*.

At the same time, the first lowering switch cam **843** is released, in a manner to be presently described, causing the same to move inwardly to where the outer surfaces of the butts on the short butt needles in group *bs* will move in sliding engagement past the same. Thus, the first lowering switch cam **843** will move into engagement with the long butt needles *lb* at the juncture of groups *bs* and *cm* and will move these needles downwardly, along with a few of the needles in group *cm* so their butts will pass beneath the first elevating switch cam **842** and thus will not be elevated by the same. This first lowering switch cam **843** is permitted to move into operative position because the cam member **933**, on the top auxiliary pattern drum **195** moves out of engagement with the control finger **932** upon the fourth step of the pattern drum **195** and at the same time that the cam member **880**, for the needle cam **842**, moves into engagement with the control finger **882**.

Also, at the same time that the control finger **882** for the needle cam **842** is engaged by the cam member **880** on the top auxiliary pattern drum **195**, the cam member **555** moves out of engagement with the control finger **554** (Figures 6, 46 and 66). Upon the knitting of the upper half of the shogging suture line **1260**, in Figure 94, and the uppermost course **1276** in the gusset B–2, both of which occur during the first shogging

operation and in a manner to be presently described, the needle cylinder **103** rotated a complete revolution, at which time the locking finger **533** moved out of engagement with the notch **522** in the locking disk **520** (Figure 10) in the manner heretofore described.

The shaft **153**, in Figure 10, then made a complete revolution in a counterclockwise direction during which time the locking finger **533** was in inoperative position, since this occurred upon the third step by the pattern drum **195**. The shaft **153** then went into another clockwise revolution, in Figure 10, and shortly thereafter, the cam **555** moved out of engagement with the control finger **554**, due to the top auxiliary pattern drum **195** moving said fourth step, thus permitting the compression spring **540** (Figure 7) to move the locking pin **533** into engagement with the periphery of the locking disk **520**, in Figure 10, at a point between the notches **524** and **523** so it would be led into the notch **523** by the corresponding lead-in slot **526**.

The disk **520** will then be rotated an additional half revolution in a clockwise direction, in Figure 10, and will simultaneously impart an additional half revolution to the needle cylinder **103** in a counterclockwise direction, in Figure 6, at which time the needles in groups *cm* and *ds*, except the long butt needle *lb* in group *ds* nearest group *am*, move through the stitch cams thus knitting the uppermost course **1276** in the gusset B–**2** (Figure 94).

It is thus seen that all of the needles remaining in group *bs* after knitting the gusset B–**1**, plus all of the needles in groups *cm* and *ds*, except the long butt needle *lb* in group *ds* nearest group *am*, will be lowered in the shogging operation as heretofore described. Attention is called to the fact that although the needle cylinder **103** rotated a complete revolution and was stopped and then rotated a half revolution, the needle cylinder **103** rotated in the same direction in both instances and, therefore, one and a half revolutions were imparted to the needle cylinder **103** so that instead of the needles *lb* at the juncture of groups *am* and *bs* moving equal distances past the knitting station upon reciprocatory movement of the needle cylinder being resumed, the needles *lb* at the junctures of groups *cm* and *ds* (Figure 49) are then positioned so they will move equal distances past the knitting station.

The revolution, which occurs before the half revolution caused by shogging the needle cylinder, causes the needles in group *bs* to draw stitches along one edge of the gusset B–**1**, which is the right-hand edge thereof, in Figure 94, defined by the upper portion of the shogging suture line **1260**, and, during the remaining revolution of the needle cylinder, the needles in groups *cm* and *ds* except the long butt needle *lb* in group *ds* nearest group *am*, draw a semi-circular row of stitches forming the uppermost course **1276** in the brown gusset B–**2**.

The last revolution made by the needle cylinder **103**, in widening at the toe pocket **1256** of a preceding stocking had been in a clockwise direction to thus cause the butt engaging end of the right-hand widening pick **645** to be disposed in an operative position such as that shown in Figures 6, 80, and 81. Now, during the knitting of the elastic top **1250**, the ring top **1251** and the first gusset B–**1** in the leg **1252** of the stocking shown in Figure 88, the butts of the needles move in a plane either above or below that of the right-hand widening pick **645** so that it will retain its position until engaged by the two needles heretofore described as being the first two needles that are engaged by the right-hand widening pick feed cam **647** causing them to traverse the pathways P–**16** and P–**17** in Figure 84 immediately preceding the first shogging operation.

Knitting gusset B–2

Upon completion of said one and one half revolutions of the needle cylinder during the first shogging operation, the top auxiliary pattern drum is moved a fifth step and, therefore, the needle cams **842**, **843**, **940** and **971**, in Figures 6, 80 and 84, are all withdrawn from operative position and the needle cylinder then goes into reciprocatory knitting during which the narrowing operation again occurs, for knitting the brown gusset B–**2** substantially as shown in Figures 82 and 83, with the exception that the needles in groups *cm* and *ds* (Figure 49) will have assumed the lowered position instead of the needles in groups *am* and *bs* while the needles in groups *am* and *bs* will have assumed an elevated position, their butts traversing the pathway P–**12** formerly assumed by the needles in groups *cm* and *ds*.

The narrowing of the needles then continues throughout the remaining courses, knitting the gusset B–**2** until the two long butt needles *lb* at the juncture of groups *cm* and *ds* pass through the stitch cams, which occurs upon the final clockwise rotation of the needle cylinder **103** in knitting the gusset B–**2**. At this point the top auxiliary pattern drum **195** is moved a sixth step to move its cam member **792** into engagement with the reading end of the control finger **795** to thus impart partial clockwise rotation to the same, in Figure 6, which will, in turn, cause the bunter **801** to engage the vertical leg **802** of the bell crank **803** causing the same to move in a counterclockwise direction in Figure 33 to impart inward movement to the right-hand widening pick feed cam **647** through the bell crank **813** in the manner heretofore described.

This will move the right-hand widening pick feed cam **647** against the butts of the medium butt needles in group *cm*, as they pass thereby in a counterclockwise direction, so as to move into operative position above the butts of the two long butt needles at the juncture of groups *cm* and *ds* to cause the remaining needles in group *ds*, plus the first few in group *am* (Figure 49) to traverse the pathway P–**15**, only, in Figure 84, because the right hand widening pick **645** is still in a lowered position as a result of the first shogging operation.

While the needle cylinder **103** is still in its counterclockwise revolution, the top auxiliary pattern drum is moved a seventh step, in the manner heretofore described, to move the right-hand widening pick feed cam **647** to inoperative position and to move the second elevating switch cam **940** and the upper oblique switch cam **971** into operative position by the cam **965** (Figures 46 and 64) in the manner heretofore described.

Therefore the butts on the short butt needles in group *ds* will continue to move from right to left, in Figure 84, traversing the pathways P–**15** and P–**17** through the stitch cams. The butts of the leading two long butt needles *lb*, at the juncture of groups *am* and *ds* engage cam **971** and are lowered to pass beneath the cam **940** and thus through the stitch cams. The butts on the few medium butt needles in group *am*, which were last lowered by the needle cam **647**, pass between the cam **971** and the needle cylinder but engage and are elevated by the cam **940** to pass above the stitch cams.

Operation of latch opener

It has already been stated that the two long butt needles *lb* at the juncture of groups *am* and *ds*, in Figure 49, were lowered by the upper oblique switch cam 971, which causes them to be moved to a substantially lower elevation than the needles which traverse the pathway P–**15** in Figure 84. Obviously, this would move these two lowered needles to a point where the latches thereon would partially move into the uppermost loops in the last previously knitted course in the fabric and which would partially close the latches on these two needles. Therefore, to insure that the latches on these two needles are opened as these needles are again moved upwardly to pass through the stitch cams, by the hardened cam **627** in Figure 84, the latch opener finger **483** is moved to operative position by the cam member **510** (Figures 6,

46 and 52) engaging the latch opener control finger **501**, causing the same to partially rotate in a clockwise direction, in Figure 6, to thereby permit the spring **491** to move the latch opener finger **483** to operative position as shown in said Patent No. 1,574,703. Although the cam member **510**, in Figures 46 and 52, is shown to be of a length equivalent to substantially three steps in movement by the top auxiliary pattern drum **195**, it is not essential that this latch opener be in operating position other than for opening the latches on the two needles heretofore stated. However, the fact that the latch opener finger **843** remains in operative position for a longer period than is necessary does not indicate that it will interfere with the operation of the rest of the needles in any way whatsoever.

Upon knitting the first counterclockwise course in the top triangular portion T–3, of the stocking shown in Figures 88 and 94, if the latches on these two needles happened to be closed, these two needles would not take the yarn and thus the course would not be knitted thereby and this would cause a hole in the stocking at this point. This hole would actually be the result of two dropped stitches.

Second shogging operation

After knitting the gusset B–2 the needle cylinder is shogged a second time, in substantially the same manner as that described for the first shogging operation, by means of the cam member **556** (Figures 46 and 66) engaging the reading end of the control finger **554**, it being understood that step-by-step rotation has been imparted to the top auxiliary pattern drum **195**, in the manner heretofore described, during which the pattern drum **195** has moved eight steps, so as to move this cam **556** to the position for engaging the reading end of the control finger **554**. Now, all of the needles in group *ds*, including the long butt needle *lb* in group *am* nearest group *ds*, were lowered to operative position during the latter counterclockwise revolution of the needle cylinder, at the termination of which the needle cylinder is stopped, by means to be presently described, for the shogging operation.

After the shogging operation the needle cylinder resumes counterclockwise movement and these needles then pass through the stitch cams while the former remaining lowered long butt needles *lb* at the juncture of groups *ds* and *cm* continue toward the stitch cams, the butt of the leading needle being elevated by the narrowing pick **641** and the long butt needle *lb* in group *ds* moving on through the stitch cams. This counterclockwise movement of the needle cylinder **103** following the shogging operation will draw stitches along the upper half of the shogging suture line **1262** and will knit the uppermost course **1277** in the triangular portion T–3 of the stocking.

Now, in the interim between the counterclockwise movements of the needle cylinder **103** the shogging mechanism (Figure 10) must operate to shog the needle cylinder a quarter revolution. While the needle cylinder **103** is moving in a counterclockwise direction in Figures 6 and 49, the shaft **153** with the shogging disk **527** is moving in a clockwise direction in Figure 10 and the cam **556** on the top auxiliary pattern drum **195** will cause the locking finger **533** to move out of engagement with the notch **523** in the locking disk **520** which will, in turn, cause the needle cylinder to stop in its counterclockwise movement at the end of a revolution as the locking finger **533** simultaneously moves out of engagement with the notch **523**. The needle cylinder then remains stationary while the shaft **153**, with the shogging disk **527**, turns a complete revolution in a counterclockwise direction, in Figure 10, and then goes into another clockwise revolution, in Figure 10, the cam **556**, in Figure 66, being so arranged as to release the locking finger **533** at a point between the notches **522** and **524** upon the top auxiliary pattern drum being moved a ninth step. Thus, the corresponding lead-in slot **526** will guide the locking finger **533** into the notch **524**, as shown in Figure 10, after which a quarter revolution will be imparted to the locking disk **520**, which is the remaining quarter revolution of that particular revolution of the shaft **153**.

Now, since a revolution had previously been imparted to the needle cylinder, this additional quarter revolution imparted thereto, when the locking finger **533** moves into the notch **524**, will result in a total of one and a quarter revolutions being imparted to the needle cylinder to thus shog the needle cylinder a quarter revolution.

Changing color of yarn in suture

It might be again stated that the stitches are drawn along the upper half of the suture line **1262**, in Figure 94, during the second shogging operation. Now, not only the stitches are drawn at this time, but since the gusset B–2 is knitted of a brown yarn and the triangle T–3 is knitted of a tan yarn, the color of the yarn must change during the knitting of the upper half of the shogging suture line **1262** in Figure 94 so the triangular portion T–3 of the leg **1252** may be of a clear solid color different from that of the adjacent gussets B–1 and B–2.

Before moving the yarn feed finger **335** to inoperative position, this yarn feed finger **335** being the finger through which the brown yarn has heretofore been fed to the needles, it is necessary to lower the yarn feed finger **332**, for the tan yarn, to operating position so that both a brown and a tan yarn will be introduced to at least three of the needles at the same time, causing the brown yarn and the tan yarn to overlap each other in knitting the upper half of the suture line **1262**, in Figure 94, so as to insure that one or the other of the brown or tan yarns is being fed to the needles at all times and to thus avoid the occurrence of dropped stitches, which would result in a defective fabric if not avoided. This overlap is shown at **1278** in Figure 93.

Also, during the period in which the tan yarn feed finger **332** is moved to operating position and, until the brown yarn feed finger **335** is moved to inoperative position, the gap closer in the latch ring **106** is moved to opened or inoperative position by the cam member **421** on the top auxiliary pattern drum **195** moving out of engagement with the gap closer control finger **426** (Figures 5 and 46). This permits the spring **438** to move the connecting rod **443** forwardly, moving the gap closer to open position. The cam member **421** (Figure 46) actually moves out of engagement with the control finger **426** at the seventh step in movement by the pattern drum **195** and the cam **422** engages the finger **426** at the ninth step in movement by the pattern drum **195**.

Referring to Figure 46, it will be observed that the cam member **410** on the top auxiliary pattern drum **195**, for controlling the yarn feed finger **335**, for the brown yarn, extends in a vertical plane beyond the leading end of the cam member **415** for controlling the yarn feed finger **332** for the tan yarn. This means that both of the yarn feed fingers **332** and **335** will be in a lowered or operative position simultaneously.

In order to introduce the tan yarn to the needles, the reading ends of the control fingers **352** and **364** are engaged by the cam **415**, on the top auxiliary pattern drum **195**, to thus elevate the control rod **392**, in Figure 4, to release the tension arm **324** associated with the yarn tension device **322—2** and at the same time, to lower the yarn feed finger **332** to operative position through intervening connections as heretofore described.

The yarn feed finger **335** is moved to inoperative position as the ninth step in movement is imparted to the top auxiliary pattern drum **195** and the cam **477** (Figure 51), on the top auxiliary pattern drum **195**, engages the reading end of the clamp and cutter control finger **476** causing the same to move in a counterclockwise direction in Figures 5 and 51, as a result of which partial clockwise movement is imparted to the bell crank having arms **470** and **472** thereon (Figure 70). This

causes the free end of the arm **470** to move upwardly, in Figure 15, in engagement with the right-hand end of the lever arm **465** to condition the clamp and cutter devices **456** and **457**, respectively, for receiving the brown yarn as it is moved into engagement with the same through movement of the needle cylinder, in a manner well known to those familiar with the art, after which the top auxiliary pattern drum **195** moves a tenth step, during which the cam member **477** moves out of engagement with the reading end of the control finger **476**.

When the clamp and cutter control finger **476** is engaged by the cam member **477** on the top auxiliary pattern drum **195**, it is moved outwardly and is engaged by the latch member **466** (Figures 2 and 5) and, therefore, when the cam **477** moves out of engagement with the reading end of the control finger **476**, upon the top auxiliary pattern drum moving an eleventh step, the latch member **466** holds the clamp and cutter control finger **476** out of engagement with the periphery of the top auxiliary pattern drum **195** until the cam member **496** on the cam cylinder **237** engages the lower end of the bell crank **488**, in Figures 2 and 8, causing the same to raise the latch member **466**, in the manner heretofore described, and to thus release the clamping and cutting devices **456** and **457**, respectively, for clamping and cutting the brown yarn.

This delay in the releasing of the clamping and cutting device, after the cam member **477** had moved out of engagement with the control finger **476**, is necessary so that the needle cylinder may advance the brown yarn to a point remote from the knitting point so it will have passed through the clamping and cutting devices **456** and **457** before they are operated. After the brown yarn feed finger **335** has moved to inoperative position, the cam member **422** on the top auxiliary pattern drum engages the control finger **426**, as shown in Figure 5, to return the gap closer to operative or closed position.

It is thus seen that the upper half of the shogging suture line **1262** is knitted by lowering all of the needles in group *ds*, except the long butt needle *lb* nearest group *cm* but including the long butt needle *lb* in group *am* nearest group *ds* (Figure 49) substantially as shown in Figure 84 and, at the same time, introducing the tan yarn to the needle circle and stopping the feeding of the brown yarn to the needle circle, all of which takes place during the second shogging operation of the needle cylinder **103**, which is during its rotation in a counterclockwise direction, in Figures 6 and 49, for one and a quarter revolutions.

Knitting triangle T–3

After knitting the uppermost course **1277** in the triangular portion T–3 (Figure 94) during the second shogging operation in the manner heretofore described, it is necessary that those needles in group *ds* remaining in a lowered position, except the long butt needle in group *ds* nearest group *am*, be elevated to inactive position. The butts on the two long butt needles *lb* at the juncture of groups *am* and *ds* would then engage the reverse oblique switch cam **1070** (Figure 87) to be lowered thereby traversing a pathway P–**18** so as to miss the reverse elevating switch cam **1111**, which will have been moved inwardly toward the needle cylinder, at the tenth step in movement by the top auxiliary pattern drum **195** to a point substantially closer to the periphery of the needle cylinder than that of the reverse oblique switch cam **1070**. The manner of moving the needle cams **1070** and **1111** to operative position will be later described. This will cause the two long butt needles *lb* at the juncture of groups *am* and *ds*, in Figure 49, to continue on toward the stitch cams traversing a pathway P–**19** while the remaining short butt needles, plus the long butt needle *lb* in group *ds* nearest group *cm*, will engage the reverse elevating switch cam **1111**, causing them to traverse a pathway P–**27** (Figure 87), being elevated so as to pass above the top center cam **635**.

The reason the long butt needle *lb* in group *ds* adjacent group *cm* will not be lowered by the cam **1070**, in Figure 87, is that this cam **1070** will be withdrawn from its path of travel by the time this particular needle reaches the same and, therefore, this long butt needle *lb* will engage and be raised by the cam **1111** to inoperative position.

Since the two long butt needles *lb* at the juncture of groups *am* and *ds* will have missed the cam **1111**, the butt on the leading one of these two long butt needles will engage and be elevated by the narrowing pick **640**, traversing a pathway P–*7a* (Figure 87), to pass above the top center cam **635** while the other one of the long butt needles *lb* will continue on through the stitch cams, traversing a pathway P–*6a*, to thus draw a stitch in knitting the second course **1280** in the triangular portion T–3.

Now, in order to move the reverse oblique switch cam **1070** and the reverse elevating switch cam **1111** into the path of travel of the butts on the long butt needles *lb* and the short butt needles, respectively, to elevate the needles in the manner last described, the cam **1105** on the top auxiliary pattern drum **195** (Figures 46 and 61) moves into engagement with the reading end of the control finger **1104** to transmit partial counterclockwise rotation thereto and, at the same time, the cam **1135** on the top auxiliary pattern drum **195** (Figures 46 and 60) moves into engagement with the reading end of the control finger **1133** to also transmit partial counterclockwise rotation thereto in Figure 60.

The left-hand end of the control finger **1104**, in Figures 5 and 6, has the control link **1093** connected thereto (Figure 6) which imparts partial clockwise movement to the actuating finger **1088** to cause its eccentrically positioned disk **1082** to engage and move the reverse oblique switch cam **1070** to a position spaced slightly apart from the needle cylinder so the short butt needles will pass by the same but the long butt needles *lb* will engage the same. Partial counterclockwise movement of the control finger **1133**, by the cam member **1135**, in Figure 60, causes the left-hand end thereof to move forwardly to thus impart partial rotation to the trangular plate **1124** which, in turn, will cause inward movement to be transmitted to the reverse elevating switch cam **1111** so its butt engaging end will be in the path of travel of the needle butts. This conditions the needles in groups *am* and *ds* for knitting the tan triangular portion T–3, in Figures 88 and 94, during which time a widening operation is effected in each course in the manner to be presently described.

During the knitting of the upper half of the suture line **1260** and immediately following the knitting of the gusset B–**1**, in Figure 94, with counterclockwise movement of the needle cylinder, it has already been described how the needles in group *bs* were lowered by the needle cams **647** and **971** to traverse the pathways P–**15** and P–**16** in Figure 84 and, it will be noted that this moves the right-hand widening pick **645** to a lowered position. The lowered needles in group *bs* were then in operating position and, consequently, they passed beneath the widening pick feed cam **646** and its associated widening pick **644**. It is thus seen that the left-hand widening pick **644** will have remained in an elevated position, as shown in Figure 80, which will have caused the right-hand widening pick **645** to remain in a lowered position, since, by referring to Figure 6, it is obvious that if the inner end of the left-hand widening pick **644** has not been moved outwardly to the position shown in Figure 6, its outer end would not have transmitted partial counterclockwise rotation to the swing arm **663**.

Now, therefore, it is necessary that the inner end of the right-hand widening pick **645** be disposed in the position shown in Figure 6 upon the next counterclockwise rotation of the needle cylinder **103**. In order to move the right-hand widening pick **645** to operating or raised posi-

tion, one of the pins **1140** on the bottom of the top auxiliary pattern drum **195** engages the right-hand portion **1144** of the control lever **1145** in Figure 6 during an eleventh step in movement by the top auxiliary pattern drum **195**. This transmits partial clockwise rotation to the control lever **1145** so its left-hand end portion **1147** engages the outer end of the right-hand widening pick **645** to move the same to operating position. This positions the right-hand widening pick **645** so it will be engaged by the leading two of the needles moved downwardly by the right-hand widening pick feed cam **647**, in the manner heretofore described, upon the first counterclockwise rotation of the needle cylinder in knitting the upper portion of the tan triangle T–3 of the stocking in Figures 88 and 94.

Operation of widening pick kick-off

Referring to Figure 70, the cam member **772** on the main pattern drum **121** is in engagement with the reading end of the reading arm **767**, integral with the vertically disposed bell crank arm **765**, during the knitting of the loopers rounds at the toe pocket of a preceding stocking and also, during the knitting of the top **1250**, ring top **1251**, and the gussets B–1 and B–2 of the stocking shown in Figure 88.

Upon going into the knitting of the gusset B–1 (Figures 88 and 94) the cam member **772** will move out of engagement with the reading end of the reading arm **767**. However, the reading end of the reading arm **767** is still prevented from moving into engagement with the peripheral surface of the main pattern drum **121** because the kick-off control finger **777** (Figure 62) is in engagement with the peripheral surface of the top auxiliary pattern drum **195** against which it is urged by the tension spring **768** (Figure 6).

After knitting the second course in the triangle T–3, during which the needle cylinder rotates in a clockwise direction, the top auxiliary pattern drum **195** is moved its eleventh step, by the means heretofore described, to thus move the cam **782** (Figures 46 and 62) into engagement with the reading end of the kick-off control finger **777**, which will cause the portion **776**, in Figure 70, to move from left to right, or forwardly and, since the reading end of the reading arm **767** is poised above the notch **775** between the cam members **771** and **772**, on the main pattern drum **121**, it is obvious that this will permit the tension spring **753** (Figure 3) to move the upper end of the switch rod **734** rearwardly, or to the right in Figure 10, to where its key portion **742** will engage the periphery of the cam ring **745** and its associated cam **743**.

Referring to Figure 22, it is evident that forward movement of the actuating rod **763**, which is permitted in view of the forward movement of the portion **776** of the control finger **777**, in Figure 70, will permit the vertically disposed knock-off bar **760**, on its bar portion **761**, to move rearwardly thus permitting the upper end of the switch bar **734** to move rearwardly in the manner heretofore described.

It has already been described how, during reciprocatory movement of the shaft **153** (Figure 10), the key portion **742** on the switch rod **734** will slidably engage opposed sides of the cam member **743**, alternately, to thus transmit oscillatory movement of the vertically disposed shaft **724** (Figures 6 and 22) through the links **731** and **730** and to thus transmit oscillatory motion to the driven oscillatable arm **721**. This oscillatory movement of the driven oscillatable arm **721** will cause the right-hand widening pick feed cam **647** (Figures 6, 80 and 85) to move into the path of travel of certain of the needle butts upon each counterclockwise revolution of the needle cylinder **103**, in Figure 6, will cause the same to be withdrawn and the left-hand widening pick feed cam **646** to move into the path of travel of the butts on certain of the needles at each clockwise revolution of the needle cylinder in Figure 6.

It has already been stated how the butt on one of the needles in group *ds*, which is the long butt needle *lb* in group *ds* adjacent group *am*, passes through the stitch cams in the same clockwise revolution during which the remaining needles in group *ds* are elevated to inoperative position. Now, by referring to Figure 86, it will be noted that the right-hand widening pick feed cam **647** and the double acting switch cam **970** are in operative position, the right-hand widening pick feed cam **647** being moved into operative position by the driven oscillatable arm **721** and the double acting switch cam **970** being moved into operative position by the cam member **1035** on the top auxiliary pattern drum **195** (Figures 6 and 65) which is also caused by the eleventh step in rotation of the top auxiliary pattern drum **195**. This cam member **1035** transmits partial counterclockwise movement to the control finger **1032** causing the same to move the cam **970** into operative position through intervening connections as clearly shown in Figure 6.

Referring again to Figure 86, there is shown the path of travel of the butts of various of the needles during the knitting of the third course in the triangular portion T–3, which is the first counterclockwise revolution of the needle cylinder following the counterclockwise movement thereof during which the brown yarn was laid along the upper half of the shogging suture line **1262** (Figure 94). The butt on the long butt needle *lb* in the group *ds* nearest group *am*, which was the only needle which passed through the stitch cams upon the last clockwise movement of the needle cylinder, will, upon the needle cylinder making a counterclockwise rotation, traverse a pathway P–**20**, in Figure 86, and will ride up the right-hand stitch cam **637** and will be engaged and carried upwardly by the right-hand narrowing pick **641** to traverse a pathway P–**21**, at the termination of which it will traverse a pathway P–**22**.

In the meantime, the butts of the needles in group *am* will commence movement from right to left in Figure 86 along the pathway P–22 and will engage the right-hand widening pick feed cam **647**. The butts on the leading two of these needles will then be directed to the right-hand widening pick **645** which will carry the butts of these two needles along a pathway P–**24** to enter the pathway P–**20** heretofore described. The butts on the remaining of the raised needles, which have been traversing the pathway P–**23**, will continue along a pathway P–**25** to be elevated by the double acting switch cam **970** to again enter the pathway P–**22** heretofore described. The butts on the two needles, which had been lowered by the right-hand widening pick **645** along the pathway P–**24**, will then traverse the pathway P–**20**, riding up the cam **637** but continuing on through the stitch cams traversing a pathway P–**26** (Figure 86) since the narrowing pick **641** will have previously been moved out of the path of travel of these needles by the preceding needle heretofore described.

Now, referring to Figure 85, it will be observed that upon the next succeeding clockwise revolution of the needle cylinder **103**, and the remaining clockwise revolutions thereof in knitting the triangular portion T–3 (Figure 94), the widening pick feed cams **646** and **647** will have switched positions, by means of the driven oscillatable bar **721**, thus moving the right-hand widening pick feed cam **647** out of the path of travel of the butts of the raised needles and projecting the left-hand widening pick feed cam **646** into the path of travel of the butts of the raised needles. The double acting switch cam **970** retains its position throughout the knitting of the tan triangular portion T–3 regardless of the direction of rotation of the needle cylinder **103**.

The butts of the two needles which had previously passed through the stitch cams, as they moved from right to left in Figure 86, will traverse a pathway P–**30** as they move from left to right in Figure 85. The butt

on the leading needle engages the left-hand narrowing pick **640** to traverse a pathway P–**31** after which it passes above the stitch cams to traverse a pathway P–**32**.

The butts on the leading two needles in group *ds* will, at the same time, traverse a pathway P–**33** and will be directed downwardly by the left-hand widening pick feed cam **646**, to the left-hand widening pick **644**, thus causing the same to traverse a pathway P–**34**, after which they traverse the pathway P–**30**. However, the butts on these needles continue on, traversing a pathway P–**35** through the stitch cams, along with the needle which had previously started its path of travel at the plane of the pathway P–**30**. The butts on the remaining needles in group *ds* will then continue along a pathway P–**36**, since the left-hand widening pick **644** will have previously been lowered out of their path of travel and these remaining needles will be elevated by the reverse leveling cam **1071** to cause their butts to traverse the pathway P–**32** heretofore described.

It might be stated that although the needles in group *am* precede the needles in group *ds*, as the needle cylinder **103** moves in a clockwise direction or from left to right in Figure 85, the widening pick feed cams **646** and **647** are so timed as to change positions so as to engage, under spring pressure the outer edges of the butts on the needles preceding the needles which had previously been lowered. Then upon the previously lowered needles moving past the widening pick feed cams **646** and **647** these cams will move into butt engaging position above the butts of the previously lowered needles. In other words, the widening pick feed cam **646** will bear against the outer surfaces of the needle butts in group *am* and will move into operative position either by engaging and elevating the two long butt needles *lb* at the juncture of groups *am* and *ds* or by moving into the space caused by these two needles having been elevated in a preceding clockwise revolution of the needle cylinder.

It is thus seen, by referring to Figures 85 and 86, that the number of needles knitting the triangular portion T–**3**, of the stocking shown in Figures 88 and 94, will be increased by one additional needle with each course knitted until all of the needles in groups *am* and *ds* plus the long butt needle *lb* in group *bs* nearest *am*, but minus the long butt needle *lb* in group *ds* nearest *cm*, have been lowered to operating position to knit the base course of the triangle T–**3** in Figure 94.

Now, upon knitting the course at the juncture of the two triangular portions T–**3** and M–**4**, the top auxiliary pattern drum is moved its fourteenth step to move the cam member **422** (Figures 5 and 46) out of engagement with the gap closer control finger **426** permitting the gap closer to move to opened position and then the yarn feed finger **331**, for the maroon yarn, is lowered to operating position by the cam member **420** (Figures 46 and 57) on the top auxiliary pattern drum **195**, and through intervening connections in the manner heretofore described. At the same time that the yarn feed finger **331** is moved into operating position, the cam member **420** also engages the yarn tension control finger **363** causing the control rod **391** to be raised thus permitting freedom of movement of the yarn tension arm **324** associated with the yarn tension device **322–1** (Figure 4).

The maroon yarn will then be fed to the needles and the yarn feed finger **332**, for the tan yarn, remains in operating position, so that several of the needles will take both the maroon and the tan yarns, simultaneously, so as to insure that there will always be a supply of yarn fed to the needles and to thereby prevent the occurrence of dropped stitches or pulling out of the yarn end at the juncture of the triangular portions T–**3** and M–**4** which juncture may be anywhere along the line **1281** in Figure 94.

The top auxiliary pattern drum **195** then moves a fifteenth step and moves cam member **415** out of engagement with the reading end of the control fingers **352** and **364** to thus move the yarn feed finger **332** to inoperative position and to move the control rod **392** (Figure 4) downwardly thereby rendering the tension arm **324** associated with the yarn tension device **322–2** inoperative. Also, the cam member **423** moves into engagement with the free end of the gap closer control finger **426** for again closing the gap in the throat of the latch ring.

The clamp and cutter devices **456** and **457**, respectively, (Figures 5 and 15) are then operated, in the manner heretofore described, by the cam member **478** (Figures 46 and 51) having moved into engagement with the control finger **476** at the fourteenth step of the top auxiliary pattern drum **195** and having moved out of engagement therewith at the fifteenth step of the top auxiliary pattern drum **195** for clamping and severing the tan yarn during the knitting of the triangular portions M–**4** and M–**5** in Figure 94.

During the knitting of the course **1281** at the juncture of the triangular portions T–**3** and M–**4**, and at the fifteenth step of the top auxiliary pattern drum **195**, the cam **782** (Figures 46 and 52) on the top auxiliary pattern drum **195** moves out of engagement with the reading end of the control finger **777** to thus permit the tension spring **768** (Figures 6, 50 and 52) to partially rotate the control arm **777** in a clockwise direction in Figure 6, causing the same to move rearwardly in Figure 7. This tension spring **768** is of substantially greater strength than the tension spring **753** (Figure 3) and will thus move the actuating rod **763** rearwardly, in Figure 22, thereby causing the vertically disposed knock-off bar **760** to move forwardly at its right-hand end, in engagement with the link **731** connected to the upper end of the switch rod **734**, and to stop further oscillation of the driven oscillatable arm **721** in Figure 6. Both of the widening pick feed cams **646** and **647** are then moved outwardly to inoperative position by their corresponding compression springs **696** and **706** (Figure 40 and 33, respectively).

If desired, the triangular portion M–**4** could be knitted from the same yarn from which triangular portion T–**3** is knitted to thus dispense with the yarn change just described.

Knitting triangle M–4

At about the same time the course **1281** is knitted at the juncture of the tan and maroon triangular portions T–**3** and M–**4** (Figures 88 and 94), the top auxiliary pattern drum **195** moves said fifteenth step and the cam member **1035** (Figures 46 and 65) moves out of engagement with the reading end **1032***a* of the control finger **1032**, which permits the tension spring **980** (Figures 6 and 26) to move the double acting switch cam **970** out of operating position.

The needles in groups *ds* and *am* then knit the triangular portion M–**4**, an additional needle being subtracted from the beginning of each course in the narrowing operations similar to those shown in Figures 82 and 83 and in the identical manner to that originally described for the needles in groups *am* and *bs*. This narrowing of the needles continues until all the needles have been elevated to inoperative position during the last counterclockwise stroke of the needle cylinder in knitting the triangular portion M–**4** in Figure 94. Also, during this last counterclockwise stroke of the needle cylinder, in knitting the triangular portion M–**4** in Figure 94, the top auxiliary pattern drum **195** will have moved to its nineteenth step to move its cam member **793** (Figures 46 and 59) into engagement with the control finger **795**. This cam member **793** is not as thick as the preceding cam members **791** and **792** heretofore engaged by the control finger **795** and will thus result in the right-hand widening pick feed cam **647** being moved only partially into operative position as the butts of the short butt needles in group *bs* (Figure 49) pass thereby but not engaging the same and to then elevate the two long butt needles *lb* at the juncture of groups *bs* and *cm* along with the medium butt needles in group *cm*.

Prior to the cam member **793** on the top auxiliary pat-

tern drum **195** being moved into engagement with the control finger **795**, the cam member **1036** (Figures 46 and 65) moves into engagement with the reading end **1032***a* of the control finger **1032** for moving the double acting switch cam **970** to operative position in the manner heretofore described.

Therefore, after the two long butt needles at the juncture of groups *bs* and *cm* move from right to left in Figure 86 their butts will be disposed in the plane of the pathway P–**22** and will be directed downwardly by the right-hand widening pick feed cam **647** to move into engagement with the right-hand widening pick **645** and to be moved downwardly traversing the pathway P–**24** and the pathway P–**20** successively to pass through the stitch cams. The leading one of these two long butt needles *lb* at the juncture of groups *bs* and *cm* will not be raised by the narrowing pick **641** at this time due to the fact that all of the needles had been elevated to inoperative position at the time of all of the needles being raised, as heretofore stated, to thus move the right-hand narrowing pick **641** upwardly and since none of the needles were lowered to engage the left-hand narrowing pick **640**, the right-hand narrowing pick **641** could not be moved downwardly to be engaged by the leading one of the two long butt needles *lb*. Now, the remaining medium butt needles in group *cm*, which had been lowered by the right-hand widening pick feed cam **647** in the manner heretofore described, will continue on traversing the pathways P–**25** and P–**22**, successively, in Figure 86, to thus pass above the stitch cams.

It might be stated that this operation takes place during the last counterclockwise revolution of the needle cylinder **103** before going into the third shogging operation and the butts of said needles do not continue on through the stitch cams and above the stitch cams, as the case may be, until after the needle cylinder has stopped for a brief interval, during which the shogging operation takes place, and upon the needle cylinder again resuming a counterclockwise motion.

Since the two long butt needles *lb* at the juncture of groups *am* and *ds* were the last needles to knit in the triangle M–**4**, and the two needles at the juncture of groups *bs* and *cm* will be the first needles to knit in the triangle M–**5**, during the shogging operation, the maroon yarn will merely float from the bottom of the triangle M–**4** along the suture line **1260** to the top of the triangle M–**5**, causing the yarn to lay against the outer surfaces of the needles in suture line **1260** and below the latches thereof so that during the widening operations to be presently described in the knitting of triangular portions M–**5** and G–**8**, as additional needles are called into play the loops of the endmost needles in sections M–**5** and G–**8** will surround the maroon yarn floated along suture line **1260**.

Prior to going into the third shogging operation, the top auxiliary pattern drum **195** moves a twentieth step, a description of the immediately preceding steps is omitted as not being pertinent to this particular pattern, and the cam member **793** moves out of engagement with the control finger **795** permitting the right-hand widening pick feed cam **647** to return to inoperative position in the manner heretofore described.

Third shogging operation

This last counterclockwise movement of the needle cylinder is a part of one and a half revolutions which are transmitted to the same by steps of first a half revolution and then a complete revolution in the interim of which a third shogging operation occurs, in the manner heretofore described. This shogging of the needle cylinder is caused by the cam member **557** (Figures 46 and 66) moving into engagement with the shogging control finger **554** at the twentieth step of the top auxiliary pattern drum **195** and out of engagement therewith on the twenty first step of the pattern drum **195**. This causes the locking finger **533** (Figure 10) to move out of engagement with the notch **524** and finally to be moved into engagement with the notch **525**. There is no change in the color of yarn in traversing the shogging suture line **1260**, extending from the lowermost to the uppermost end thereof in Figure 94.

In the widening operations to be presently described as well as the widening operations heretofore described in knitting the triangular portions of a stocking where it is stated that the courses are widened one needle for each course, it is to be understood that one needle is subtracted at the beginning of each course and two needles are added at the end of the course throughout the operation. In the heretofore described narrowing operations and in narrowing operations to be hereafter described one needle is subtracted at the beginning of each course.

Knitting triangles M–5 and T–6

In knitting the second course in the triangular portion M–**5** (Figures 88 and 94), the leading of the two needles, which had previously passed through the stitch cams upon the needle cylinder moving in a counter clockwise direction following the shogging operation, will upon the first clockwise revolution of the needle cylinder, be elevated along the pathway P–**31**, in Figure 85, while the first two needles in group *bs* adjacent group *cm* will traverse the pathways P–**33**, P–**34**, P–**30** and P–**35**, successively, in the manner heretofore described.

The number of needles knitting in each successive course will be increased by one needle in the widening operation, as heretofore described with reference to Figures 85 and 86, due to cam **783**, at the twenty-first step by the top auxiliary pattern drum **195**, moving into engagement with the kick-off control finger **777**, until all of the needles in groups *bs* and *cm* will have been lowered to operative position to knit the lowermost course in the triangular portion M–**5** at its juncture with the triangular portion T–**6**.

The top auxiliary pattern drum **195** is then moved a twenty-second step in the manner heretofore described, to move the cam member **479** into engagement with the clamp and cuttter control finger **476** to move the same into operative position. At this time, the cam member **423**, (Figure 5) moves out of engagement with the gap closer control finger **426**, permitting the spring **438** to move the gap closer to open position, after which the tan yarn is again introduced to the needles, in the mannere heretofore described, and after both the tan and the maroon yarns have been taken by several of the needles, the maroon yarn feed finger **331** is again moved to inoperative position since the corresponding yarn feed control finger **351** (Figure 57) is no longer engaged by the cam member **420** on the top auxiliary pattern drum **195**. On the other hand, the corresponding control finger **352** (Figure 56) for the tan yarn feed finger **332** will be engaged by the cam member **416** on the top auxiliary pattern drum **195**. It is obvious that the corresponding tension devices **322** will also be controlled in the manner heretofore described by the cam members **420** and **416** as regards the maroon yarn and tan yarn, respectively.

The top auxiliary pattern drum **195** then moves a twenty-third step and the cam member **479** moves out of engagement with the control finger **476** to thus permit the clamp and cutter devices **456** and **457** to clamp and cut the tan yarn.

At the time of knitting the course **1282** at the juncture of the triangular portions M–**5** and T–**6**, the cam member **783** on the top auxiliary pattern drum **195** (Figures 46 and 52) will move out of engagement with the reading end of the control finger **777** to thus cause the key portion **742**, on the switch rod **734** in Figure 10, to move out of engagement with the cam member **743** on the annular ring **745** through the intervening connections shown in Figures 3, 70 and 22, respectively. This will, of course,

permit both of the widening pick feed cams **646** and **647** to be moved outwardly by their corresponding compression springs **686** and **706** (Figures 40 and 33, respectively). This will cause the needles in groups *bs* and *cm* to automatically go into a narrowing operation upon knitting each course, in the manner shown in Figures 82 and 83, until only the butt of the single long butt needle *lb* in group *bs* nearest group *cm* passes through the stitch cams during the last clockwise rotation of the needle cylinder in forming the triangular portion T–6 shown in Figures 88 and 94.

Fourth shogging operation

The needle cylinder **103** is then shogged a fourth time by first moving a quarter revolution in a counterclockwise direction and, after a brief pause, then moving another complete revolution in the same direction by means of the top auxiliary pattern drum **195** advancing through twenty-ninth, thirtieth and thirty-first steps causing the cam member **558** (Figures 46 and 66) to engage the reading end of the control finger **554** to actuate the shogging mechanism shown in Figures 7 and 10 and to move the locking finger **533** out of engagement with the notch **525** and into engagement with the notch **523** in a manner substantially the same as that heretofore described for the second shogging operation. During this one and a quarter revolutions of the needle cylinder **103** in a counterclockwise direction, in Figures 6 and 49, all of the needles in group *cm* must be lowered, plus the long butt needle *lb* in group *ds* adjacent group *cm*, and the color of the yarn is changed from tan to green. This necessitates operation of the gap closer and the clamping and cutting means so as to clamp and cut the tan yarn.

Immediately before the fourth shogging operation, that is, during the first of the two steps in rotation by the needle cylinder during which it is shogged a quarter revolution in a counterclockwise direction in Figures 6 and 49, the right-hand widening pick feed cam **647** is again moved into operative position so the butts of the needles in group *cm*, along with the long butt needle *lb* in group *ds* adjacent group *cm*, will traverse the pathways P–**15** and P–**16** shown in Figure 84. The cam **647** is not moved into operative position far enough to engage the butts on the short butt needles but it will engage the butts on the long and medium butt needles.

It might be stated that during the knitting of the lower half of the shogging suture line **1262**, in Figure 94, during which the needles in group *cm* along with the needle in group *ds* adjacent group *cm* are employed, the two long butt needles *lb* at the juncture of groups *bs* and *cm*, which are the trailing needles of those needles passing through the stitch cams at this time, will knit the uppermost course **1283** in the gusset G–**7**.

The right-hand widening pick feed cam **647** is moved into operative position at this time by the cam member **794** (Figure 59) engaging the reading end of the control finger **795**, at the twenty-seventh step by the top auxiliary pattern drum **195**, thereby transmitting partial clockwise movement to the control finger **794** and causing the bunter **801** (Figure 6) to engage the upper portion of the vertically disposed arm **802** of the bell crank **803** and causing the auxiliary bell crank **813** to move the cam **647** partially into operating position since the cam member **794** (Figures 46 and 59) is of less thickness than the cam members **791** and **792**. Now, after the butts of the needles in group *cm*, plus the long butt needle *lb* in group *ds* nearest group *cm*, have moved past the needle cam **647**, the top auxiliary pattern drum moves its twenty-eighth step, in the manner heretofore described, thus moving the cam member **794** out of engagement with the control finger **795** to release the right-hand widening pick feed cam **647**, permitting the same to return to inoperative position. At the next step of the top auxiliary pattern drum **195**, the cam member **558** engages the reading end of the control finger **554** for actuating the shogging mechanism shown in Figures 7 and 10, in the manner heretofore described.

Also, during the stepped movement of the needle cylinder for one and a quarter revolutions in knitting the lower half of the shogging suture line **1262** and after the lowering of the needles in group *cm*, plus the long butt needle *lb* in group *ds* nearest group *cm*, as they pass through the stitch cams, the top auxiliary pattern drum **195** will have moved in a step-by-step manner, as heretofore described, so as to move the cam member **413** thereon into engagement with the reading end of the control fingers **353** and **365** for moving the yarn feed finger **333** into operating position and for releasing the tension arm **324** on the yarn tension device **322—3** (Figures 3 and 4), so that both the tan and the green yarns will be knitted by a few of the needles, simultaneously, after which the top auxiliary pattern drum **195** moves another step so as to move the cam member **416** thereon out of engagement with the reading ends of the control fingers **352** and **364** (Figures 46 and 56) to thus move the yarn feed finger **332** to inoperative position and to move the yarn tension arm **324** associated with the yarn tension device **322—2** (Figures 3 and 4) downwardly to relax the tension on the yarn in the manner heretofore described.

At the time the yarn feed finger **322** for the tan yarn is moved to inoperative position, the yarn clamping and cutting devices **456** and **457** are again operated by the reading end of the control finger **476** (Figures 46 and 51) having been engaged by the cam member **480** at the thirteenth step of the top auxiliary pattern drum and then this cam member **480** moving out of engagement with the reading end of the control finger **476**, at the thirty-first step of the pattern drum **195**, to operate the clamping and cutting devices **456** and **457** in the manner heretofore described.

This completes the shogging operation in knitting the lower half of the shogging suture line **1262** prior to going into the knitting of the triangular portion G–**7** of the leg **1252** (Figures 88 and 94) but during which the uppermost course **1283** is knitted in the lower gusset G–**7** by the two needles heretofore described.

Now, on the next succeeding movement of the needle cylinder, which is its first clockwise revolution, in Figures 6 and 49, in knitting the second course **1284** at the top of the triangular portion G–**7**, the control fingers **1133** and **1104** (Figures 60 and 61, respectively) are engaged by the cam members **1136** and **1106**, respectively, which also occurs at the thirty-first step of the top auxiliary pattern drum **195**, to again cause the reverse elevating switch cam **1111** and the reverse oblique switch cam **1070**, respectively, to be projected into the path of travel of the needles, in the manner heretofore described, so the long butt needles *lb* at the juncture of groups *ds* and *cm* will engage the cam **1070**, traversing the pathway P–**18** in Figure 87 below the horizontal plane of the lower edge of the cam **1111**. The remaining needles in group *cm* with the long butt needle *lb* in group *bs* adjacent group *cm* will engage and be elevated by the reverse elevating switch cam **1111** to traverse the pathway P–**27** above the stitch cams.

The reverse oblique switch cam **1070** will have moved out of the path of travel of the long butt needles *lb* at the juncture of groups *bs* and *cm* because the top auxiliary pattern drum is moved a thirty-second step during the initial part of which the cam member **1106** will have moved out of engagement with the control finger **1104**, in Figure 61, before the cam member **1136** moves out of engagement with the control finger **1133**, in Figure 60, and, therefore, both of these long butt needles *lb* at the juncture of groups *bs* and *cm* will also be elevated along with the rest of the needles in group *cm*. Now, since the two needles at the juncture of groups *ds* and *cm* will pass beneath the reverse elevating switch cam **1111**, in Figure

87, the first of these needles, which is said long butt needle *lb* in group *ds*, will engage and be elevated by the left-hand narrowing pick **640** while the other long butt needle will continue on through the stitch cams.

The top auxiliary pattern drum continues through its thirty-second step and the cam **1136** (Figure 6) then moves out of engagement with the control finger **1133**, to move the reverse elevating switch cam **1111** out of the path of travel of the needle butts and, at about the same time, the cam **784** (Figures 46 and 62) will engage the reading end of the control finger **777** to again permit the key portion **742** on the switch rod **734** (Figure 10) to move into engagement with the cam ring **745** and the cam **743**, in the manner heretofore described, for transmitting oscillatory motion to the driven oscillatable arm **721** for alternately projecting the widening pick feed cams **646** and **647** into the path of the needle butts *ds* and *cm*, respectively, depending upon the direction of rotation of the needle cylinder, so the needle cylinder may then go into reciprocatory knitting, performing its widening operations so as to increase the number of needles in knitting the gusset G–7 (Figures 88 and 94) in the manner shown in Figures 85 and 86.

It will be observed, in Figure 84, that the right-hand widening pick **645** was moved to a lowered position by the leading two of the needles traversing the pathway P–12 in Figure 84, these leading needles being the leading two of the needles in group *cm*, and upon the next clockwise revolution of the needle cylinder **103**, in Figures 6 and 49, the butts of all of the needles in the needle circle are either above or below the horizontal plane of the left-hand widening pick **644**. Now, since the first widening operation takes place upon the needle cylinder moving in a counterclockwise direction, during the knitting of the gusset G–7, and upon the thirty-first step in rotation by the top auxiliary pattern drum **195**, the second of the pins **1140** (Figures 6 and 46) moves into engagement with the portion **1144** of the control arm **1145** to again cause the same to move the right-hand widening pick **645** to raised or operative position in the manner heretofore described, so as to be disposed in the path of travel of the leading needle butts upon the first counterclockwise revolution of the needle cylinder **103** in the first widening operation relative to the knitting of the gusset G–7 heretofore described.

At the same time that the cam member **784** on the top auxiliary pattern drum **195** engages the control finger **777** for starting oscillatory motion of the driven oscillatable arm **721**, the double acting switch cam **970** is moved into operative position by the cam member **1038** on the top auxiliary pattern drum **195** (Figure 65). This cam member **1038** also transmits partial counterclockwise movement to the control finger **1032** to cause the same to move the needle cam **970** into operative position through the intervening connections which are clearly shown in Figure 6. This double acting switch cam **970** cooperates with the widening pick feed cam **647** in elevating certain of the needles as is clearly shown in Figures 85 and 86.

This widening operation continues until all of the needles in group *cm*, plus the first two adjacent needles in group *bs* and all of the needles in group *ds* minus its long butt needle *lb* nearest group *am*, will have been lowered to operative position with the last counterclockwise movement of the needle cylinder **103** in knitting the gusset G–7.

The fifth shogging operation

This last counterclockwise movement of the needle cylinder **103** in knitting the gusset G–7 is actually the first step in rotation of the needle cylinder **103** prior to the fifth shogging operation and after which another step in the same direction is transmitted to the needle cylinder **103** in a manner to be later described. This first step by the needle cylinder **103** is approximately a half a revolution, after which the needle cylinder **103** pauses momentarily and then continues for another complete revolution in the same direction to complete the shogging operation. However, during this first step by the needle cylinder **103**, the widening pick feed cams **646** and **647** are rendered inoperative by the cam member **784** on the top auxiliary pattern drum **195** moving out of engagement with the control finger **777**, as the top auxiliary pattern drum is moved a thirty-third step, thereby moving the key portion **742** on the switch rod **734** (Figure 10) out of engagement with the annular ring **745** and the cam **743** in the manner heretofore described.

Also, at the same time that the cam member **784** on the top auxiliary pattern drum **195** (Figures 46 and 62) moves out of engagement with the control finger **777**, the cam member **1038** (Figures 46 and 65) moves out of engagement with the reading end **1032***a* of the control finger **1032**. Now, this would ordinarily permit the tension spring **980** (Figures 6 and 26) to move the double acting switch cam **970** to inoperative position.

However, at substantially the same time that the cam member **1038** on the top auxiliary pattern drum **195** moves out of engagement with the reading end **1032***a* of the control finger **1032** (Figure 65), a step in rotation is transmitted to the lower auxiliary pattern drum **830**, which is controlled by the conventional pattern chain **166**, to move the cam member **1060**, on the lower auxiliary pattern drum **830**, into engagement with the reading projection **1052** on the control arm **1051** (Figure 69), causing the link **1044** to move downwardly in Figures 23 and 69. This will transmit partial clockwise rotation to the pivoted L-shaped dog **1040**, in Figure 23, thus causing the upper portion thereof to engage the actuating lever **1025** to cause the double acting switch cam **970** to remain in an operative position for a predetermined period, although the free end of the control finger **1032** (Figure 65) is not being engaged by any one of the cam members **1035** to **1039**, inclusive, on the top auxiliary pattern drum **195**.

At the same time that the right-hand widening pick feed cam **647** moves to inoperative position as a result of the cam member **784** moving out of engagement with the control finger **777**, the cam member **881** on the top auxiliary pattern drum **195** (Figure 46) moves into engagement with the reading end of the control finger **882** to thus move the first elevating switch cam **842** into operative position, as shown in Figure 81, for purposes to be later described.

At the time of knitting the last course in the gusset G–7, the conventional pattern chain **166** transmits the first step in rotation to the main pattern drum **121** to cause its cam member **447** (Figures 48 and 72) to move into engagement with the lower end of the thrust rod **444** to elevate the same so as to condition the same for holding the gap closer in closed position when the top auxiliary pattern drum **195** is finally moved a thirty-sixth step to where the cam member **425** thereon will move out of engagement with the reading end of the control finger **426**, since this movement of the cam member **425** out of engagement with the control finger **426** occurs during the reciprocatory knitting of the lower gusset G–8.

At the same time that the cam member **447** on the main pattern drum **121** moves into engagement with the thrust rod **444** (Figure 72), the cam member **593** on the main pattern drum **121** also moves into engagement with the lower end of the thrust rod **591** to thereby elevate the same so as to condition the same for the final step in rotation of the top auxiliary pattern drum at which time the cam member **410** (Figures 46 and 53) moves into engagement with the control fingers **367** and **355** which would, ordinarily, permit the yarn feed finger **335** to move to operative position which is not desired until after the ring heel **1253**, the heel pocket **1254**, the foot **1255**

and the toe pocket **1256**, along with the loopers rounds have been knitted.

The needle cylinder **103** is then shogged for the fifth time and for a half revolution by first rotating approximately a half revolution in a counterclockwise direction, in Figures 6 and 49, after which the needle cylinder **103** pauses momentarily and then continues for approximately another complete revolution in the same direction as heretofore stated, this being caused by the top auxiliary pattern drum moving a thirty-fourth step so the cam member **559** (Figures 46 and 56) will, through intervening connections, cause the locking finger **533** to move out of engagement with the notch **523** in the locking disk **520** (Figure 10) and to finally move into engagement with the notch **522** in the locking disk **520** as the pattern drum is moved a thirty-fifth step. During this one and one-half revolutions of the needle cylinder in a counterclockwise direction, the needles in group *cm*, plus the first two adjacent needles in group *bs* and all of the needles in group *ds* minus its long butt needle *lb* nearest group *am*, which were last lowered by the widening picks **645** and **644**, are elevated by the first elevating switch cam **842** and the double acting switch cam **970**, in the manner heretofore described and shown in Figure 84.

Now, when the cam member **784** moved out of engagement with the kick-off control finger **777**, at the thirty-third step of the top auxiliary pattern drum, the notch **750** (Figure 10) between opposed ends of the cam member **743** was not positioned in immediate alinement with the key portion **742** on the switch rod **734**. Thus, the movement of the right-hand widening pick feed cam **647** to inoperative position was delayed for a short period after the first elevating switch cam **842** had been moved to operative position. Therefore, if the double acting switch cam **970** had not been in operative position at this time, those needles lowered by the right-hand widening pick feed cam **647** would have continued in a straight horizontal plane and would have passed through the stitch cams. However, these needles, which will have been moved downwardly by the right-hand widening pick feed cam **647**, as well as the needles that are elevated by the first elevating switch cam **842**, will engage and ride up the double acting switch cam **970** to thus pass above the stitch cams substantially as shown in Figures 81 and 86.

Attention is called to the fact that the needles in group *am* will all raise to inoperative position at the time of traversing the lower half of the shogging suture line **1260** between the triangle M–**4** and the gusset G–**8** so that the needles in group *am* will not have drawn stitches along the lower half of this suture line **1260**. Therefore, the green yarn was merely laid-in, engaging the outer surfaces of the needles, to be later surrounded by the loops of the stitches in knitting the lower gusset G–**8**, in the same manner as heretofore described in changing from triangular sections M–**4** to M–**5**.

It will be noted, in Figure 84, that the right-hand widening pick **645** is moved to lowered position by two of the needles in the group of needles which are in the raised position, during the knitting of the last course, in a counter-clockwise direction, in the gusset G–**7**, and which, incidentally, are the leading needles in group *cm* and, therefore, at about the time that the needle cylinder **103** goes into its first clockwise revolution, after the fifth shogging operation and during which all of the needles in the needle circle remain in an elevated position, the portion **1144** of the control arm **1145** is again engaged by the last of the pins **1140**, as the thirty-sixth or final step in movement is transmitted to the top auxiliary pattern drum **195** to move the right-hand widening pick **645** to raised or operative position so as to be engaged by the butts on the two long butt needles *lb* at the juncture of groups *am* and *bs*, which are the leading needles lowered by the right-hand widening pick feed cam **647** upon the next counter-clockwise revolution of the needle cylinder **103** in Figures 6 and 49.

The right-hand widening pick feed cam **647** is moved into operative position at this time by the key portion **742** on the switch rod **734**, in Figure 10, again being moved into operating position relative to the cam **743** on the annular ring **745** by the cam member **781** (Figures 46 and 52), on the top auxiliary pattern drum **195**, engaging the reading end of the control finger **777**, and through intervening connections as heretofore described. The needle cylinder **103** then goes into a widening operation upon each reciprocatory revolution thereof substantially shown in Figures 85 and 86, increasing the needles by one additional needle in each course as heretofore described until all of the needles in groups *am* and *bs* have been lowered to operative position for knitting the lowermost course in the gusset G–**8** to thus complete the knitting of the leg portion **1252** of the stocking shown in Figures 88 and 94.

The main pattern drum **121** and the lower auxiliary pattern drum **830** then move another step, by the means heretofore described. This moves the cam member **771**, in Figure 70, into engagement with the reading arm **767** to again permit the widening pick feed cams **646** and **647** to become inoperative although the control finger **777** is still in engagement with the cam member **781** as has heretofore been described. This completes the knitting of the ornamental pattern portion of the stocking and positions the top auxiliary pattern drum **195** with the indicator **193** (Figure 5) again pointing to the vertically designated line **56** (Figure 46) on the top auxiliary pattern drum **195**, at which time the various control fingers associated with the lateral spaces 1 to 17, in Figure 46, will again occupy the positions indicated by the circular dots in Figure 46.

At the time of knitting the last course in the lower gusset G–**8**, the pattern chain **166** again causes the clutch member **154** to change its position in a conventional manner so as to transmit continuous rotation from the shaft **131** to the main shaft **153** to thus cause the knitting machine to go into rotary knitting.

Also at this same time, the lower auxiliary pattern drum **830**, as well as the main pattern drum **121**, are moved another step to cause the cam member **1060** on the lower auxiliary pattern drum **830** to move out of engagement with the reading projection **1052** on the control arm **1051** permitting the tension spring **1053**, in Figure 23, to move the connecting rod **1044** upwardly to thereby transmit partial counterclockwise movement to the bell crank **1040**. It is obvious that this will move the upper portion of the bell crank **1040** out of engagement with the actuating lever **1025** permitting the same to be moved in a clockwise direction, in Figure6, by virtue of the tension spring **980** associated with the double acting switch cam **970** to thereby permit the cam **970** to move to inoperative position.

Also, at this same time, the cam member **824** on the lower auxiliary pattern drum **830** (Figures 47 and 68) moves into engagement with the reading projection **841** (Figures 68) on the control arm **832**, causing the connecting link **810** to move downwardly to again transmit partial counterclockwise rotation to the bell crank **803** in Figure 33. This will move the arm **814** of the auxiliary bell crank **813** into engagement with the angle clip **710** on the right-hand widening pick feed cam **647** to thereby move the right-hand widening pick feed cam **647** into operative position.

Thus, the right-hand widening pick feed cam **647** will lower all of the remaining elevated needles to operating position during the last counterclockwise rotation of the needle cylinder in knitting the lower course of the gusset G–**8** and also the first ring course in the ring heel **1253** in the stocking shown in Figure 88.

One might assume that from this point on conventional knitting to form the heel, foot and toe portions could be

carried out, but such is not the case in this machine since certain conventional parts have been omitted from this machine and have been replaced by parts controlled by the various pattern control means, the conventional parts being omitted being parts such as conventional switch cams and stopper or widening picks and therefore it is necessary to continue to control the operation of this machine to knit the remainder of the stocking by the lower auxiliary pattern drum and the main pattern drum.

Following the knitting of the first course in the ring heel **1253**, any desired number of courses may then be knitted by rotary knitting to form the ring heel **1253**. Now, during the knitting of the last course in the ring heel **1253**, the conventional pattern chain **166** again causes a step in rotation to be transmitted to the lower auxiliary pattern drum **830** causing the cam member **824** thereon to move out of engagement with the reading projection **841** on the control arm **832** (Figure 58) to thereby permit the right-hand widening pick feed cam **647** to return to inoperative position in the manner heretofore described.

Also, at this time, the step **875** of the cam member **873** on the lower auxiliary pattern drum **830** is moved into engagement with the reading projection **871** on the control arm **870** (Figures 47 and 57) causing the link **865** to move downwardly in Figures 67 and 31, respectively. This will cause the pivoted dog **856** to move in a partial counterclockwise direction, in Figure 31, to move the first elevating switch cam **842** into operative position far enough to engage only the long and medium butt needles, which are the two long butt needles *lb* at the juncture of groups *bs* and *cm*, in Figure 49, as well as the medium butt needles in group *cm*. Now, as the needles in group *cm* move along the needle cam **842**, the reading projection **871** on the control arm **870** is engaged by the high point of the cam member **873** (Figure 67) to again impart additional inward movement to the first elevating switch cam **842** so it will elevate the remaining needles in group *cm* as well as all of the needles in group *ds*, with the exception of the long butt needle *lb* in group *ds* nearest group *am*.

The reason the long butt needles *lb* at the juncture of groups *am* and *ds* are not elevated by the needle cam **842**, is that at the same time the high point of the cam **873**, in Figure 67 moves into engagement with the reading projection **871**, the cam member **921** on the main pattern drum **121** (Figure 71) moves out of engagement with the reading end of the reading arm **915** on the bell crank **911** and the reading arm **915** is urged into engagement with the cam member **925** by the tension spring **913** to permit the first lowering switch cam **843** to move partially into operative position by its tension spring **896** (Figure 36). It might be stated that this first lowering switch cam **843** does not move all the way into operative oposition since the cam member **925** is of such height as to limit this inward movement.

Therefore, this first lowering switch cam **843** will then move the butts of the two long butt needles *lb* at the juncture of groups *am* and *ds*, and a few of the adjacent needles in group *am*, so they will pass beneath the first elevating switch cam **842** at which time the cam member **873** on the lower auxiliary pattern drum **830** (Figures 47 and 67) moves out of engagement with the projection **871** on the control arm **870** to again permit the first elevating switch cam **842** to move to inoperative position and also, at which time, the cam member **922** (Figure 71) on the main pattern drum **121** moves into engagement with the reading end of the reading arm **915** of the bell crank **911** to also move the second switch cam **843** to inoperative position. However, since the needles in groups *am* and *bs* had previously been lowered, immediately upon going into knitting of the ring heel **1253**, those two needles at the juncture of groups *am* and *ds* and the few remaining needles in group *am* that had been lowered by the cam **843** will pass although the stitch cams along with the remaining needles in groups *am* and *bs* but not including the long butt needle *lb* in group *bs* nearest group *cm* since this needle had previously been elevated to pass above the needle cam in the manner heretofore described.

The pattern chain **166** then causes the needle cylinder **103** to again go into reciprocatory knitting in a conventional manner during which the needles in groups *am* and *bs* that had been previously lowered during the knitting of the ring heel are narrowed in the usual manner to form the heel pocket.

It might be stated here that the auxiliary pattern chain **265** serves to control the step-by-step rotation of the auxiliary pattern drum. The auxiliary pattern chain **265** is racked four steps each time the main pattern chain **166** is racked one time, in other words, the auxiliary pattern chain **265** makes four steps of movement for each one step of the main pattern chain **166**.

After knitting the ring heel **1253**, the conventional pattern chain **166** causes the needle cylinder **103** to go into reciprocatory knitting during which the narrowing picks **640** and **641** decrease the number of needles knitting in the forming of the heel pocket substantially in the manner shown in Figures 82 and 83 until a desired number of needles have been taken out of action, after which the cam **771** (Figure 70) moves out of engagement with the reading end of the reading arm **767** permitting the same to fall into the notch **773** on the main pattern drum **121**. This will permit the vertically disposed bell crank arm **765** to move forwardly at its upper end to thus permit the key portion **742** on the switch rod **734** to again move into engagement with the cam **743** and its cam ring **745** (Figure 10) by means of the spring **753** (Figure 3), since forward movement of the upper end of the arm **765** in Figure 70 will allow the intervening connections shown in Figure 22 to respond accordingly to the tension in the tension spring **753**. The double acting switch cam **970** is also moved into operative position, at the time the cam **771** moves out of engagement with the reading arm **767**, by the cam member **1061** on the lower auxiliary pattern drum **830**, in the manner heretofore described.

This will, of course, cause the driven oscillatable arm **721**, in Figure 6, to oscillate with reciprocatory movement of the needle cylinder **103** to perform the widening operations, substantially as shown in Figures 85 and 86, until all of the needles which were elevated by the narrowing picks **640** and **641** are again lowered to operating position.

Another step is then transmitted to the lower auxiliary pattern drum **830**, in the manner heretofore described, to cause its cam member **1061** to move out of engagement with the reading projection **1052** on the control arm **1051** (Figure 69) to thereby release the double acting switch cam **970** permitting the same to return to inoperative position in the manner heretofore described. Upon this same movement of the lower auxiliary pattern drum **830**, the cam member **825** is moved into engagement with the projection **841** on the control arm **832** (Figure 68) to again move the right-hand widening pick feed cam **647** all the way into operative position so as to lower all of the elevated needles, which are those needles which remain inactive during the knitting of the heel pocket. Since all of the needles in the needle circle are now lowered to an operative position, the conventional pattern chain **166** again causes the needle cylinder **103** to go into rotary knitting and at the same time it transmits another step in movement to the main pattern drum **121** to cause the cam member **770** (Figures 48 and 70) to move into engagement with the reading arm **767** to thereby cause the substantially vertically disposed bell crank arm **765** to move from right to left, to move the switch rod **734** and its key **742** to inoperative position and to cause the widening pick feed cams **646** and **647** to remain inactive during this rotary knitting

and during which the foot portion **1255** of the stocking shown in Figure **88** is formed.

After the foot portion **1255** is knitted, the toe pocket **1256** is knitted in the same manner in which the heel pocket was knitted and during which the cam member **874**, in Figure 67, engages the projection **871** on the control arm **870** prior to the narrowing operation, and the cam member **1062** (Figure 69), on the lower auxiliary pattern drum **830**, engages the reading projection **1052** on the control arm **1051** prior to the widening operation. Also, the cam member **826** (Figure 68) engages the reading projection **841** on the control arm **832** immediately after widening to operate the corresponding needles cams **842**, **970** and **647**, respectively.

Now, immediately before going into the knitting of the toe pocket, the needle cam **843** is moved to operative position because of the cam member **922** moving out of engagement with the reading arm **915** of the bell crank **911** in Figure 71 and during the narrowing operation the cam member **923** is again moved into engagement with the reading end of the reading arm **915** of the bell crank **911** to again move the cam member **843** to inoperative position in the same manner in which it is controlled during the knitting of the heel pocket. Also, after the narrowing in the toe pocket, the cam member **770** moves out of engagement with the reading arm **767** in Figure 70, to again effect operation of the winding pick feed cams **646** and **647** in the manner heretofore described with respect to the heel pocket **1254**.

The conventional pattern chain **166** then causes the needle cylinder to go into rotary knitting to knit a few courses beyond the toe pocket, including a first loose course and a plurality of loopers rounds of the stocking.

If desired, ornamental stripes can be formed along the shogging suture line, for example, at the lower edges of portions T–6 and B–2, by shogging a quarter revolution and knitting from the lower point back and forth by reciprocatory knitting between the lower point of portion T–6 and the upper right-hand corner of B–2 as many courses as desired. Also, when portion M–4 is completed, the cylinder can be shogged a quarter revolution and a plurality of courses can be knitted from the lower point of M–4 to the topmost point of portion T–6. Also, if desired, it would not be necessary to knit all the way from the lower point of T–6 to the upper right-hand corner of B–2, but, without shogging, the needles along the lower left-hand edge of T–6 could be raised to inoperative position and the needles along the right-hand lower edge of T–6 could be in operation and several courses could be knitted from the lower corner of T–6 to the upper right-hand corner of T–6. Or, for example, one could shog a quarter revolution after knitting the gusset B–2 and before beginning the knitting of portion T–3, could reciprocate several times and knit a plurality of courses attached to the lower right-hand edge of B–2 to coincide with the border stripe at the right-hand edge of portion T–6 which will be knitted after knitting portions T–3, M–4, M–5 and T–6. Many variations in this form of knitting could be carried out with or without slight changes in the cams on the auxiliary pattern drum.

Gap closer

After the knitting of the gusset G–8, the cam member **447** on the main pattern drum **121** (Figures 48 and 72) moves out of engagement with the lower end of the thrust rod 444 to permit the gap closer to return to open position during the knitting of the ring heel.

Upon completing the knitting of the ring heel **1253**, the cam member **448** on the main pattern drum **121** moves into engagement with the lower end of the thrust rod 441 in Figure 72 to move the gap closer to closed position during the knitting of the heel pocket **1254** and upon the knitting of the heel pocket **1254** being completed, the cam member 448 moves out of engagement with the thrust rod **444** so the gap closer may remain in opened position during the knitting of the foot portion **1255** of the stocking shown in Figure 88.

Upon completion of the knitting of the foot portion and prior to going into the knitting of the toe portion **1256**, the cam member 449 (Figure 72) moves into engagement with the lower end of the thrust rod **444** to again move the gap closer to closed position during reciprocatory knitting of the toe after which the cam member **449** moves out of engagement with the lower end of the thrust rod **444** to again move the gap closer to opened position for the knitting of the loopers rounds, the rib top **1250** and the ring top **1251** after which the gap closer in the latch ring **106** is controlled by the top auxiliary pattern drum **195** in the manner heretofore described.

The conventional clamp and cutter devices **456** and **457** are actuated in a conventional manner by the stepped cam member **461** on the main pattern drum **121** severing the yarn in this manner after the yarn feed finger **333** is moved to inoperative position, and the yarn feed finger **335** for the brown yarn is moved to operative position for starting the top of the succeeding stocking in the manner heretofore described.

The stocking shown in Figure 89 is formed of two colors of yarn. However, this stocking may be knitted on the present machine without changing any of the cams or other parts of the machine from the manner in which these parts are arranged for knitting the stocking shown in Figure 88. The only requirement for knitting the stocking shown in Figure 89 on the machine which was originally set up for knitting the stocking in Figure 88, is to replace the brown yarn and the green yarn in yarn feed fingers **335** and **333**, respectively, with an orange yarn, also replacing the tan yarn in the yard feed finger **332** with a brown yarn and replacing the maroon yarn in the yarn feed finger **331** with a brown yarn.

Referring to Figure 89, the arrangement of the yarns being fed to the yarn feed fingers in the manner described would cause a rear gusset and a front gusset O–1 and O–2, respectively to be knitted of an orange yarn and would cause a brown diamond B–3 to be knitted at opposite sides of the stocking, only one of which is shown in Figure 89. The bottom gussets O–7 and O–8 would be knitted of an orange yarn, as shown in Figure 89, after which the remainder of the stocking would also be knitted of the orange yarn.

Although the yarn feed fingers **331** and **332** would change positions at the time of knitting the widest course in the diamonds B–3, since both of these yarn feed nngers **331** and **332** feed the same colored yarn to the needle circle, the entire area of the diamond B–3 would be the same color. Now, if so desired, the cams on the top auxiliary pattern drum may be changed so that only two of the yarn feed fingers **331** to **335**, inclusive, need be employed in feeding the orange yarn and the brown yarn to the needle circle for knitting the stocking shown in Figure 89.

Referring now to the stocking shown in Figure 91, it will be noted that the ornamental pattern portion **1252** thereof is identical to the ornamental pattern portion **1252** of the stocking shown in Figure 88 and therefore the various sections of the ornamental pattern portion **1252** in Figure 91 will bear the same reference characters as corresponding portions of the stocking shown in Figure 88. The only difference between the ornamental pattern portions **1252** in Figures 88 and 91 is that the stocking in Figure 91 is knitted with the upper and lower ends of the triangular portions T–3 and M–4 being disposed at the front of the stocking instead of at the side of the stocking as shown in Figure 88. In this instance, it is merely necessary to change the relative position of the shogging mechanism and the relative position of the various other related parts of the ma-

chine so that the locking finger 533 will be in engagement with the notch 525 instead of the notch 522 in the locking disk 520 upon going into the reciprocatory knitting of the ornamental pattern portion 1252.

Referring to Figure 90 there is shown another stocking having the ornamental design pattern portion 1252 thereon which includes upper gussets B–11 and B–12 and lower gussets B–23 and B–24 which define diamond shaped areas at opposite sides of the stocking shown in Figure 90, only one side of which is shown. The central portion is then divided into sections G–13, M–14, T–15, M–16 and G–17. The gussets B–11, B–12, B–23 and B–24 as well as the heel, foot and toe portions of the stocking are knitted of a brown yarn while, of the portions defined by the diamond at the center of the stocking shown in Figure 90, the sections G–13 and G–17 are knitted of a green yarn, the sections M–14 and M–15 being knitted of a maroon yarn and the central section T–15 being knitted of a tan yarn.

In order to knit a stocking, the ornamental design portion 1252 of which is knitted of the colors of yarn shown in Figure 90, the present machine may be set up in exactly the same manner in which it is set up for making the stocking shown in Figure 88 with the exception that the cams on the top auxiliary pattern drum 195 for controlling the yarn feed fingers 331 to 335, inclusive, must be changed so as to introduce the various colors of yarn to the stocking in the proper timed relation to produce the effect shown in Figure 90. It is obvious that it is also necessary to rearrange the cam members 421 to 425, inclusive, for the gap closer and the cam members 477 to 480, inclusive, for the clamp and cutter means, since the gap closer must move to inoperative position as each yarn feed finger changes position and the clamp and cutter means must clamp and cut the yarn after knitting each of the portions B–12, G–13, M–14, T–15, M–16 and G–17 in Figure 90.

If desired, the pattern shown in Figures 88 to 91 could be continued through the foot portion after the heel pocket is knitted as it would only entail repeating the rotation of the top auxiliary pattern drum for another round for the foot portion. The pattern such as shown in Figure 95 can also be reproduced on this machine by cutting 8 notches instead of 4 in the clutch member 520, in Figure 10, and by adding a greater number of revolutions to the top auxiliary pattern drum as has heretofore been described. A few of the minor controls which will be apparent to those skilled in the art would be modified, but it is evident that this machine may be employed for knitting other types of stockings than is shown in the drawings and Figure 95 is given as one of the examples.

In Figure 95 there is shown two triangular portions indicated at 1285 and four rectangular portions 1286 and also two rectangular portions 1287 in each side of the stocking. The front and rear portions, respectively, of the stocking would have rectangular portions 1288 and 1289 thereon and also triangular portions 1290, 1291 and 1292. The other side of the stocking would be identical to the side shown in Figure 95.

It is thus seen that many different variegated designs may be knitted into a stocking and although the juncture between different colors of yarn may not be parallel to either the courses or the wales of the stocking, the loops from a previously knitted portion or section of the stocking will be picked up by the needles knitting a succeeding portion of the stocking thus eliminating the necessity of reverse plating the yarns.

Although various attempts have been made to produce an ornamental portion in a stocking wherein the juncture of the ornamental portions extends at an angle relative to the wales and the courses of the knitted fabric, it has heretofore been necessary to provide a seam or an area with several sets of overlapping loops, usually at the rear of the leg of the stocking, which necessity has also been eliminated with the present invention.

A particularly important feature of a stocking produced with the present machine is that the loops at the juncture of the design portions, which juncture extends at an angle relative to the wales and courses of the stocking, are single loops and, therefore, do not form a ridge in the stocking at this juncture, heretofore referred to as the suture of the stocking, since in the succeeding loops of a portion being connected to a previously knitted portion, the knitted portions are looped onto the outermost loops of the preceding knitted portion rather than the loops of adjacent portions overlapping each other as has also been the case heretofore.

Another important feature of the present invention is that the entire stocking, including the top, may be knitted on this machine, the only operation being required to be done on another machine is that of looping at the toe to join the proximate edges of the toe portions.

Throughout the specification the two auxiliary pattern drums have been referred to as the top auxiliary pattern drum and the lower auxiliary pattern drum. In the claims these shall be referred to respectively as the first auxiliary pattern drum and the second auxiliary pattern drum.

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. An improvement in a circular knitting machine having a knitting station and also having a needle cylinder and also having means for selectively transmitting rotary and reciprocatory motion to the needle cylinder, and a plurality of vertically movable needles in the needle cylinder and said knitting machine also having a rotatably and oscillatably driven shaft thereon and a gear on the needle cylinder, said improvement comprising means for shogging the needle cylinder a predetermined amount so as to permit the center of a group of the needles in the needle cylinder to move equi-distant past the knitting station during reciprocatory motion of the needle cylinder and for shogging the needle cylinder so as to cause the vertical center of a succeeding group of needles to move equi-distant past the knitting station said means for shogging the needle cylinder comprising a gear rotatably mounted on the driven shaft and meshing with the gear on the needle cylinder, a locking disk secured to one side of said gear and having a plurality of equally spaced notches cut in the periphery thereof, a shogging disk fixedly mounted on the driven oscillatable shaft and in sliding engagement with the locking disk, a locking finger oscillatably mounted on the periphery of the shogging disk, pattern controlled means for moving the free end of said locking finger on the shogging disk into engagement with one of the notches on the locking disk so as to transmit oscillatory and rotary motion from the shaft through the shogging disk to the gear associated with the locking disk for transmitting reciprocatory and rotary motion to the needle cylinder, said pattern controlled means including means for automatically moving the free end of said locking finger out of engagement with a particular notch in the locking disk to permit the needle cylinder to cease reciprocatory movement although the driven shaft may continue to oscillate and said pattern controlled means again moving the locking finger into engagement with another of said notches in said locking disk to cause the locking disk to resume transmission of reciprocatory motion to the needle cylinder but with the result that a given point on the needle cylinder stops and starts at a different location relative to the rest of the machine than it had previously to the transition of the locking finger to a different notch in the locking disk.

2. In a circular knitting machine having a rotatable

needle cylinder and also having means for alternately transmitting reciprocatory and rotary motion to the needle cylinder, said cylinder having a plurality of vertically movable latch needles having needle butts thereon, said machine also having pattern controlled feed fingers for introducing different yarns to the needles, means for shogging the needle cylinder including moving the needle cylinder through a part of a revolution in one direction and stopping movement of the needle cylinder momentarily and then again transmitting rotation to the needle cylinder in the same direction for a fractional part of a revolution, the combined movements of the needle cylinder before and after the interim between movements thereof being greater than a complete revolution of the needle cylinder, needle cams movable into operable position during the interim between the movements of the needle cylinder in the same direction whereby, upon the needle cylinder resuming reciprocatory or rotary motion said movable needle cams will be disposed in the path of travel of certain of the needle butts.

3. In a circular knitting machine having a needle cylinder, and having means for imparting reciprocatory and rotary motion to said needle cylinder according to a desired pattern and also having a plurality of vertically movable needles carried by the needle cylinder, means for shogging the needle cylinder in steps, each step being a fractional part of a revolution but said steps when combined, including more than a revolution of the needle cylinder, pattern controlled feed fingers for selectively feeding various yarns to the needles in the needle cylinder, stationary stitch cams and other movable needle cams arranged around the needle cylinder, means included in the needle cams for rendering a first selected group of said needles inoperative and for rendering a second selected group of the needles operative so as to knit only a part of a course during reciprocatory knitting, means automatically operable during reciprocatory knitting for successively elevating the needles in said second group of needles to form a first knitted area after which the needle cylinder may be shogged, while a change in yarn is being made in the yarn being fed to the needles, means operable during the shogging of the needle cylinder for lowering certain of the last elevated needles in the second group for drawing stitches thereby and to then elevate these same needles to inoperative position to retain the loops thereon, and pattern controlled means for successively lowering the needles in the first selected group of needles for interknitting a second area of different yarn with the first knitted area.

4. In a circular knitting machine the combination of knitting instrumentalities having a plurality of selecting butts of varying lengths thereon, means for elevating and lowering the knitting instrumentalities, means for controlling the means for elevating and lowering the knitting instrumentalities comprising a first auxiliary pattern drum and a second auxiliary pattern drum, said knitting machine having also a main pattern drum thereon for also controlling the means for elevating and lowering the knitting instrumentalities and said knitting machine also having a conventional pattern controlled means for imparting rotation in a step-by-step manner to the second auxiliary pattern drum, means for transmitting step-by-step rotation to the first auxiliary pattern drum, pattern controlled means to which the means for transmitting step-by-step rotation to the first auxiliary pattern drum is responsive, connections between the first auxiliary pattern drum and the means for elevating and lowering the knitting instrumentalities, connections between the second auxiliary pattern drum and the means for elevating and lowering the knitting instrumentalities, connections between the main pattern drum and the means for elevating and lowering the knitting instrumentalities, and said pattern drums being adapted to override one another during the knitting of different portions of a stocking in controlling the means for elevating and lowering the knitting instrumentalities.

5. In a circular knitting machine having a single feeding station provided with a plurality of yarn feeding means and having a cylinder provided with a plurality of vertically slidable needles, means for imparting rotary and reciprocatory motion to the needle cylinder, means for shogging the needle cylinder a partial revolution so as to cause the center of a group of needles to be disposed adjacent the single feeding station, said shogging means comprising a gear for driving the needle cylinder, a locking disk mounted to rotate said gear and having a plurality of spaced notches in the periphery thereof, a shogging disk disposed in the means for imparting reciprocatory motion to the cylinder, and being in sliding engagement with the locking disk, a locking finger oscillatably mounted on the periphery of the shogging disk, and pattern controlled means for moving the free end of the finger on the shogging disk into engagement with one of the notches on the locking disk so as to transmit oscillatory and rotary motion to the needle cylinder.

6. In a circular knitting machine having a cylinder provided with a plurality of vertically slidable needles, means for imparting rotary and reciprocatory motion to the needle cylinder, means for shogging the needle cylinder a partial revolution so as to cause the center of a group of needles to be disposed adjacent the throat plate of the knitting machine, said shogging means comprising a gear for driving the needle cylinder, a locking disk mounted to rotate with said gear and having a plurality of spaced notches in the periphery thereof, a shogging disk disposed in the means for imparting reciprocatory motion to the cylinder and being in sliding engagement with the locking disk, a locking finger oscillatably mounted on the periphery of the shogging disk, pattern controlled means for moving the free end of the finger on the shogging disk into engagement with one of the notches on the locking disk so as to transmit oscillatory and rotary motion to the needle cylinder, said pattern controlled means including means for automatically moving the free end of the locking finger out of engagement with a particular notch in the locking disk to cause the needle cylinder to cease reciprocatory movement although the oscillating means may continue to rotate, said pattern controlled means serving to again move the locking finger into engagement with another of said notches in the locking disk to cause the locking disk to resume movement of the needle cylinder but with the result that a given point on the needle cylinder stops at a different location relative to the throat plate of the machine.

7. In a circular knitting machine having a needle cylinder provided with a plurality of vertically slidable needles and having means for imparting rotary movement to the needle cylinder as well as means for imparting reciprocatory movement to the needle cylinder, a pair of spaced widening pickers universally mounted on said machine at their ends furthest from the needle cylinder, an oscillatable member mounted adjacent the needle cylinder and having opposite ends thereof engaging the widening pickers, one of the pickers being engageable by the outer face of the needles upon reciprocatory movement of the needle cylinder in one direction and also being engageable by the butts on certain needles to lower the needles whereby engagement by the needles with the latter picker will swing the oscillatable member and cause the picker on the other end thereof to move into the path of the needles upon their return movement to lower the needles passing thereby.

8. In a circular knitting machine having a needle cylinder provided with a plurality of vertically slidable needles and having means for imparting rotary movement to the needle cylinder as well as means for imparting reciprocatory movement to the needle cylinder, an oscillatable member mounted adjacent the needle cylinder, a

pair of widening pickers mounted for horizontal and vertical movement on said machine and engaging opposite ends of the oscillatable member, one of the pickers being engageable by the outer face of the needles upon reciprocatory movement of the needle cylinder in one direction and also being engageable by the butts on certain needles to lower the needles whereby engagement by the needles with the latter picker will swing the oscillatable member and cause the picker on the other end thereof to move into the path of the needles upon their return movement to lower the needles passing thereby, and each of said pickers being provided with a notch in its lower surface of such depth that a picker will engage only two needles to lower the same before being pushed outwardly to oscillate the oscillatable member.

9. In a circular knitting machine having a needle cylinder provided with a plurality of vertically slidable needles and having means for imparting rotary movement to the needle cylinder as well as means for imparting reciprocatory movement to the needle cylinder, an oscillatable member mounted adjacent the needle cylinder, a pair of spaced widening pickers mounted for horizontal and vertical movement on said machine, each of the widening pickers slidably engaging an end of the oscillatable member, one of the pickers being engageable by the outer face of the needles upon reciprocatory movement of the needle cylinder in one direction and also being engageable by the butts on certain needles to lower the needles whereby engagement by the needles with the latter picker will swing the oscillatable member and cause the picker on the other end thereof to move into the path of the needles upon their return movement to lower the needles passing thereby, each of said pickers being provided with a notch in its lower surface of such depth that a picker will engage only two needles to lower the same before being pushed outwardly to oscillate the oscillatable member, a pair of independently movable widening pick feed cams disposed in close proximity to the pickers for directing certain needles to either of the widening pickers, and pattern controlled means for controlling the widening pick feed cams.

10. In a circular knitting machine having a needle cylinder provided with a plurality of vertical slidable needles and having means for imparting rotary movement to the needle cylinder as well as means for imparting reciprocatory movement to the needle cylinder, a pair of spaced widening pickers mounted on said machine adjacent the needle cylinder, an oscillatable member mounted adjacent the needle cylinder and having slidable engagement with a widening picker on each end thereof, one of the pickers being engageable by the outer face of the needles upon reciprocatory movement of the needle cylinder in one direction and also being engageable by butts on certain needles to lower the needles whereby engagement by the needles with the latter picker will swing the oscillatable member and cause the picker on the other end thereof to move into the path of the needles upon their return movement to lower the needles passing thereby, said pickers being mounted for horizontal and vertical movement, each picker being provided with a notch in its lower surface of such depth that a picker will engage only two needles to lower the same before being pushed outwardly to oscillate the oscillatable member, a pair of radially movable widening pick feed cams disposed adjacent the pickers and the needle cylinder for directing certain needles to either of the pickers, and means for alternately moving the widening pick feed cams into operative position.

11. In a circular knitting machine having a needle cylinder provided with a plurality of vertically slidable needles and having means for imparting rotary movement to the needle cylinder as well as means for imparting reciprocatory movement to the needle cylinder, a pair of spaced widening pickers disposed adjacent the needle cylinder, an oscillatable member mounted adjacent the needle cylinder and having a widening picker in sliding engagement with each end thereof, one of the pickers being engageable by the outer face of the needles upon reciprocatory movement of the needle cylinder in one direction and also being engageable by the butts on certain needles to lower the needles whereby engagement by the needles with the latter picker will swing the oscillatable member and cause the picker on the other end therof to move into the path of the needles upon their return movement to lower the needles passing thereby, said pickers being mounted for horizontal and vertical movement, each picker being provided with a notch in its lower surface of such depth that a picker will engage only two needles to lower the same before being pushed outwardly to oscillate the oscillatable member, a pair of independently movable widening pick feed cams disposed in close proximity to the pickers for directing certain needles to either of the widening pickers, pattern controlled means for controlling the widening pick feed cams, and means responsive to said pattern control means for alternately moving the widening pick feed cams into operative position.

12. In a circular knitting machine having a needle cylinder provided with a plurality of vertically slidable needles and having means for imparting rotary movement to the needle cylinder as well as means for imparting reciprocatory movement to the needle cylinder, said machine also having a main pattern drum and auxiliary pattern means, a pair of spaced widening pickers disposed adjacent the needle cylinder, an oscillatable member mounted adjacent the needle cylinder and having a widening picker slidably engaging each end thereof, one of the pickers being engageable by the outer face of the needles upon reciprocatory movement of the needle cylinder in one direction and also bring engageable by the butts on certain needles to lower the needles whereby engagement by the needles with the latter picker will swing the oscillatable member and cause the picker on the other end thereof to move into the path of the needles upon their return movement to lower the needles passing thereby, said pickers being mounted for horizontal and vertical movement and each picker being provided with a notch in its lower surface of such depth that a picker will engage only two needles to lower the same before being pushed outwardly by the needles to oscillate the oscillatable member, a pair of independently movable widening pick feed cams disposed in close proximity to the pickers for directing certain needles to either of the widening pickers, means for alternately moving the widening pick feed cams into operative position, and kick-off means controlled by the auxiliary pattern means and the main pattern drum at different times for rendering the means for alternately moving the widening pick feed cams into operative position inoperative.

13. In a knitting machine having a needle cylinder provided with a plurality of vertically movable needles therein and having means for imparting rotary or oscillatory movement thereto and all of the needles having butts thereon, a pair of spaced widening pick feed cams disposed adjacent the needle cylinder, an oscillatable member mounted adjacent the exterior of the needle circle and having slidable engagement with the pair of widening pick feed cams, means for alternately moving one of the widening pick feed cams to operative position for lowering certain of the needles for purposes other than widening, a first auxiliary pattern drum, a second auxiliary pattern drum and independent means controlled by either of the two auxiliary pattern drums for independently controlling the operation of the widening pick feed cams.

14. In a knitting machine having a needle cylinder provided with a plurality of vertically movable needles therein and having means for imparting rotary or oscillatory movement thereto and all of the needles having butts thereon, a pair of spaced widening pick feed cams disposed adjacent the needle cylinder, an oscillatable member mounted adjacent the exterior of the needle circle and hav-

ing slidable engagement with the pair of widening pick feed cams, means for alternately moving one of the widening pick feed cams to operative position for lowering certain of the needles for purposes other than widening, a first auxiliary pattern drum, a second auxiliary pattern drum, independent means controlled by either of the two auxiliary pattern drums for independently controlling the operation of the widening pick feed cams, a resilient connection between the first auxiliary pattern drum and one of the widening pick feed cams, said resilient connection also being disposed between the second auxiliary pattern drum and the widening pick feed cams so the widening pick feed cams may be urged against the peripheral edges of a plurality of needle butts so as to be conditioned for moving into operative position and as these particular needles pass by the widening pick cam in sliding engagement for acting upon the butts of succeeding needles so that the latches of the succeeding needles will be at an operative level.

15. In a knitting machine having a needle cylinder provided with a plurality of vertically movable needles therein and having means for imparting rotary or oscillatory movement thereto and all of the needles having butts thereon, and oscillatable member mounted adjacent the exterior of the needle circle, a pair of widening pick feed cams adjacent the periphery of the needle cylinder and engageable by the ends of the oscillatable member, means for alternately moving one of the widening pick feed cams to operative position for lowering certain of the needles for purposes other than widening, the widening pick feed cams being movable by the oscillatable member, a first auxiliary pattern drum and a second auxiliary pattern drum and independent means controlled by each of the two auxiliary pattern drums for independently controlling the operation of the widening pick feed cams, a resilient connection between the first auxiliary pattern drum and one of the widening pick feed cams, said resilient connection also being disposed between the second auxiliary pattern drum and the widening pick feed cams so the widening pick feed cams may be urged against the peripheral edges of a plurality of needle butts so as to be conditioned for moving into operative position and these particular needles pass by the widening pick cam in sliding engagement for acting upon the butts of succeeding needles so that the succeeding needles will be at an operative level, and means controlled by the first auxiliary pattern drum for at times moving one of the pick feed cams all the way into operative position so that it will operate upon all of the needle butts and at other times to move said widening pick feed cam only partially into operative position so it will operate only upon certain of the needle butts which are longer than the rest of the needle butts.

16. In a knitting machine having a needle cylinder provided with a plurality of needles divided into groups having different length butts, including long butts, thereon, means for imparting both circular and reciprocatory knitting to the needle cylinder, means for feeding different yarns to different groups of needles, means for feeding yarn to a group of the needles including at least one long butt needle while the cylinder is engaged in reciprocatory knitting and means for shogging the cylinder varying distances to present other groups of needles each including at least one long butt needle to knitting position to receive and knit a different yarn.

17. In a knitting machine having a needle cylinder provided with a plurality of needles divided into groups having different length butts, including long butts, thereon, means for imparting both circular and reciprocatory knitting to the needle cylinder, means to independently feed different yarns to the needles including means for feeding yarn to a group of the needles including at least one long butt needle while the cylinder is engaged in reciprocatory knitting, pattern controlled means for successively shogging the cylinder varying parts of a revolution to present different groups of needles each including at least one long butt needle to knitting position to receive and knit a different yarn and means for varying the number of needles placed into operation from course to course to vary the length of the courses during reciprocatory knitting.

18. In a needle cylinder provided with a plurality of vertically slidable needles therein, said needles being disposed in groups and each group having different length butts from the needles of an adjacent group, a pair of widening picks disposed outside the needle circle and being movable into engagement with at least some of the butts on the needles in the needle circle, means to move either pick into inoperative position upon the other of the picks moving into operative position and pattern controlled means for moving at least one of the widening picks into operative position upon having previously been moved into inoperative position and upon failure of the other of the widening picks to move the first of the widening picks into operative position.

19. In a circular knitting machine having a needle cylinder with a plurality of vertically slidable needles therein, the needles being divided into groups, some of the groups having short butt needles and others of the groups having medium butt needles and at least one long butt needle disposed between each adjacent pair of said groups, means for widening and narrowing by respectively increasing and decreasing the number of active needles in a group of needles during reciprocatory knitting for knitting partial courses, means for raising terminal needles employed in knitting each partial course for retaining the loops thereon, cam means for engaging only long butt needles to lower the same in a knitting operation at the beginning or end of a widening operation, and other cam means for engaging the medium butt needles and the long butt needles to perform a knitting operation without engaging the short butt needles.

20. In a knitting machine having a rotary needle cylinder provided with vertically slidable independently operable needles therein and the needles being divided into long butt groups, short butt groups and at least two medium butt groups, said long butt groups each including one or more needles defining a juncture between adjacent short and medium butt groups, means for imparting reciprocatory motion to the needle cylinder, means for lowering all of the needles in either of the medium butt groups independently of the needles in the remaining medium butt group to operating level along with the long butt needles which define the ends of the courses being knitted during reciprocatory knitting, and means for elevating endmost needles knitting a course during reciprocatory knitting for retaining the loops thereon.

21. In a knitting machine having a rotary needle cylinder provided with vertically slidable independently operable needles therein and the needles being divided into long butt groups, short butt groups and at least two medium butt groups, said long butt groups each including one or more needles defining a juncture between adjacent short and medium butt groups, means for imparting reciprocatory motion to the needle cylinder, means for lowering all of the needles in either of the medium butt groups independently of the needles in the other medium butt groups to operating level along with the long butt needles which define the ends of courses being knitted during reciprocatory knitting, means for elevating endmost needles knitting a course during reciprocatory knitting for retaining loops thereon, cam means for lowering all of the needles in two adjacent medium and short butt groups and including long butt needles at the opposed ends of the lowered medium and short butt groups, means for elevating the leading one of the long butt needles to inoperative position while the remaining needles in the medium and short butt groups continue to move through an operating level, and pattern controlled means for intercepting the butts of the trailing long butt needles to move the same to inoperative position resulting in only

the medium butt and short butt needles continuing to move through an operating level.

22. In a knitting machine having a rotary needle cylinder provided with vertically slidable independently operable needles therein and the needles being divided into long butt groups, short butt groups and medium butt groups, said long butt groups each including one or more needles defining a juncture between adjacent short and medium butt groups, means for imparting reciprocatory motion to the needle cylinder, means for lowering all of the needles in either of the medium butt groups independently of the needles in the other medium butt groups to operating level along with the long butt needles which define the ends of courses being knitted during reciprocatory knitting, means for elevating endmost needles knitting a course during reciprocatory knitting for retaining the loops thereon, and other pattern controlled means for elevating all of the short, medium and long butt needles with the exception of a single long butt needle during a single revolution of the needle cylinder during reciprocatory knitting.

23. In a circular knitting machine having a needle cylinder provided with a plurality of needles and a feeding station having a plurality of yarn feed fingers for feeding yarn to the needles, the needles in the needle cylinder being divided into substantially four quadrants with alternate quadrants having medium butt needles and the other quadrants having short butt needles, one or more long butt needles interposed between the quadrants of needles, means for selectively positioning the needle cylinder with long butt needles so they move equidistant past the yarn feeding fingers through which yarn is being fed during reciprocatory knitting, means for elevating all of the needles in the needle cylinder to inoperative position, means for lowering the long butt needles between two quadrants of needles at the beginning of reciprocatory knitting to knit the yarn thereon, means for elevating at least one additional needle in each course for each reciprocation to retain the loops thereon throughout the knitting of a plurality of partial courses, means for shogging the cylinder to present to the feeding station another set of long butt needles disposed between one of the quadrants of needles just used and an additional quadrant so that when reciprocatory motion is imparted to the cylinder, additional needles of the new quadrant will be called into play while additional needles of one of the quadrants just used will be called into play to knit another portion of fabric and to thus interknit terminal loops of the portion just knitted with the new portion of fabric being knitted.

24. In a circular knitting machine having a needle cylinder provided with a plurality of needles and a single feeding station having a plurality of yarn feed fingers for feeding yarn to the needles, the needles in the needle cylinder being divided into substantially four quadrants with alternate quadrants having medium butt needles and the other quadrants having short butt needles, one or more long butt needles interposed between the quadrants of needles, means for selectively positioning the needle cylinder with long butt needles so they move equi-distant past the yarn feeding fingers through which yarn is being fed during reciprocatory knitting, means for elevating all of the needles in the needle cylinder to inoperative position, means for lowering the long butt needles between two quadrants of needles at the beginning of reciprocatory knitting to knit the yarn thereon, means for lessening the number of needles used in knitting each course for each reciprocation, means causing outermost needles in each course to retain the loops thereon throughout the knitting of a plurality of partial courses, means for shogging the needle cylinder to present another set of long butt needles disposed between two new quadrants of needles to the feeding station whereby, during reciprocatory knitting, additional needles in each course will be called into play to take the yarns, and means for causing terminal needles knitting in each course to interknit the loops thereon with terminal loops being knitted by the said two new quadrants of needles.

25. In a knitting machine having a needle cylinder and a plurality of vertically movable latch needles therein provided with suitable butts, a first elevating switch cam mounted outside the needle circle and adapted to slide inwardly into engagement with the butts of certain needles, said machine having a main pattern drum and a first auxiliary pattern drum and a second auxiliary pattern drum, means controlled by the first auxiliary pattern drum for controlling the first elevating switch cam, means controlled by the second auxiliary pattern drum for controlling the first elevating switch cam during portions of knitting during which the means controlled by the first auxiliary pattern drum are inoperative for controlling said first elevating switch cam.

26. In a knitting machine having a needle cylinder and a plurality of vertically movable latch needles therein provided with suitable butts, a first and second elevating switch cam mounted outside the needle circle and adapted to slide inwardly into engagement with the butts of certain needles, said machine having a main pattern drum and a first auxiliary pattern drum and a second auxiliary pattern drum, means controlled by the first auxiliary pattern drum for controlling the first elevating switch cam, means controlled by the second auxiliary pattern drum for controlling the first elevating switch cam during other portions of knitting during which the means controlled by the first auxiliary pattern drum are inoperative for controlling said first elevating switch cam, means also controlled by the first auxiliary pattern drum for controlling the second elevating switch cam, other means controlled by the second auxiliary pattern drum for controlling the second elevating switch cam when the means controlled by the first auxiliary pattern drum is inoperative.

27. In a knitting machine having a rotary needle cylinder provided with a plurality of vertically slidable latch needles therein divided into groups of long butt needles, short butt needles and medium butt needles and having a main pattern drum and a first auxiliary pattern drum and a second auxiliary pattern drum and having a reverse lowering switch cam and a reverse elevating switch cam disposed adjacent each other, the lower edge of the reverse lowering switch cam being at a lower level than the lower edge of the reverse elevating switch cam, means controlled by the main pattern drum for moving the reverse lowering switch cam inwardly to a point where it will engage only the long butt needles so they will travel in a path below the reverse elevating switch cam and whereby the reverse elevating switch cam will engage the medium and short butt needles to elevate the same and thus cause the long butt needles only to be directed to the stitch cams.

28. In a knitting machine having a rotary needle cylinder provided with a plurality of vertically slidable latch needles therein divided into groups of long butt needles, short butt needles and medium butt needles and having a main pattern drum and a first auxiliary pattern drum and a second auxiliary pattern drum and having a reverse lowering switch cam and a reverse elevating switch cam disposed adjacent each other, the lower edge of the reverse lowering switch cam being at a lower level than the lower edge of the reverse elevating switch cam, means controlled by the main pattern drum for moving the reverse lowering switch cam inwardly to a point where it will engage only the long butt needles so they will travel in a path below the reverse elevating switch cam and whereby the reverse elevating switch cam will engage the medium and short butt needles to elevate the same and thus cause the long butt needles only to be directed to the stitch cams, the reverse lowering switch cam being movable inwardly and outwardly in quick succession to engage only the long butt needless and to be retracted from the

needle cylinder to allow all other long butt needles in the needle circle to be passed thereby without being lowered.

29. In a knitting machine having a single feeding station having a plurality of yarn feed fingers and having a needle cylinder provided with a plurality of needles divided into groups having different length butts, including long butts, thereon, means for imparting both circular and reciprocatory motion to the needle cylinder, means for feeding yarn to a group of the needles including at least one long butt needle while the cylinder is engaged in reciprocatory knitting and means for successively shogging the cylinder varying parts of a revolution to present other groups of needles each including at least one long butt needle to the feeding station independently of each other to receive and knit different yarn.

30. In a knitting machine for knitting tubular articles, said machine having a single feeding station having a plurality of yarn feed fingers and having a needle cylinder provided with a plurality of needles divided into groups having different length butts, including long butts, thereon, means for imparting both circular and reciprocatory motion to the needle cylinder, means for feeding yarn to a group of the needles including at least one long butt needle while the cylinder is engaged in reciprocatory knitting, means for shogging the cylinder in increments of less than a half revolution a plurality of times during the knitting of a single article to successively present different groups of needles each including at least one long butt needle to the feeding station to receive and knit different yarns, and means for varying the number of needles in operation from course to course to vary the length of the courses during reciprocatory knitting.

31. In a knitting machine having a needle cylinder and a plurality of vertically slidable latch needles therein, the needles being divided into sections and having different length butts and one or more long butt needles disposed between two adjacent sections of needles having shorter butts thereon, a plurality of means for feeding various yarns to a single point on the needle circle, means for feeding yarn to a section of needles and causing the yarn to be knit on one or more long butt needles, means for causing reciprocation of the needle cylinder and raising at least one marginal needle knitting in each partial course to inoperative position to retain the loops thereon until all of the needles are in inoperative position, means for shogging the needle cylinder to place in knitting position another section of needles, the long butt needle or needles associated therewith being in the center of the section, and causing reciprocatory knitting, means for effecting lowering of selected needles to knitting position beginning when all the needles except long butt needles are in inoperative position and lowering the needles to operating position and lowering at least one marginal needle to operative position on each counterclockwise movement of the cylinder until a predetermined number of needles have been lowered to operative position, means to stop the lowering of the needles when a desired number of needles have been lowered and means for continuing reciprocatory knitting, means for raising one needle to inoperative position upon such reciprocatory movement of the cylinder until all the needles have been raised to inoperative position.

32. In a circular knitting machine having a needle cylinder provided with a plurality of needles and having a plurality of yarn feed fingers for feeding yarn to the needles, in the needle cylinder being divided into substantially four quadrants with alternate quadrants having medium butt needles and the other quadrants having short butt needles, one or more long butt needles interposed between the quadrants of needles, means for positioning the needle cylinder with long butt needles so they move equidistant past the yarn feeding fingers through which yarn is being fed during reciprocatory knitting, means for elevating all of the needles in the needle cylinder to inoperative position, and means for lowering the long butt needles between two quadrants of needles at the beginning of reciprocatory knitting to knit the yarn thereon, means for calling into play at least one additional needle in each course for each reciprocation, and means causing an outermost needle knitting in each course to draw the initial loop through a previously knitted loop in a suture throughout the knitting of a plurality of partial courses.

33. In a knitting machine having a needle cylinder and yarn feed fingers for feeding yarn to the needles in the needle cylinder, said machine also having means for imparting rotary and reciprocatory movement to the needle cylinder, and wherein, normally, a given point on the needle cylinder moves equi-distant past the yarn feed fingers during reciprocation of the cylinder, the needles in the needle cylinder being divided into a plurality of sections some of which have long butt needles, others of which have short butt needles and others of which have medium butt needles, means for rendering all of the needles operable during circular knitting and means for rendering only a portion of the needles operable during reciprocatory knitting, means for raising a portion of the needles to inoperative position prior to going into reciprocatory knitting and widening and narrowing means for rendering operative and inoperative additional needles along the edges of a section of needles to vary the width of a segment of fabric being knitted and retaining endmost loops on endmost of the inoperative needles, means for shogging the cylinder in varying increments to successively present other points on the needle cylinder to the yarn feed fingers, and means for imparting reciprocatory motion to the needle cylinder subsequent to shogging the needle cylinder to knit additional segments of fabric whereby endmost loops at one edge of a knitted segment may be interknitted with endmost loops at the adjacent edge of another segment of fabric.

34. In a circular knitting machine having a needle cylinder with a plurality of vertically slidable needles therein, the needles being divided into groups, some of the groups having short butt needles and others of the groups having medium butt needles and at least one long butt needle disposed between each adjacent pair of said groups, means for widening and narrowing by respectively increasing and decreasing the number of active needles in a group of needles during reciprocatory knitting for knitting partial courses, means for raising at least one terminal needle employed in knitting each partial course while decreasing the number of active needles from course to course for retaining the loops thereon, and cam means for engaging only long butt needles to lower the same in a knitting operation at the beginning or end of a widening operation.

35. An improvement in a circular knitting machine having a knitting station and also having a needle cylinder and also having means for selectively transmitting rotary and reciprocatory motion to the needle cylinder, and a plurality of vertically movable needles in the needle cylinder and said knitting machine also having a rotatably and oscillatably driven shaft thereon and a gear on the needle cylinder, said improvement comprising means for shogging the needle cylinder a predetermined amount so as to permit the center of a group of the needles in the needle cylinder to move equi-distant past the knitting station during reciprocatory motion of the needle cylinder and for shogging the needle cylinder so as to cause the center of a succeeding group of needles to move equidistant past the knitting station, said means for shogging the needle cylinder comprising a gear rotatably mounted on the driven shaft and meshing with the gear on the needle cylinder, a locking disk secured to one side of said gear and having a plurality of equally spaced notches cut in the periphery thereof, a shogging disk fixedly mounted on the driven oscillatable shaft and in sliding engagement with the locking disk, a locking finger oscillatably mounted on the periphery of the shogging disk, pat-

tern controlled means for moving the free end of said locking finger on the shogging disk into engagement with one of the notches on the locking disk so as to transmit oscillatory and rotary motion from the shaft through the shogging disk to the gear associated with the locking disk for transmitting reciprocatory and rotary motion to the needle cylinder, said pattern controlled means including means for automatically moving the free end of said locking finger out of engagement with a particular notch in the locking disk to permit the needle cylinder to cease reciprocatory movement although the driven shaft may continue to oscillate and said pattern controlled means again moving the locking finger into engagement with another of said notches in said locking disk to cause the locking disk to resume transmission of reciprocatory motion to the needle cylinder but with the result that a given point on the needle cylinder stops and starts at a different location relative to the rest of the machine than it had previously to the transition of the locking finger to a different notch in the locking disk.

36. In a knitting machine having a needle cylinder, a plurality of vertically movable needles therein, the needles being divided into sections and having different length butts and one or more long butt needles disposed between adjacent sections of needles having shorter butts thereon, means for feeding yarn to a single point on the needle circle, means for feeding yarn to a section of needles and to cause the yarn to be knit on one or more long butt needles, means for causing reciprocation of the cylinder and raising at least one marginal needle knitting in each partial course to inoperative position to retain the loops thereon until all the needles are in inoperative position, means for shogging the cylinder to place another section

of needles in knitting position and for causing reciprocatory knitting, the long butt needle or needles thereof being in the center of the last-named section, means for effecting lowering of selected needles to knitting position beginning when all the needles except long butt needles are in inoperative position and for lowering at least one marginal needle to operative position on each movement of the cylinder in either direction until a predetermined number of needles have been lowered to operative position, means to stop the lowering of the needles when a desired number of needles have been lowered, means for continuing reciprocatory knitting, and means for raising one needle to inoperative position upon each reciprocatory movement of the cylinder until all the needles have been raised to inoperative position.

References Cited in the file of this patent

UNITED STATES PATENTS

1,238,052	Scott	Aug. 21, 1917
1,306,523	Childrey	June 10, 1919
1,574,703	Scott	Feb. 23, 1926
1,685,860	Page	Oct. 2, 1928
1,721,824	Lerner	July 23, 1929
1,853,519	Page	Apr. 12, 1932
1,945,227	Montagne et al.	Jan. 30, 1934
2,143,952	Lawson et al	Jan. 17, 1939
2,217,022	Lawson et al.	Oct. 8, 1940
2,254,409	Allen	Sept. 2, 1941
2,260,650	Allen	Oct. 28, 1941
2,287,131	Redeen	June 23, 1942
2,378,315	Minton	June 12, 1945
2,527,534	Ellis	Oct. 31, 1950