May 18, 1965 F. H. J. BEEREN ETAL 3,184,158

GARMENT CUTTING MACHINE AND METHOD

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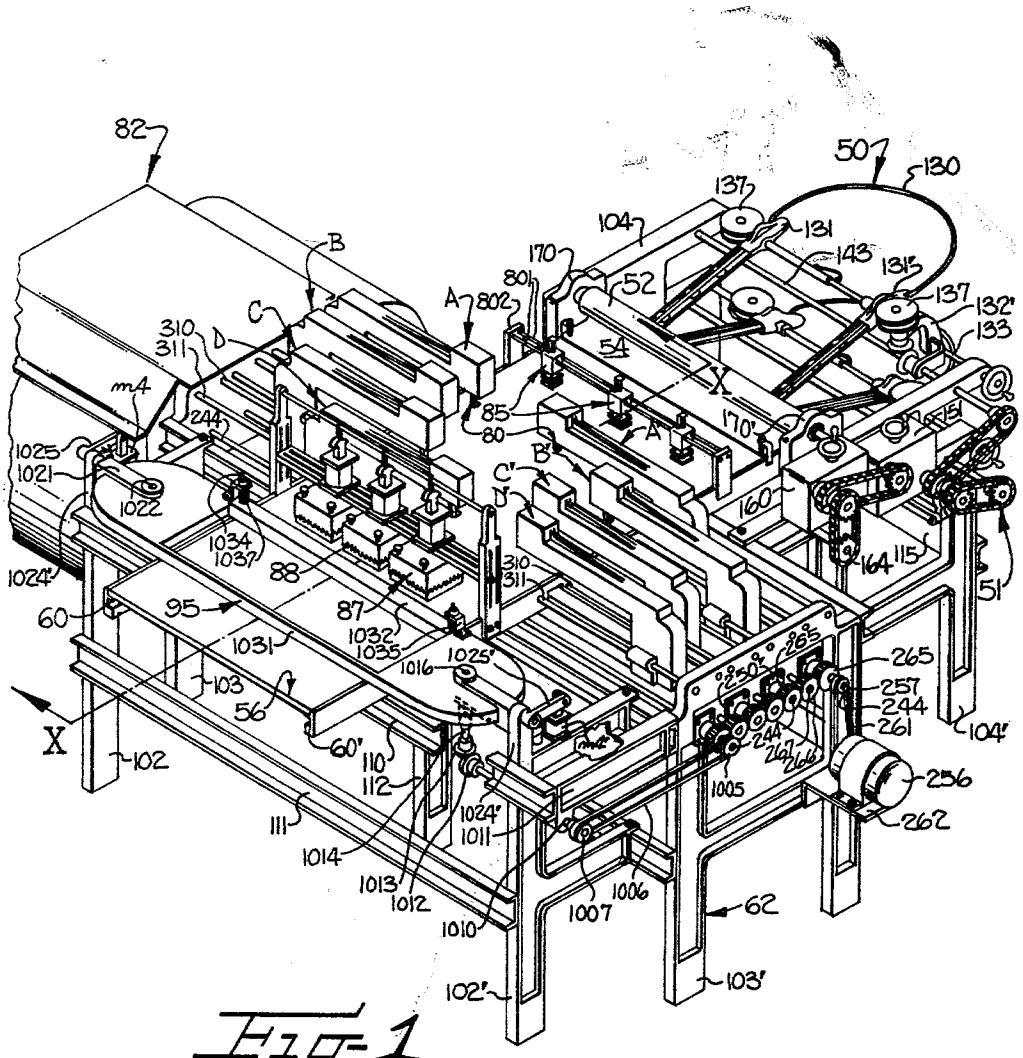


Fig-1

INVENTORS:
FRANCISCUS H. J. BEEREN
and WILLIAM BAIN

BY Eaton, Bell, Hunt & Seltzer

ATTORNEYS

May 18, 1965 F. H. J. BEEREN ETAL 3,184,158

GARMENT CUTTING MACHINE AND METHOD

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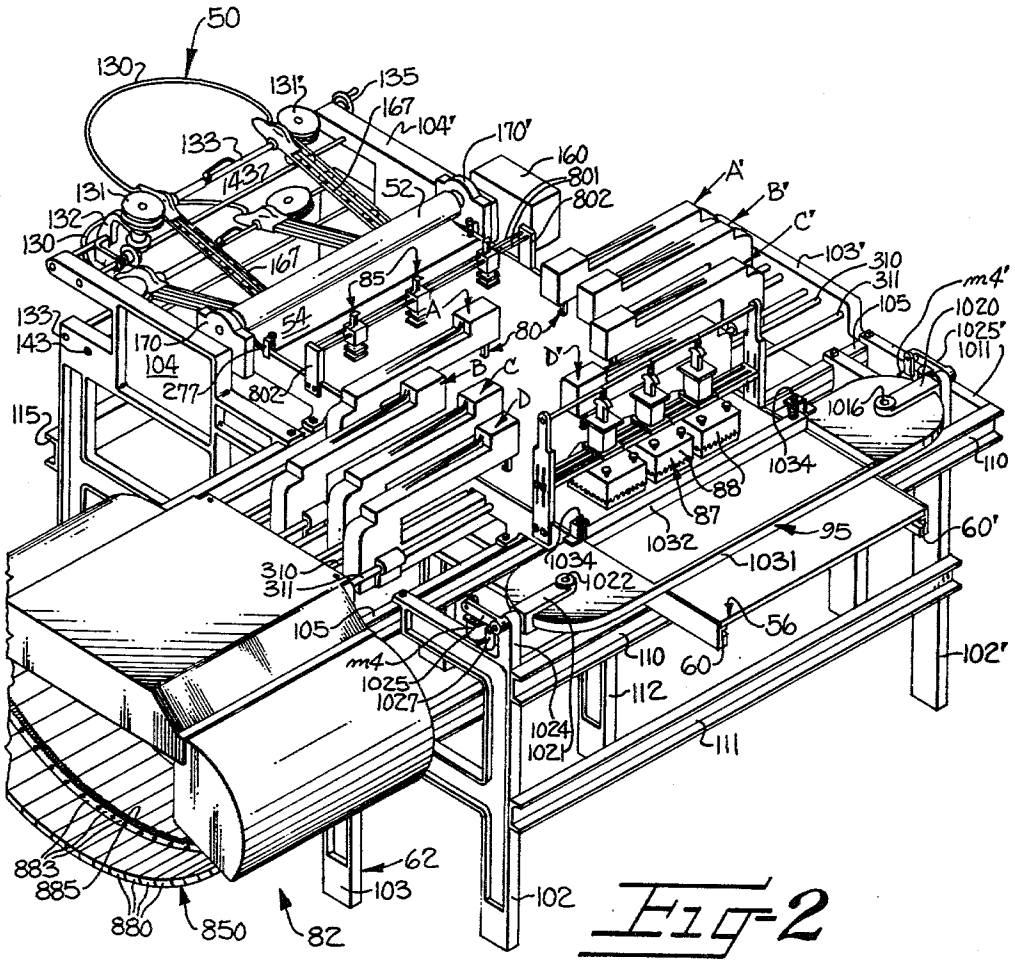


Fig-2

INVENTORS:
FRANCISCUS H. J. BEEREN
and WILLIAM BAIN

BY Eaton, Bell, Hunt & Selzer

ATTORNEYS

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GARMENT CUTTING MACHINE AND METHOD

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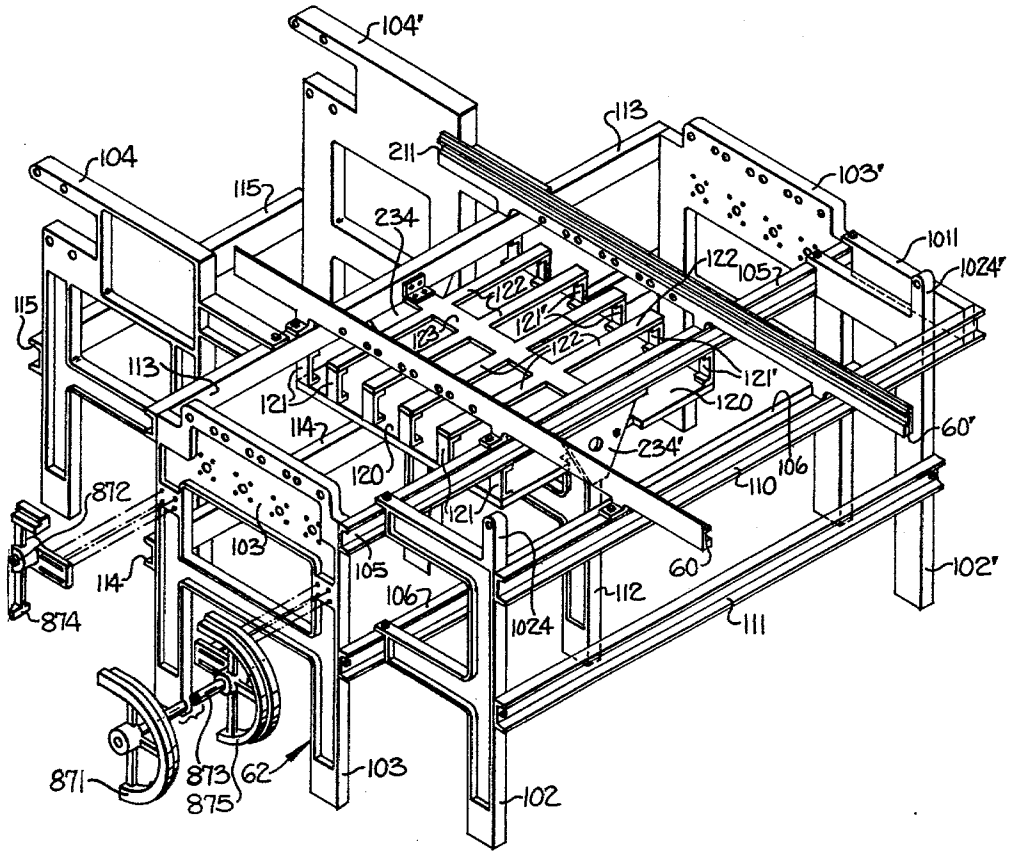


FIG-3

INVENTORS:
FRANCISCUS H. J. BEEREN
and WILLIAM BAIN

BY Eaton, Bell, Hunt & Seltzer
ATTORNEYS

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GARMENT CUTTING MACHINE AND METHOD

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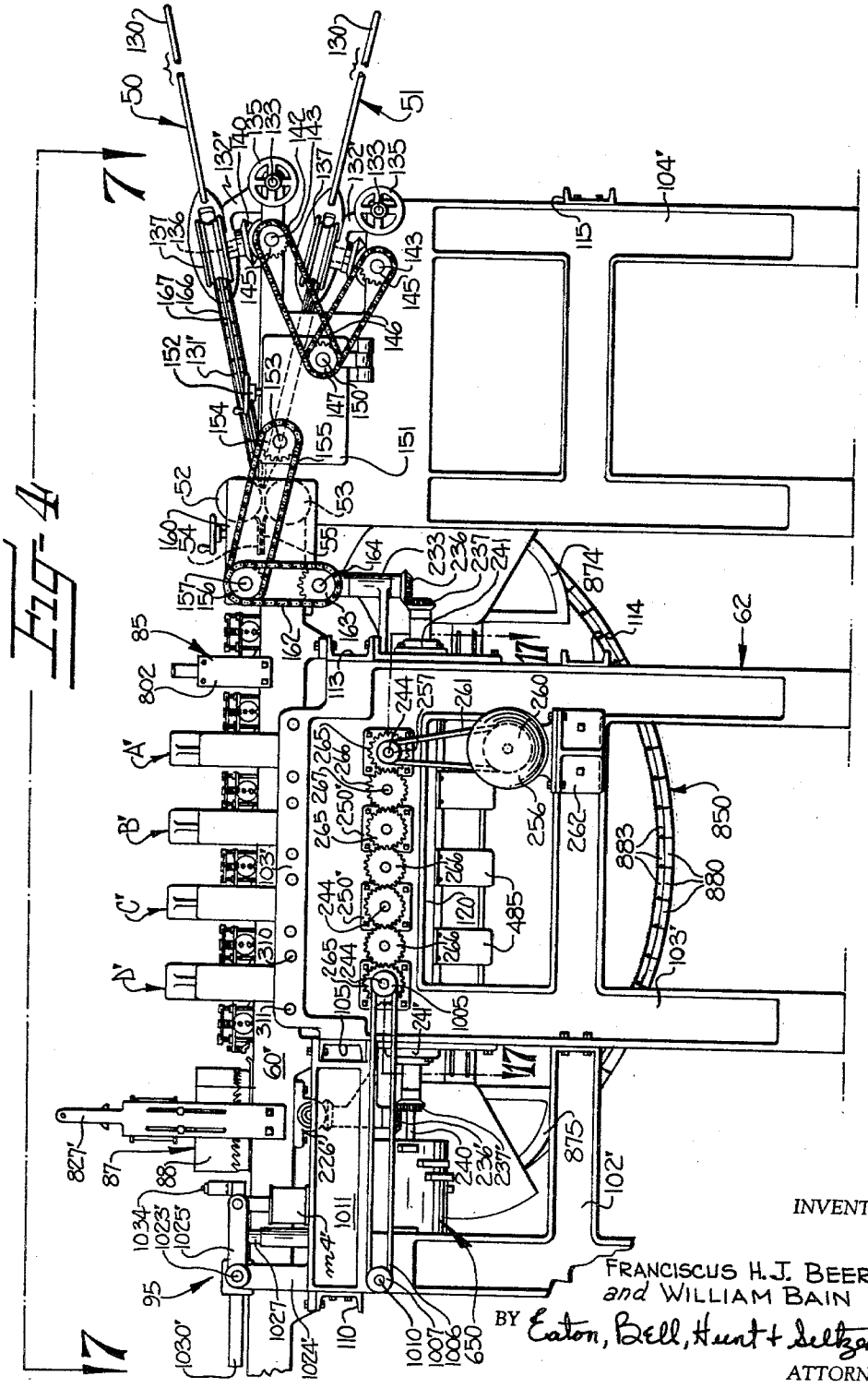


Fig. 4

INVENTORS:
FRANCISCUS H. J. BEEREN
and WILLIAM BAIN
BY Eaton, Bell, Hunt & Seltzer
ATTORNEYS

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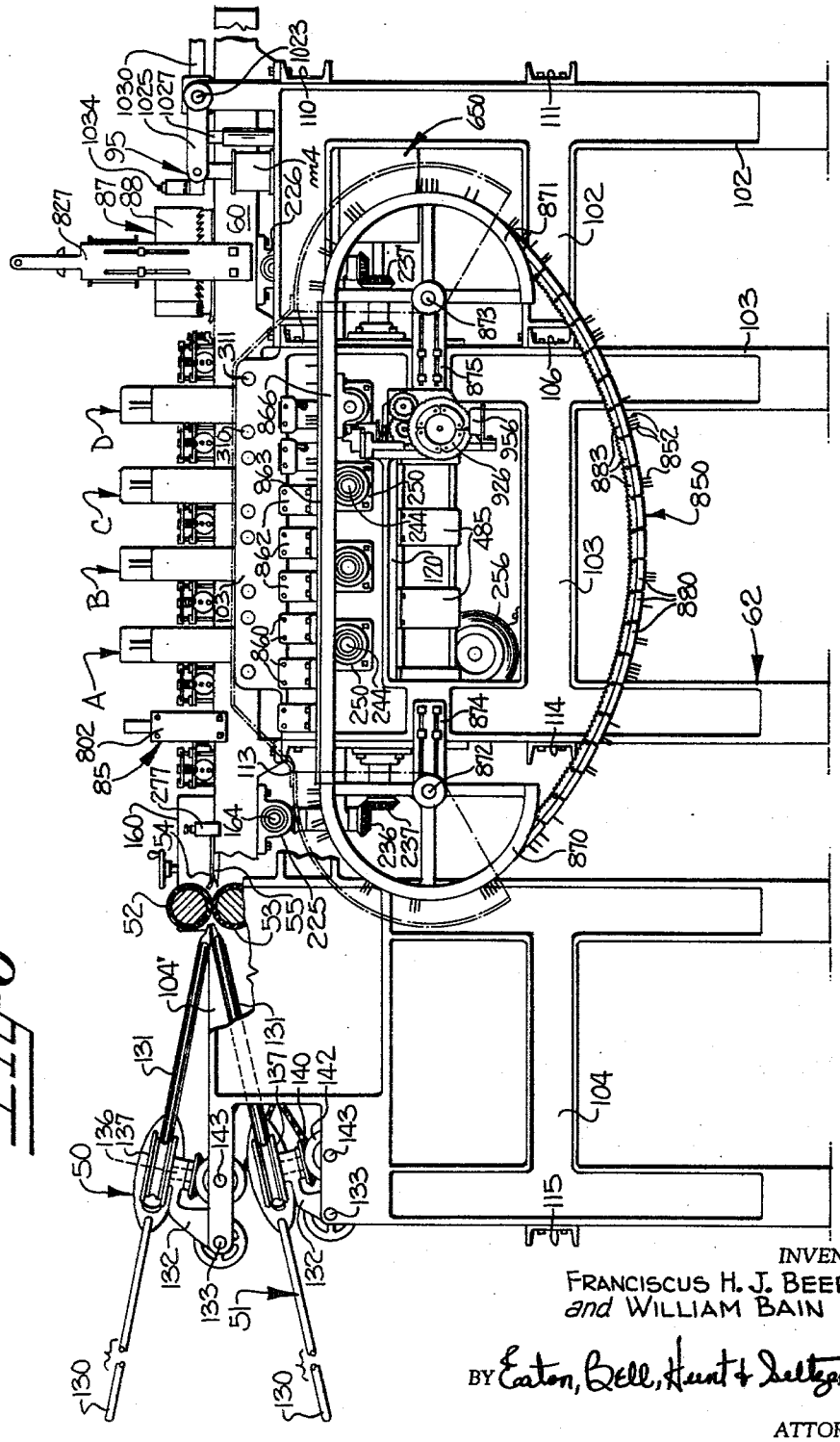


FIG 5

INVENTORS:
FRANCISCUS H. J. BEEREN
and WILLIAM BAIN

BY Eaton, Bell, Hunt & Seltzer

ATTORNEYS

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GARMENT CUTTING MACHINE AND METHOD

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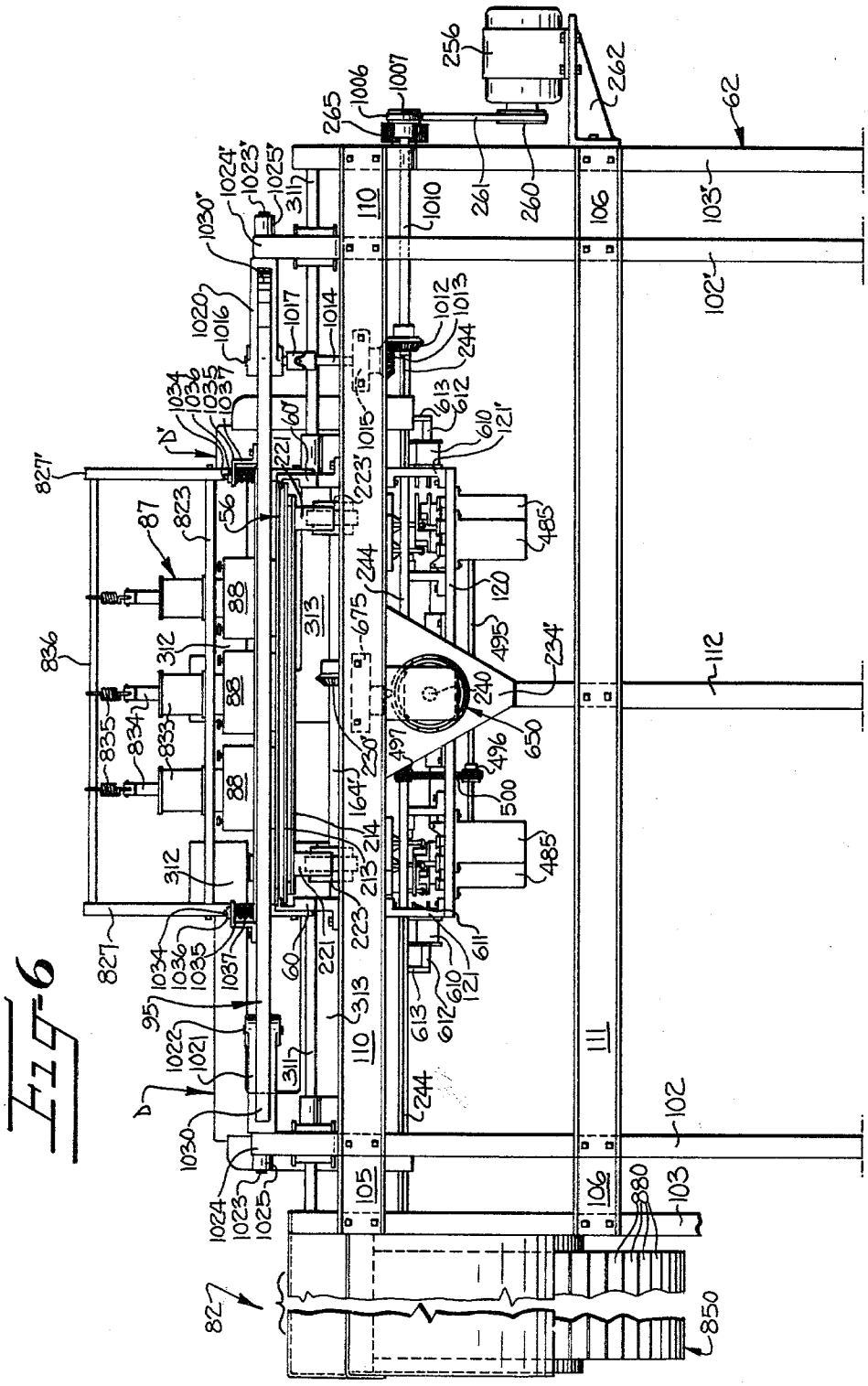


FIG 6

May 18, 1965 F. H. J. BEEREN ETAL 3,184,158

GARMENT CUTTING MACHINE AND METHOD

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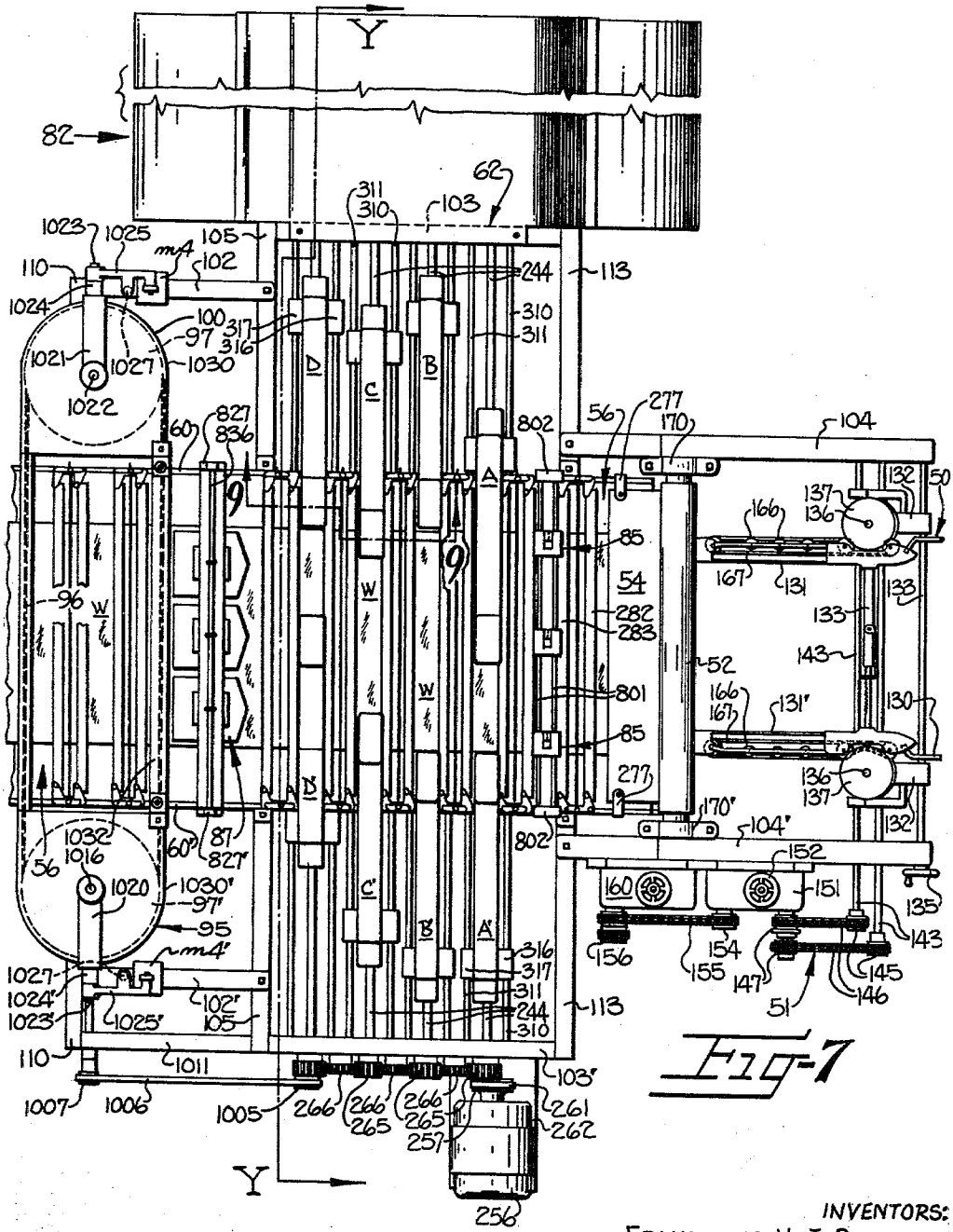


Fig-7

INVENTORS:
FRANCISCUS H. J. BEEREN
and WILLIAM BAIN

BY Eaton, Bell, Hunt & Seltzer

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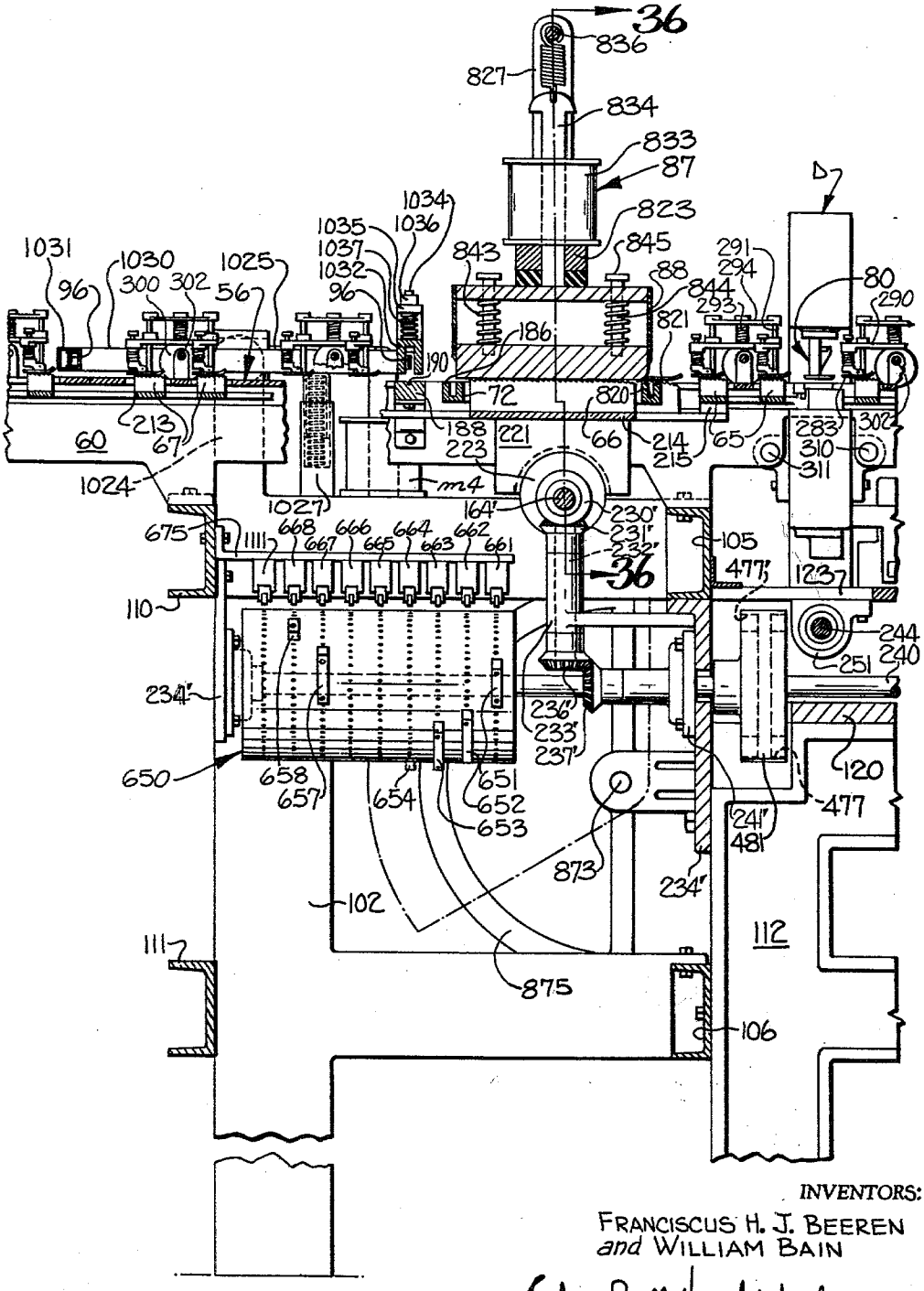


FIG. 8

INVENTORS:
FRANCISCUS H. J. BEEREN
and WILLIAM BAIN

BY Eaton, Bell, Hunt & Seltzer
ATTORNEYS

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GARMENT CUTTING MACHINE AND METHOD

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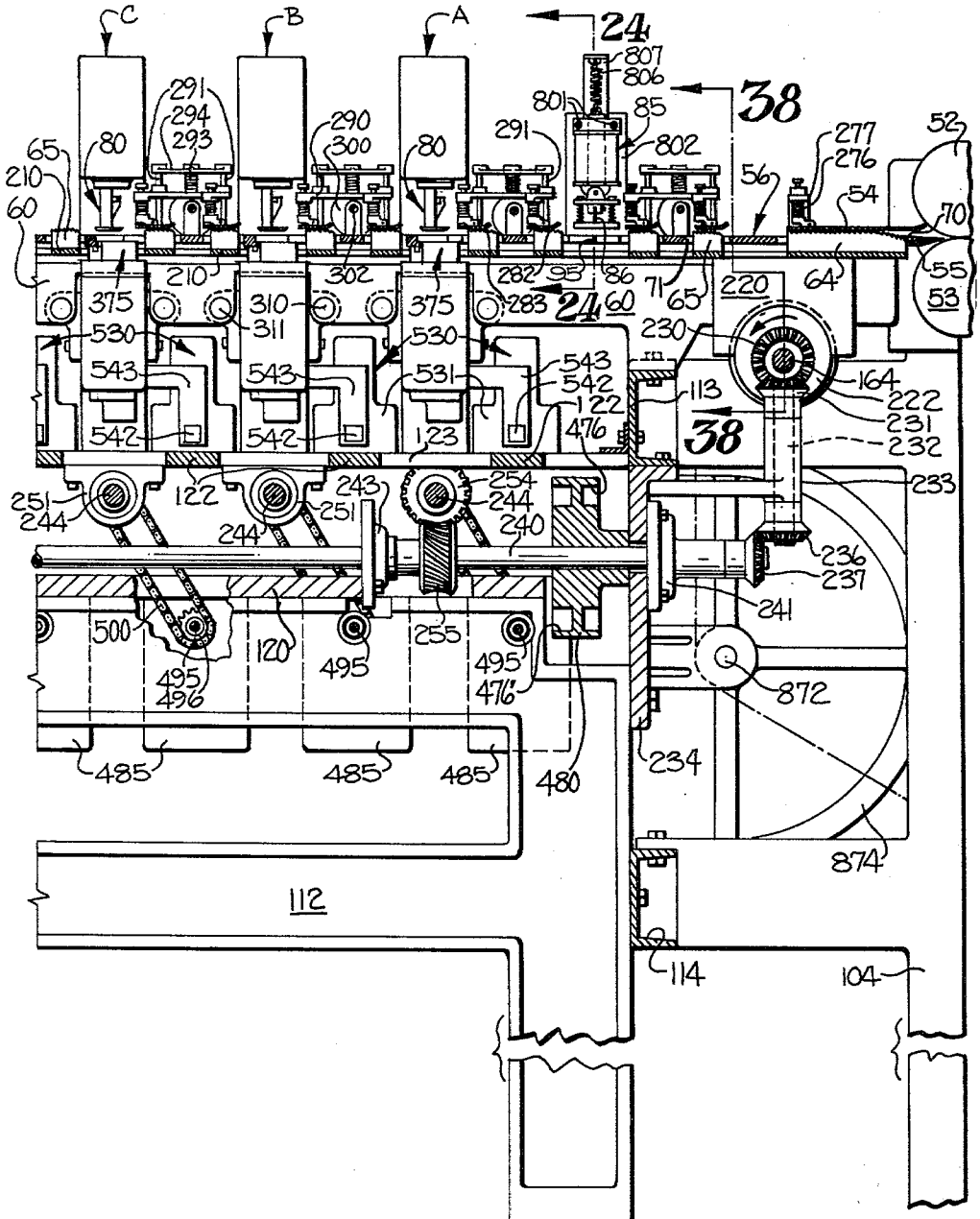


Fig. 8-A

INVENTORS:
FRANCISCUS H. J. BEEREN
and WILLIAM BAIN

BY Eaton, Bell, Hunt & Seltzer

ATTORNEYS

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GARMENT CUTTING MACHINE AND METHOD

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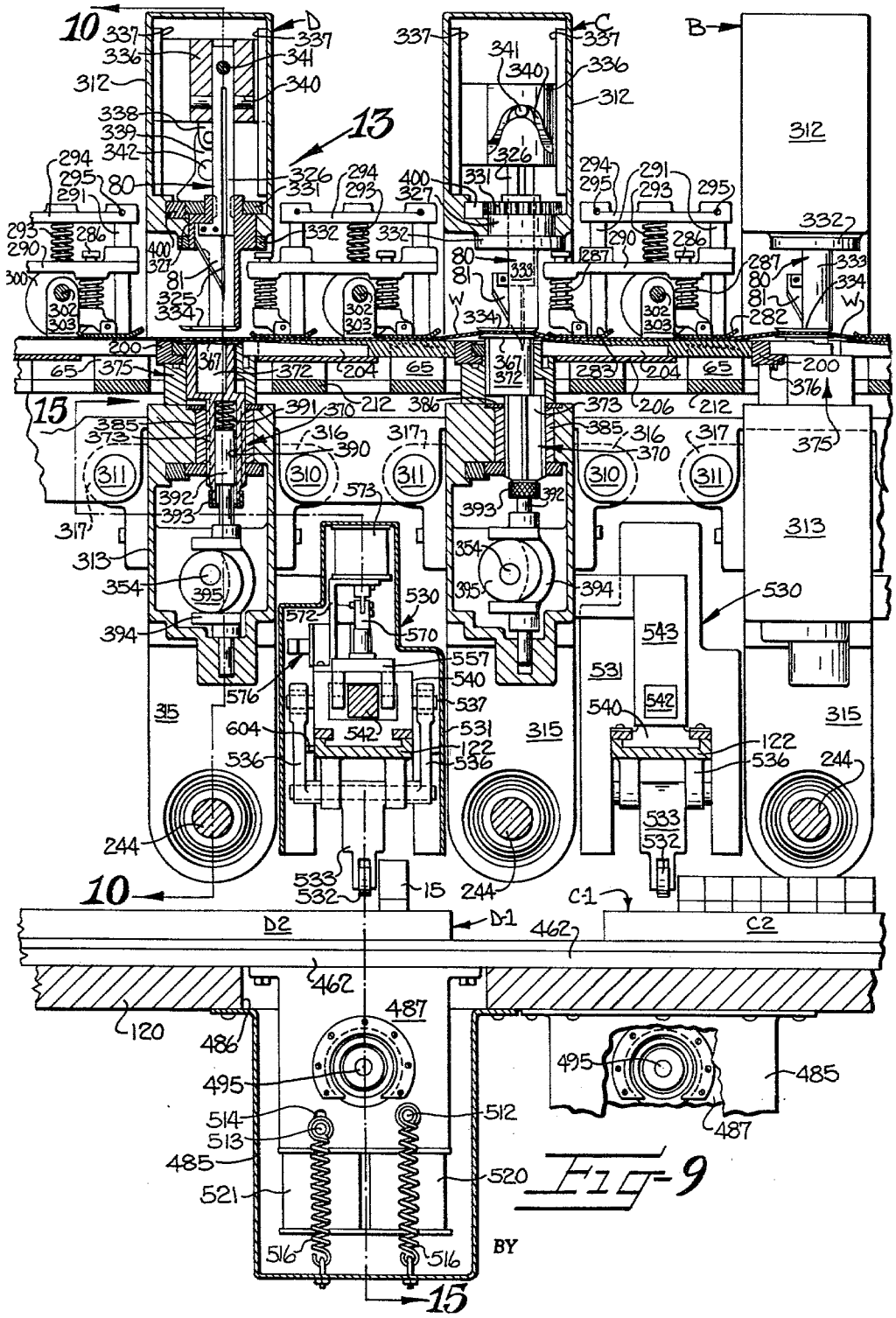


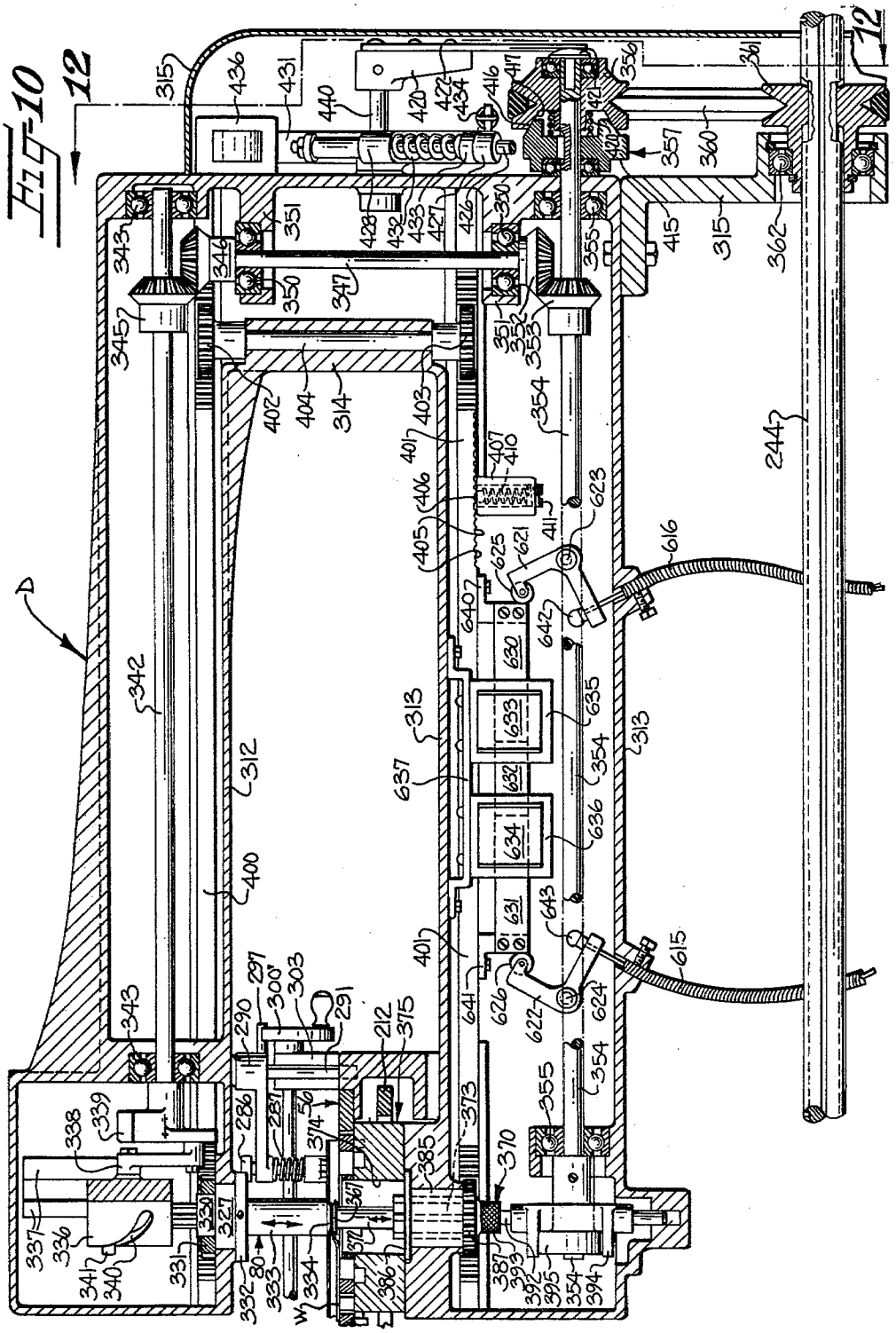
Fig-9

May 18, 1965 F. H. J. BEEREN ETAL 3,184,158

GARMENT CUTTING MACHINE AND METHOD

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FIG-10



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GARMENT CUTTING MACHINE AND METHOD

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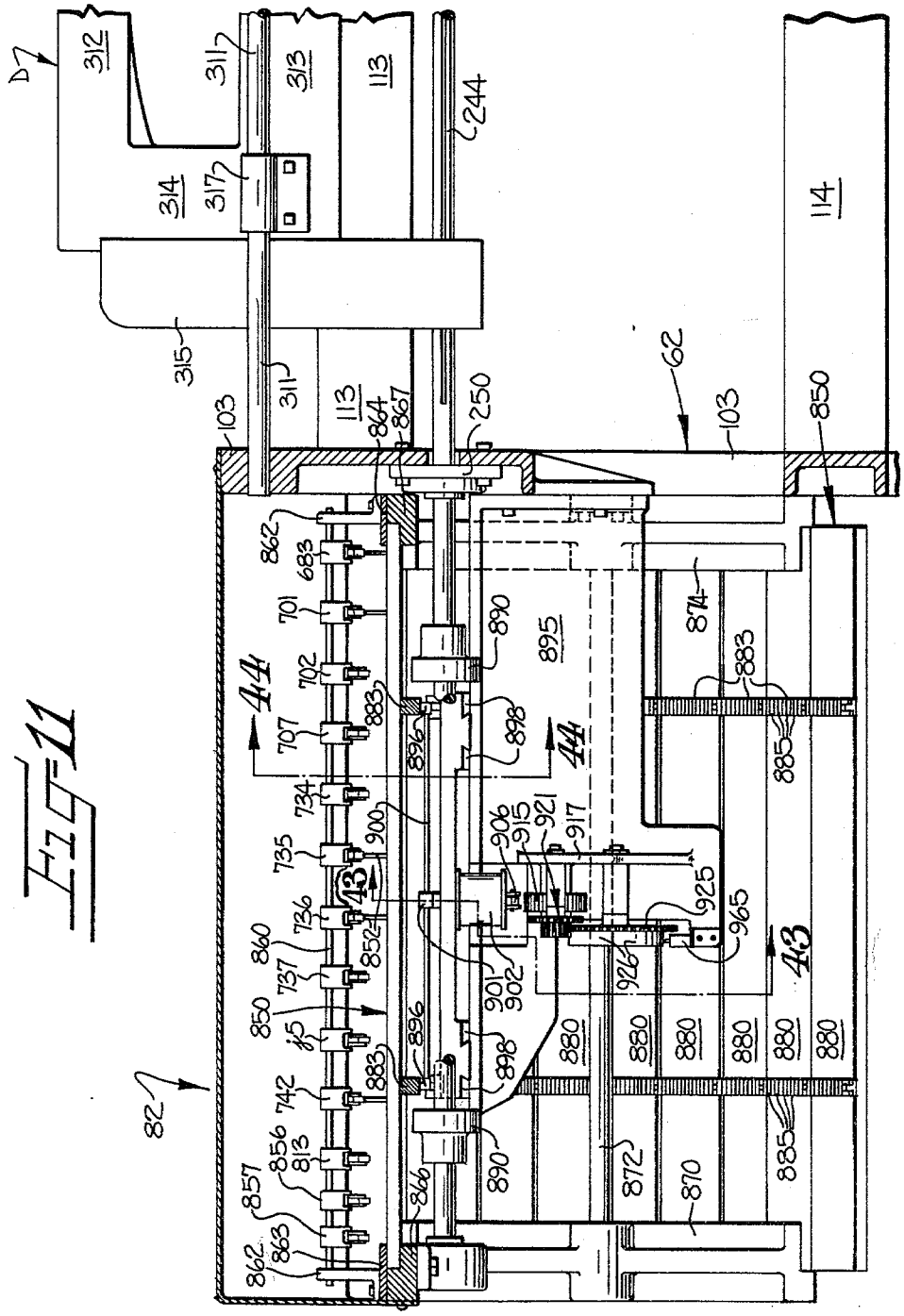


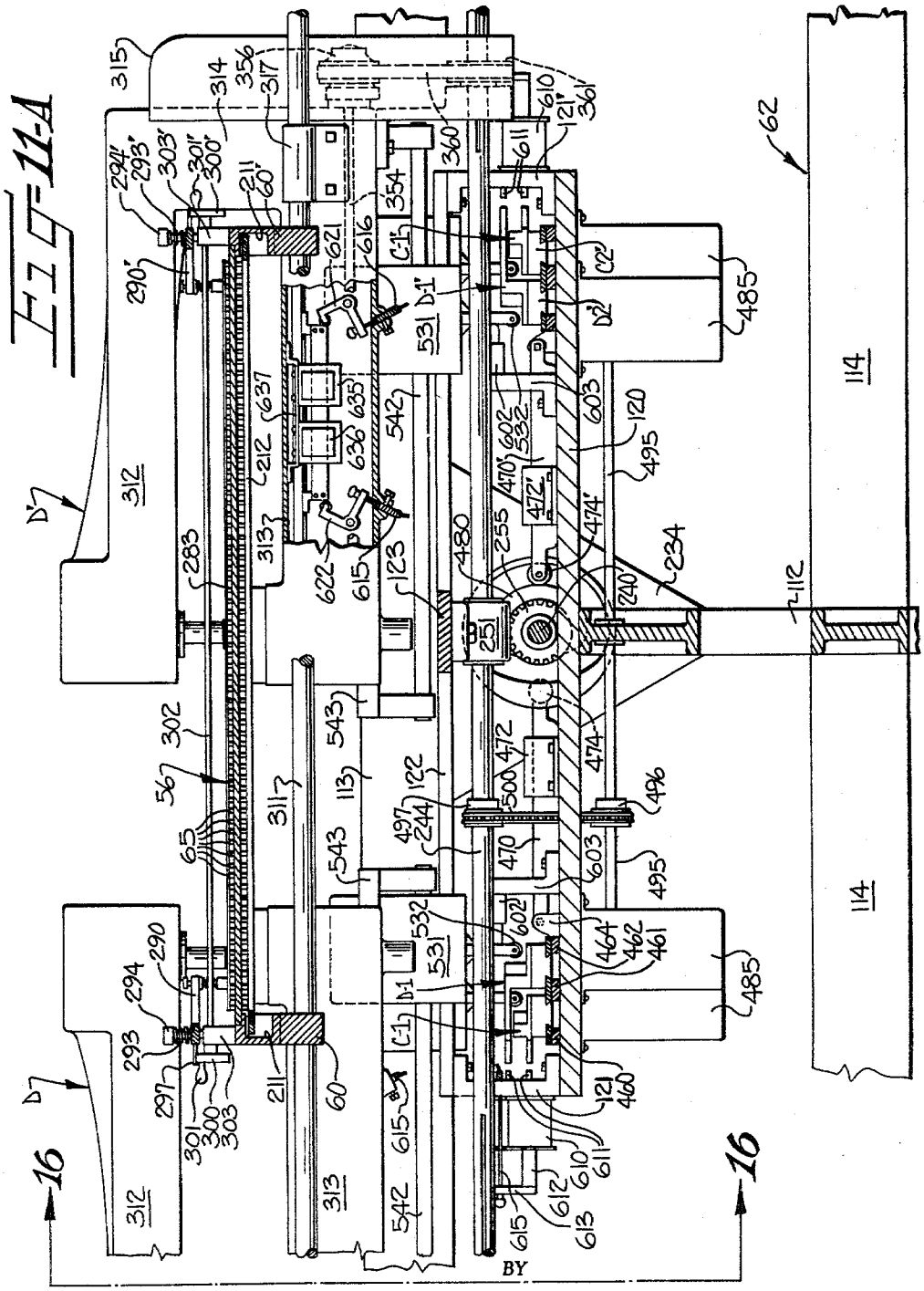
FIG-11

May 18, 1965 F. H. J. BEEREN ETAL 3,184,158

GARMENT CUTTING MACHINE AND METHOD

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FIG-11-A



May 18, 1965 F. H. J. BEEREN ETAL 3,184,158

GARMENT CUTTING MACHINE AND METHOD

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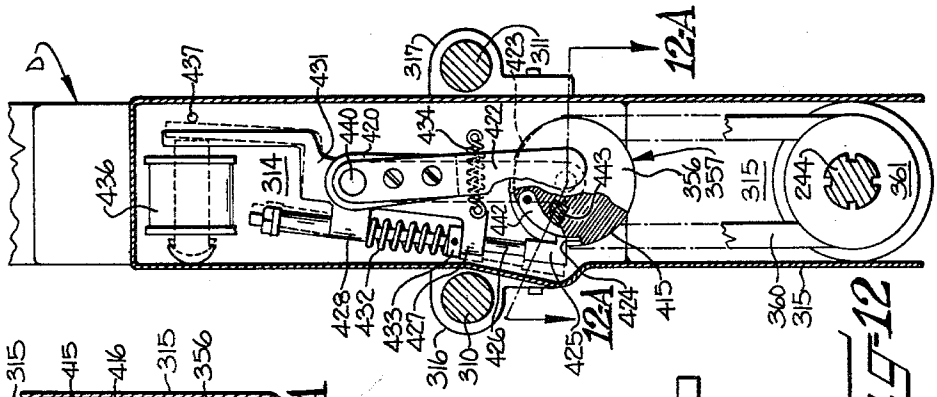


FIG-12

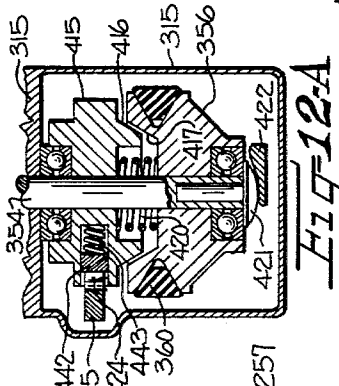


FIG-12-A

FIG-11-B

INVENTORS:
FRANCISCUS H. J. BEEREN
and WILLIAM BAIN

BY Eaton, Bell, Hunt & Seltzer

ATTORNEYS

May 18, 1965 F. H. J. BEEREN ETAL 3,184,158

GARMENT CUTTING MACHINE AND METHOD

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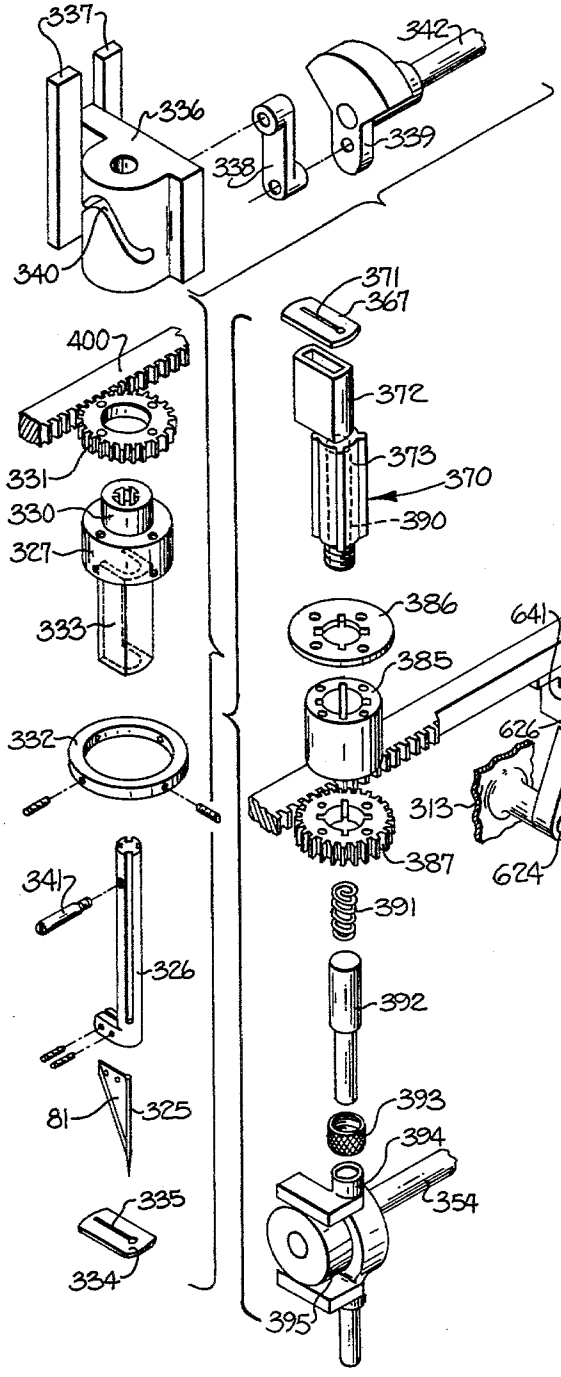


Fig-13

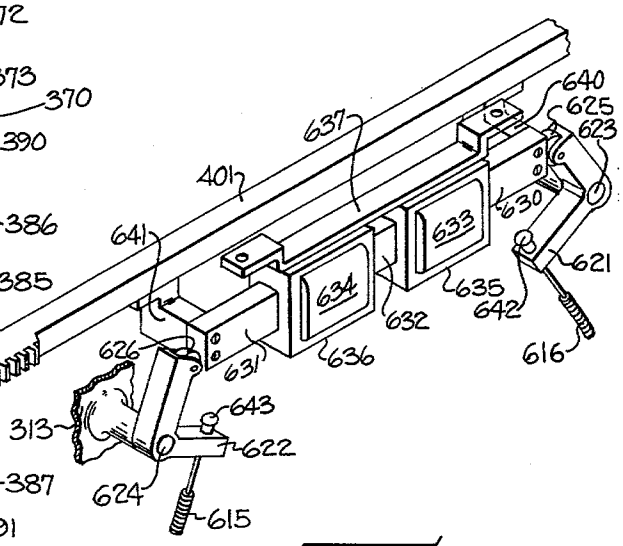


Fig-14

INVENTORS
FRANCISCUS H. J. BEEREN
and WILLIAM BAIN

BY Eaton, Bell, Hunt & Deltzer

ATTORNEYS

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GARMENT CUTTING MACHINE AND METHOD

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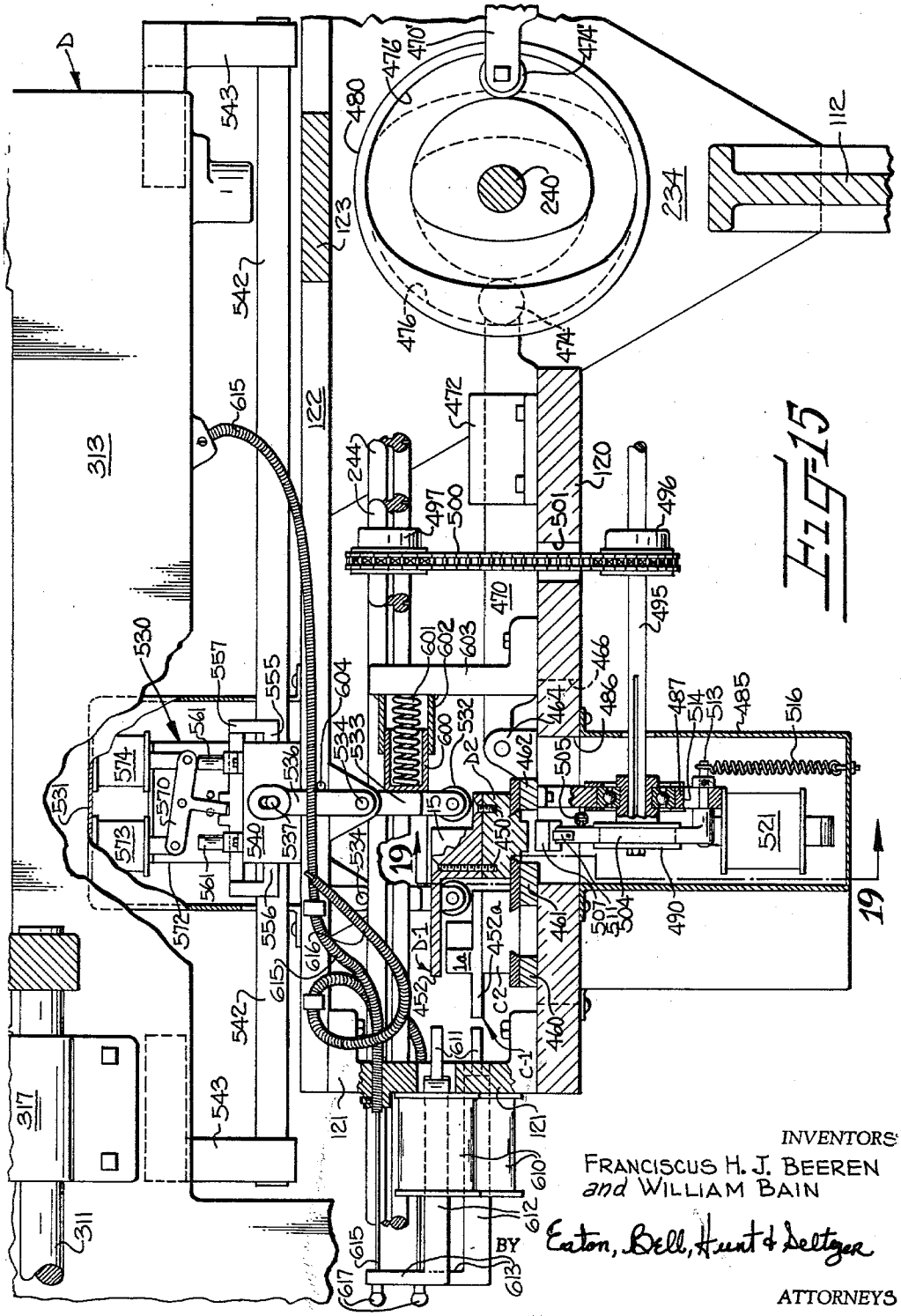


FIG-15

INVENTORS
FRANCISCUS H. J. BEEREN
and WILLIAM BAIN

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ATTORNEYS

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GARMENT CUTTING MACHINE AND METHOD

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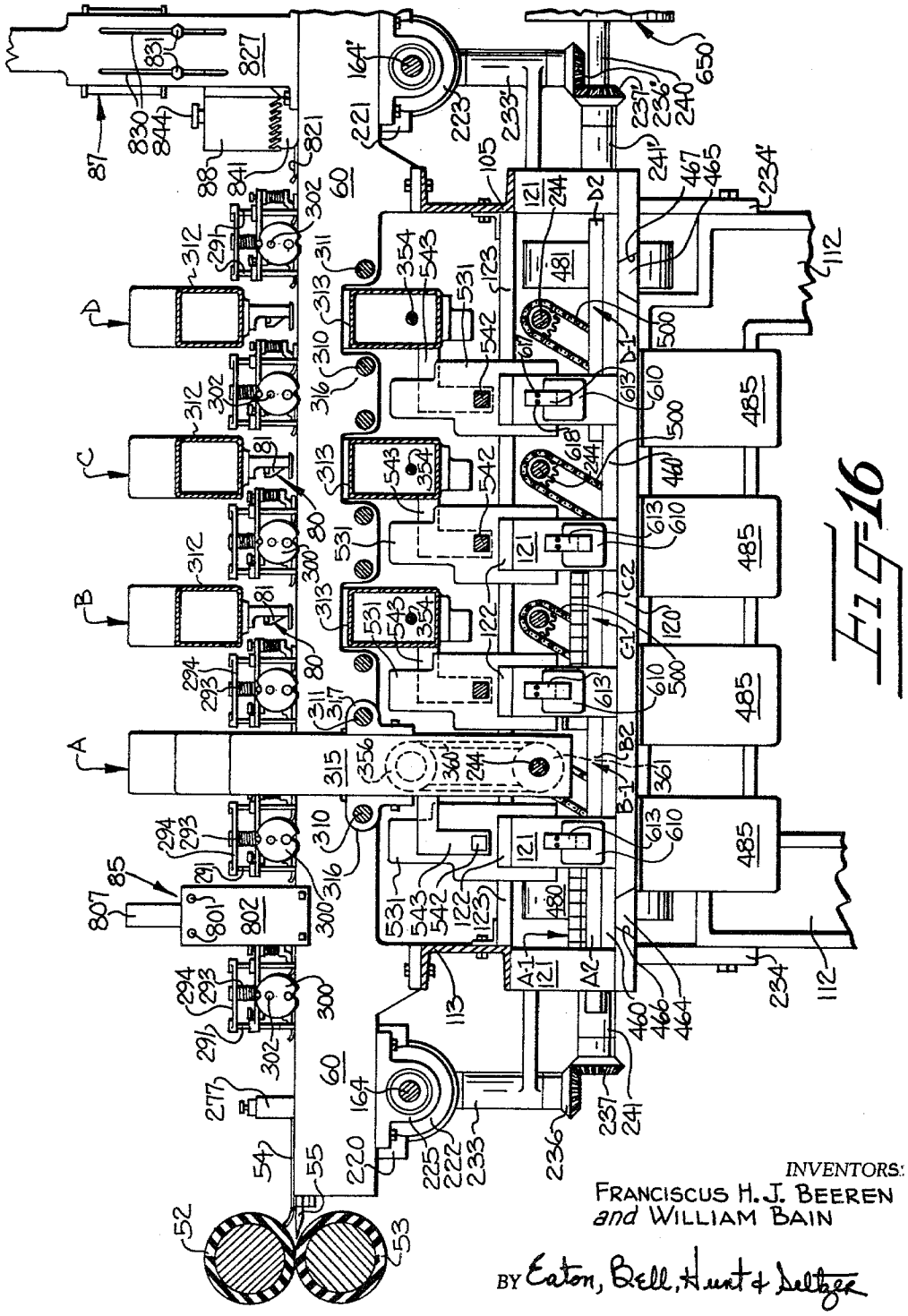


FIG-16

INVENTORS:
FRANCISCUS H. J. BEEREN
and WILLIAM BAIN

BY Eaton, Bell, Hunt & Deltzer

ATTORNEYS

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GARMENT CUTTING MACHINE AND METHOD

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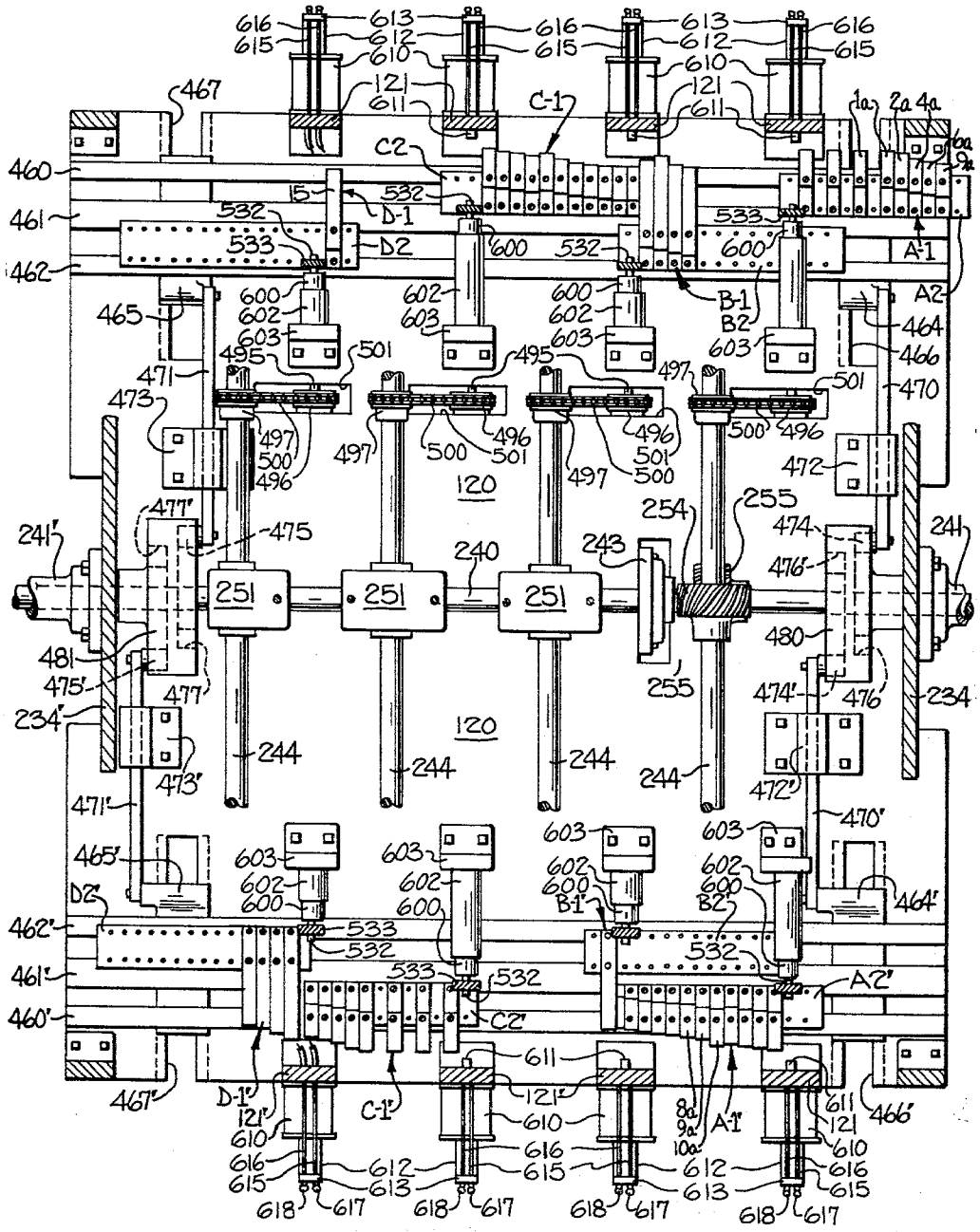


Fig-17

DIRECTION OF WEB MOVEMENT

INVENTORS:
FRANCISCUS H. J. BEEREN
and WILLIAM BAIN
BY Eaton, Bell, Hunt & Deltzer
ATTORNEYS

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GARMENT CUTTING MACHINE AND METHOD

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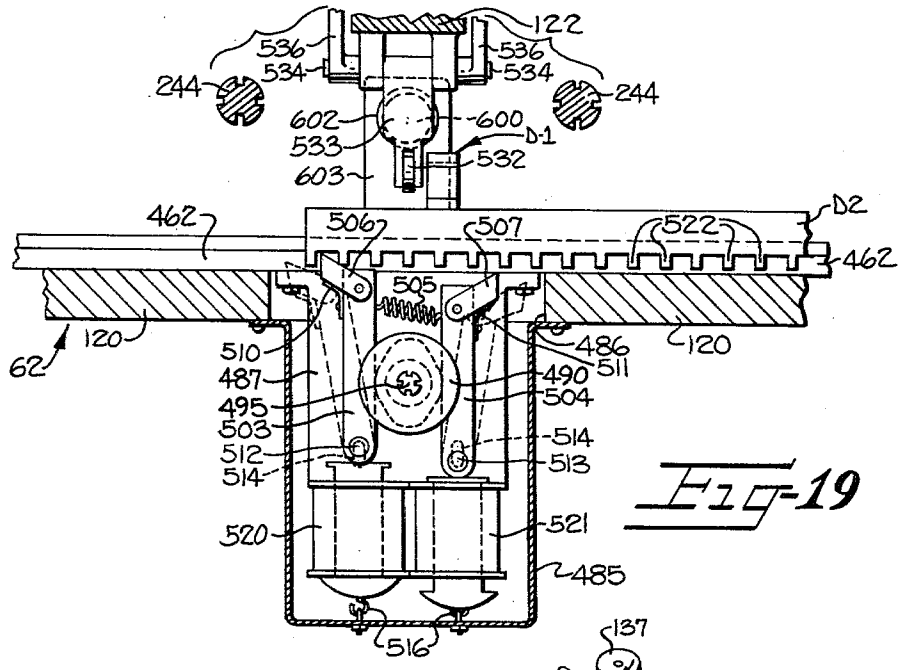


Fig-19

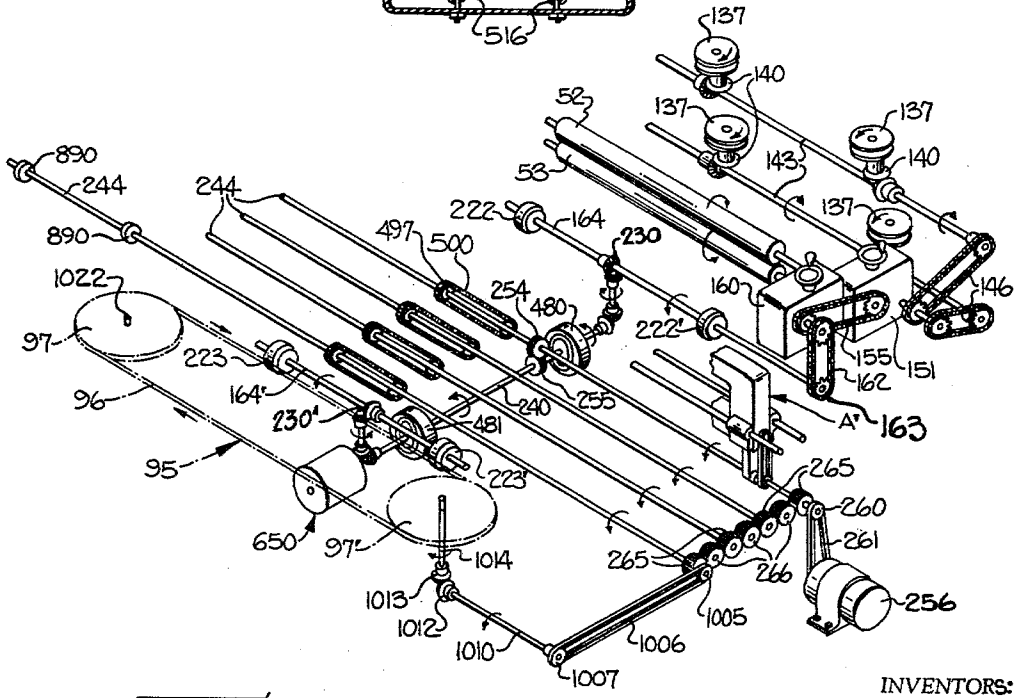


Fig-18

INVENTORS:
FRANCISCUS H. J. BEEREN
and WILLIAM BAIN
BY Eaton, Bell, Hunt & Deltzer
ATTORNEYS

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GARMENT CUTTING MACHINE AND METHOD

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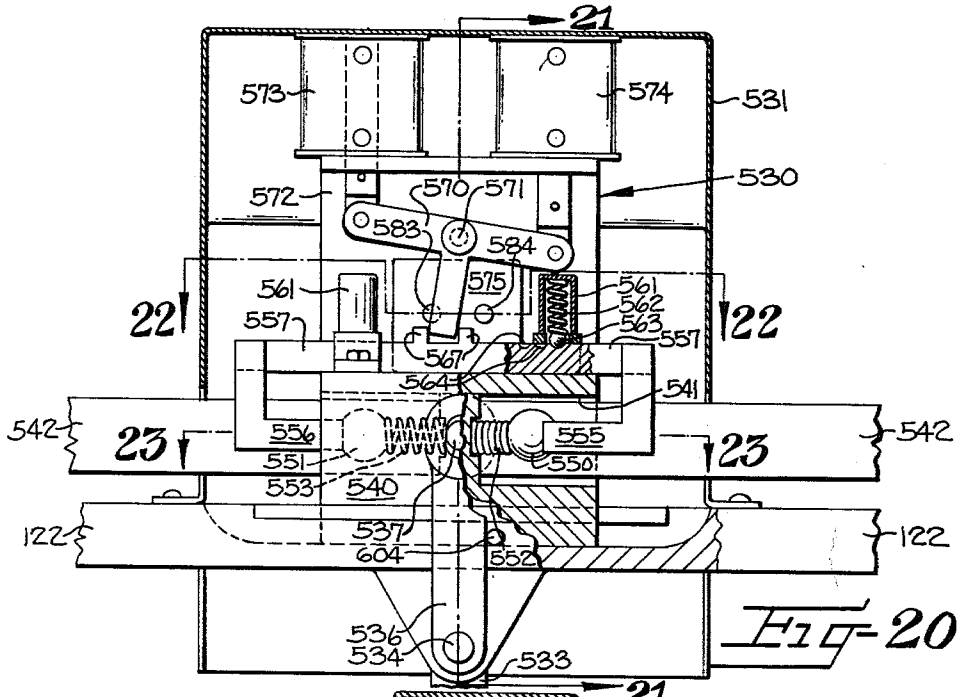


Fig-20

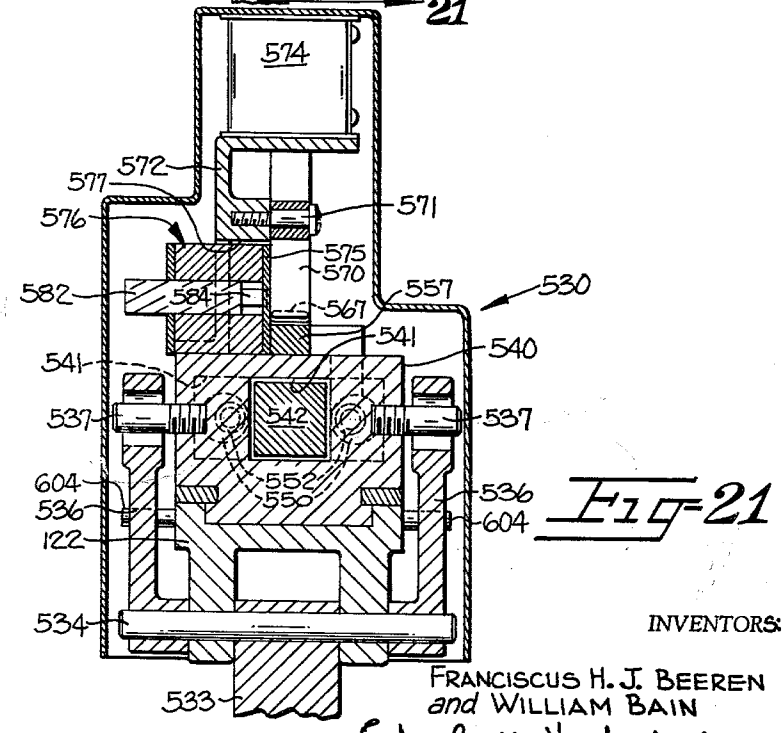


Fig-21

INVENTORS:
FRANCISCUS H. J. BEEREN
and WILLIAM BAIN
BY Eaton, Bell, Hunt & Seltzer
ATTORNEYS

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GARMENT CUTTING MACHINE AND METHOD

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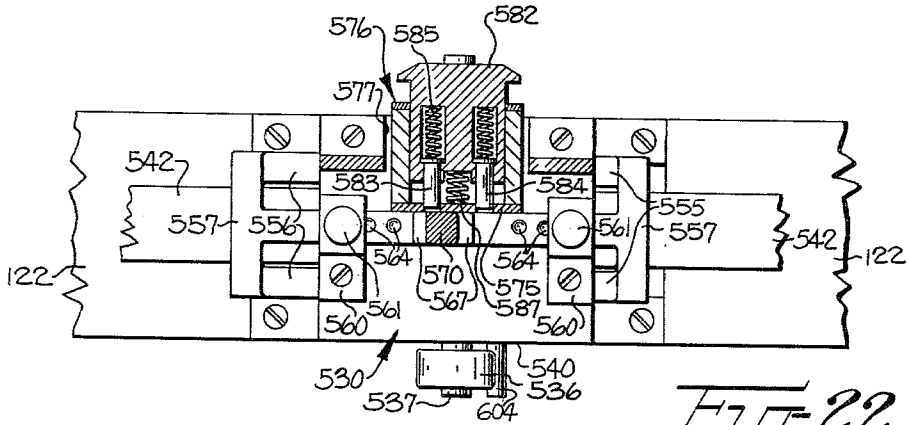


Fig-22

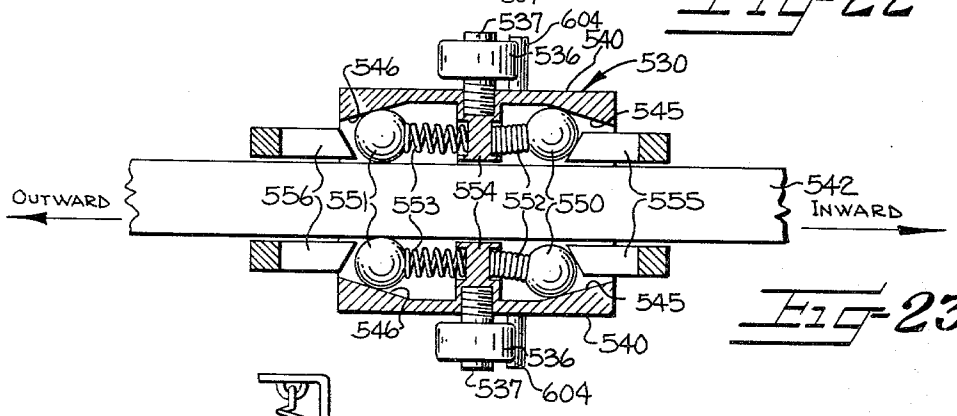


Fig-23

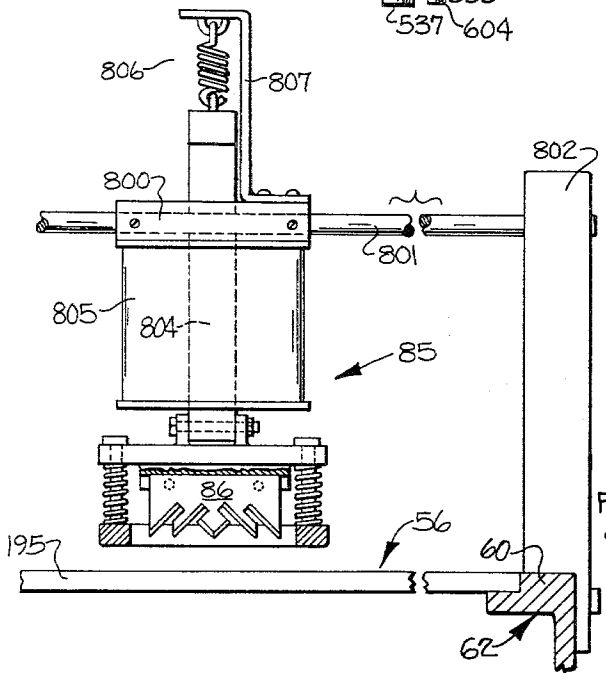


Fig-24

INVENTORS:
FRANCISCUS H.J. BEEREN
and WILLIAM BAIN
By Eaton, Bell,
Hunt & Seltzer
ATTORNEYS

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GARMENT CUTTING MACHINE AND METHOD

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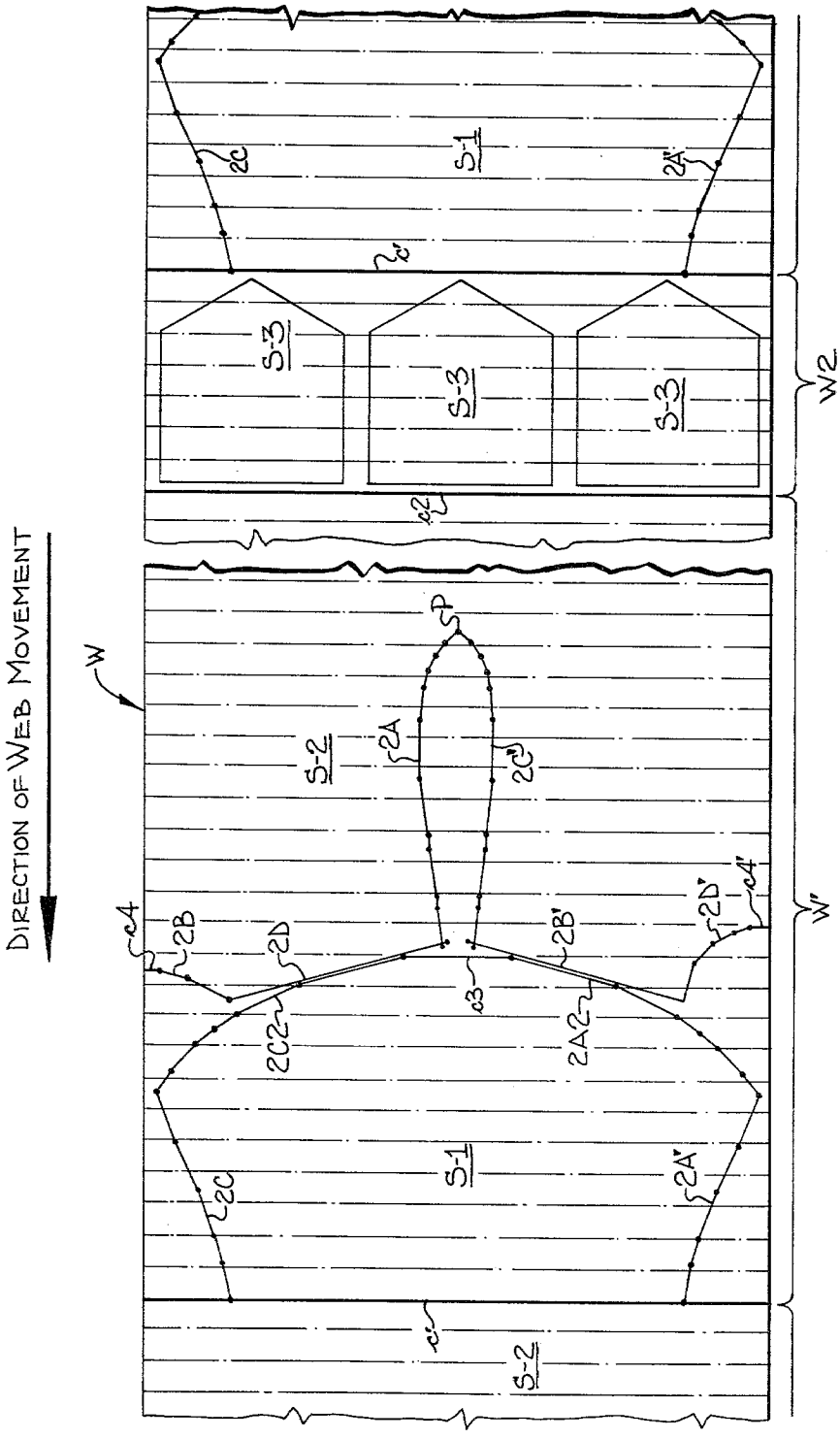


FIG-25

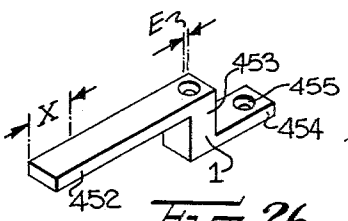


Fig-26

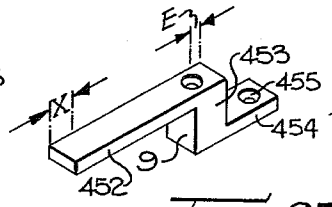


Fig-27

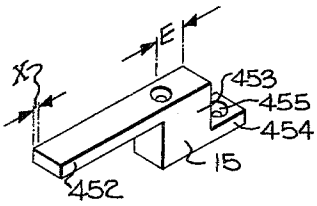


Fig-28

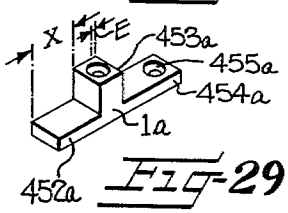


Fig-29

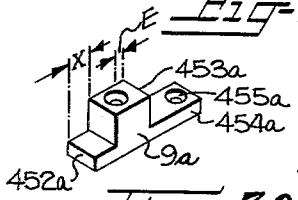


Fig-30

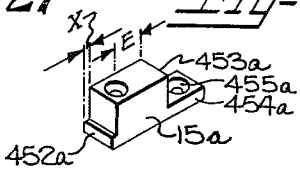


Fig-31

CUTTER INCREMENT CAMS

REF. NUMBER V	DIMENSION X	BLADE ANGLE Y	DIMENSION E
0	NO CAM	0°	NONE
1	.9265	5°	.0109
2	.8720	10°	.0220
3	.8175	15°	.0334
4	.7630	20°	.0455
5	.7085	25°	.0583
6	.6540	30°	.0722
7	.5995	35°	.0875
8	.5450	40°	.1050
9	.4905	45°	.125
10	.4360	50°	.1489
11	.3815	55°	.1784
12	.3270	60°	.2166
13	.2725	65°	.2681
14	.2180	70°	.3439
15	.1635	75°	.4665
16	.0000	90°	.0000

Fig-32

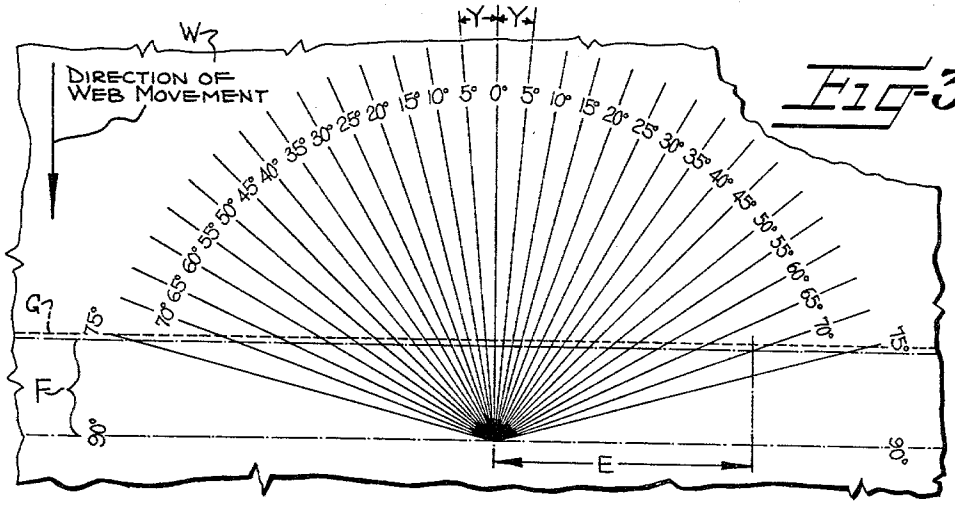


Fig-33

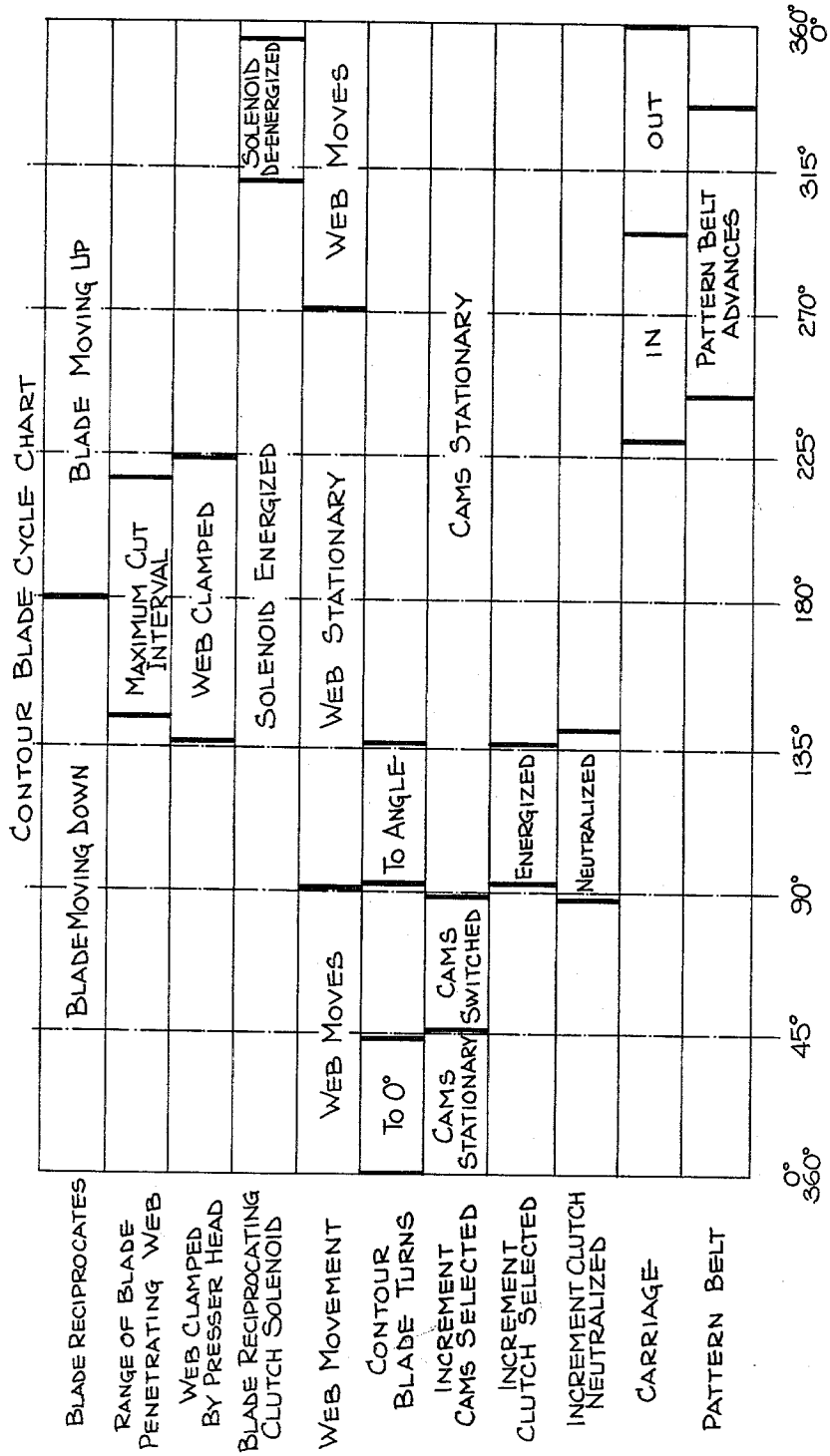

CONTOUR BLADE CYCLE CHART
BLADE RECIPROCATES
BLADE MOVING DOWN
BLADE MOVING UP
RANGE OF BLADE PENETRATING WEB
MAXIMUM CUT INTERVAL
WEB CLAMPED BY PRESSER HEAD
WEB CLAMPED
BLADE RECIPROCATING CLUTCH SOLENOID
SOLENOID ENERGIZED
SOLENOID DE-ENERGIZED
WEB MOVEMENT
WEB MOVES
WEB STATIONARY
WEB MOVES
CONTOUR BLADE TURNS
TO 0°
TO ANGLE
INCREMENT CAMS SELECTED
CAMS STATIONARY
CAMS SWITCHED
CAMS STATIONARY
INCREMENT CLUTCH SELECTED
ENERGIZED
INCREMENT CLUTCH NEUTRALIZED
NEUTRALIZED
CARRIAGE
IN
OUT
PATTERN BELT
PATTERN BELT ADVANCES
0° 360°
45°
90°
135°
180°
225°
270°
315°
360° 0°

FIG. 34

May 18, 1965 F. H. J. BEEREN ETAL 3,184,158

GARMENT CUTTING MACHINE AND METHOD

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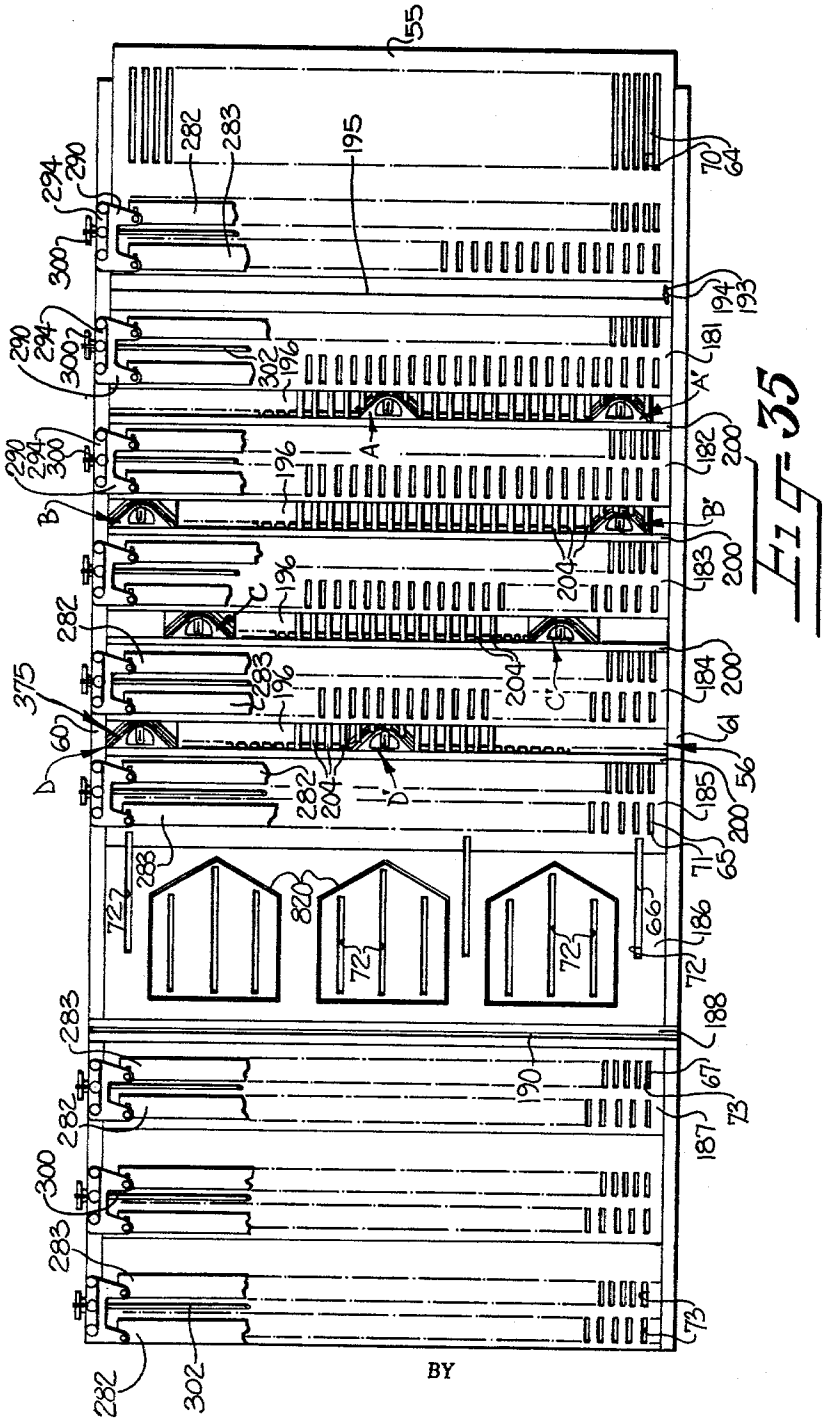


FIG. 35

May 18, 1965 F. H. J. BEEREN ETAL 3,184,158

GARMENT CUTTING MACHINE AND METHOD

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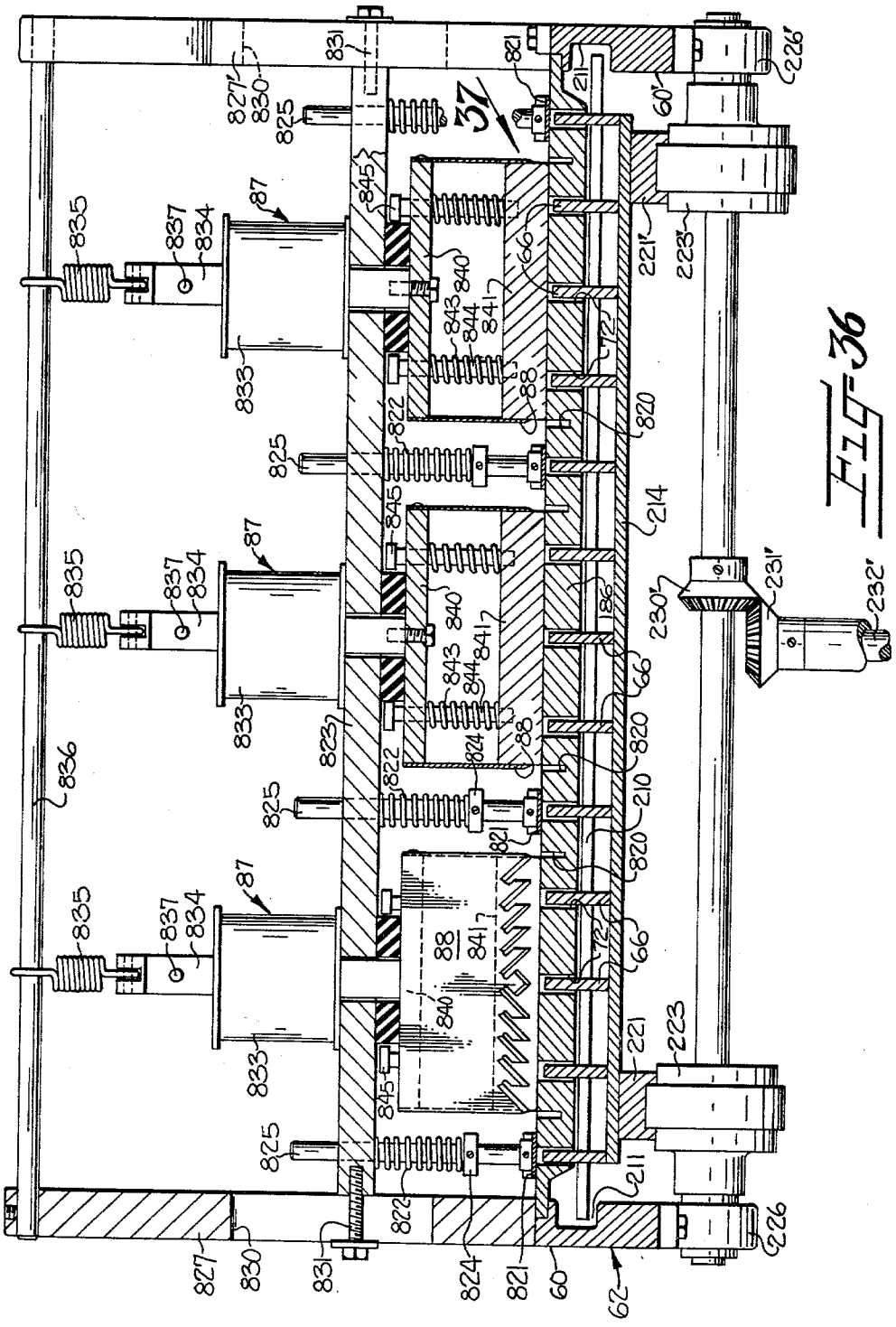


FIG-36

May 18, 1965 F. H. J. BEEREN ETAL 3,184,158

GARMENT CUTTING MACHINE AND METHOD

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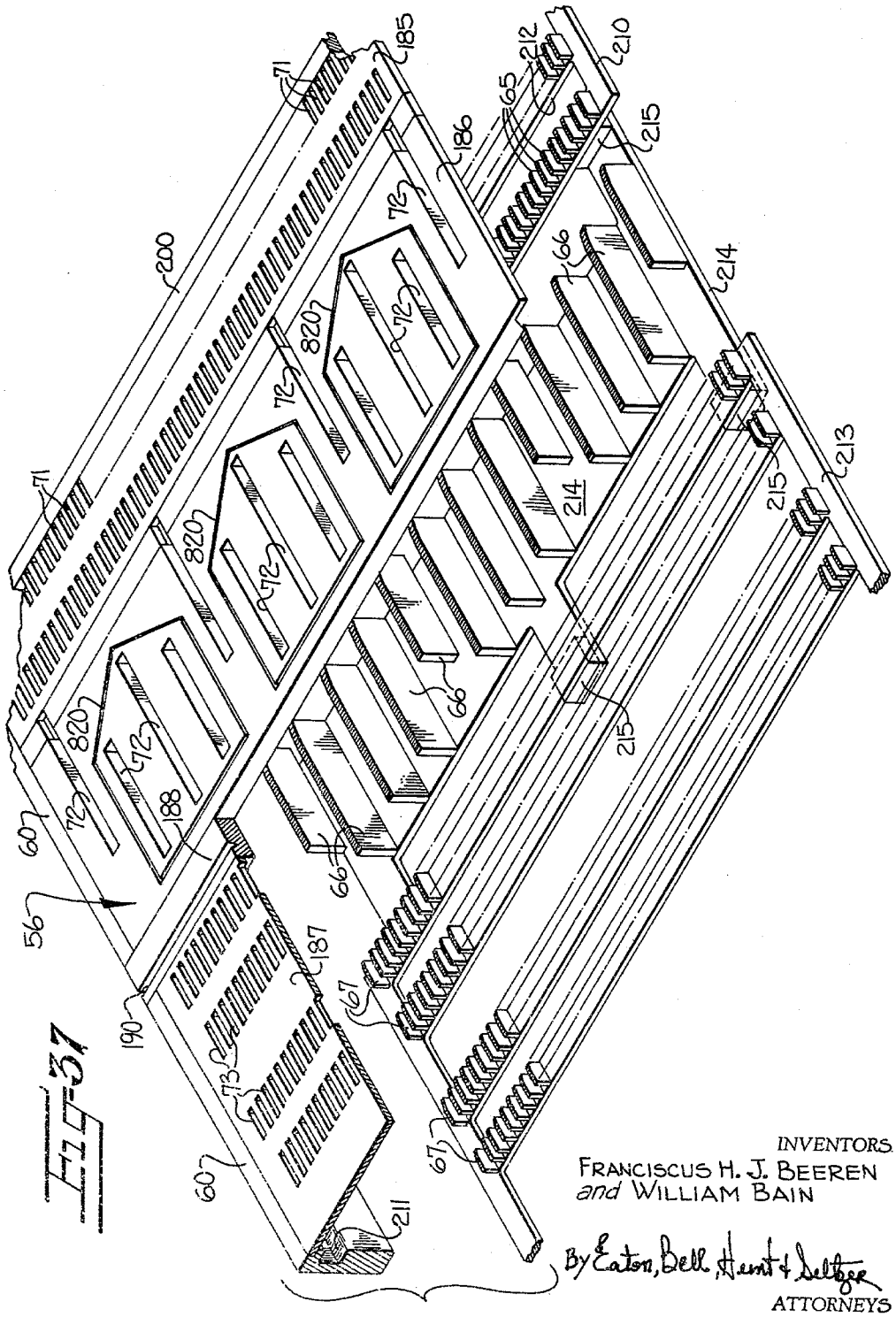


FIG. 37

INVENTORS
FRANCISCUS H. J. BEEREN
and WILLIAM BAIN

By Eaton, Bell, Hunt & Deltzer
ATTORNEYS

May 18, 1965 F. H. J. BEEREN ETAL 3,184,158

GARMENT CUTTING MACHINE AND METHOD

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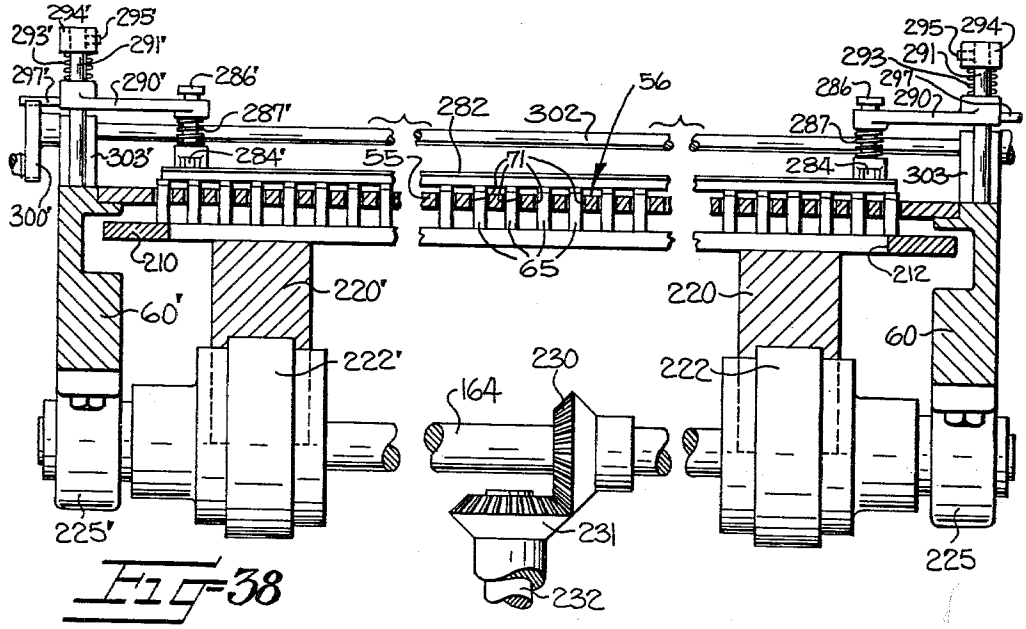
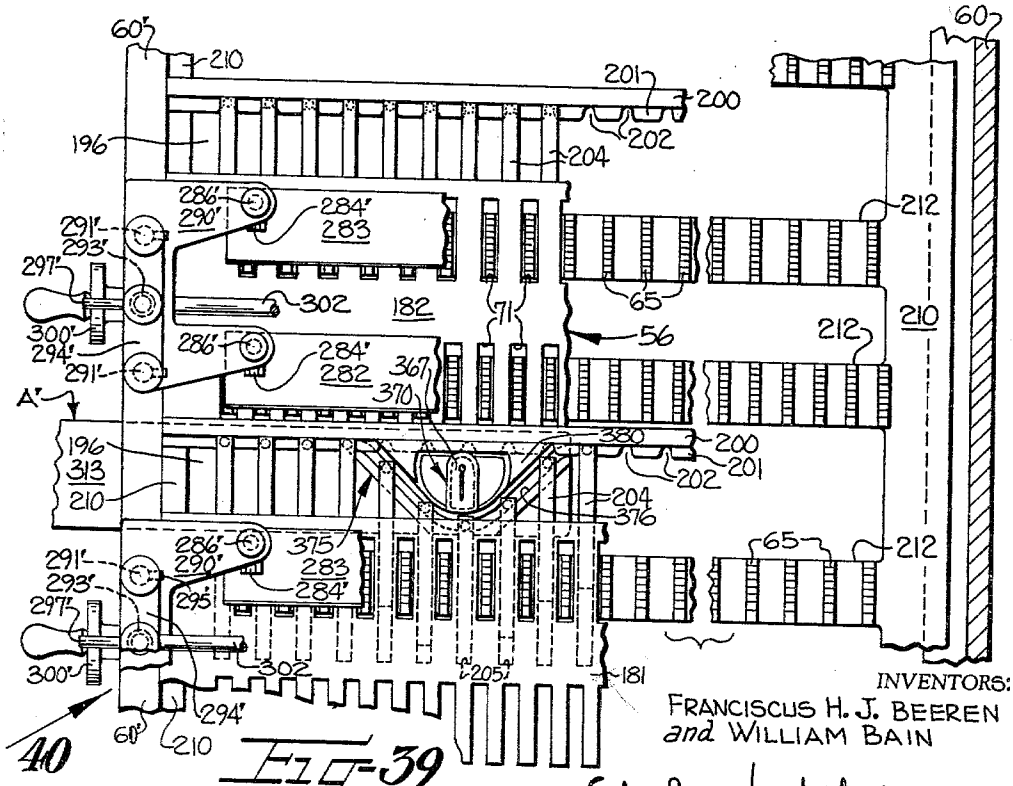


Fig-38



40

Fig-39

INVENTORS:
FRANCISCUS H. J. BEEREN
and WILLIAM BAIN

BY Eaton, Bell, Hunt & Beltzer

ATTORNEYS

May 18, 1965 F. H. J. BEEREN ETAL 3,184,158

GARMENT CUTTING MACHINE AND METHOD

Filed Dec. 18, 1961 36 Sheets-Sheet 29

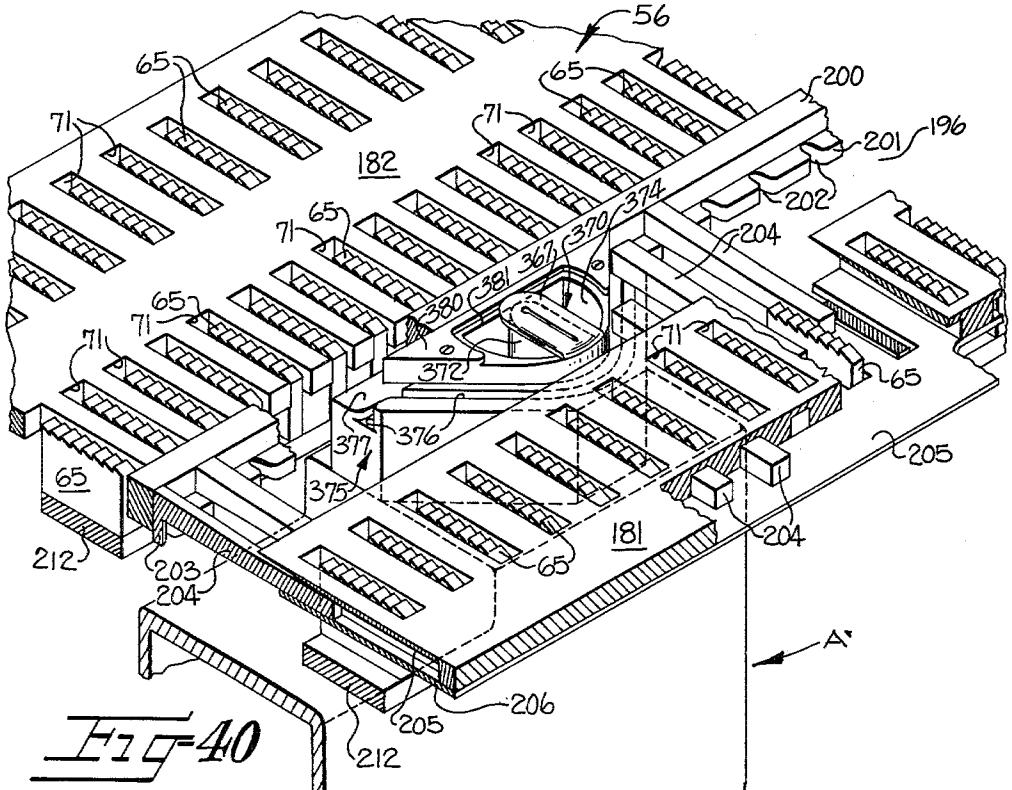


Fig-40

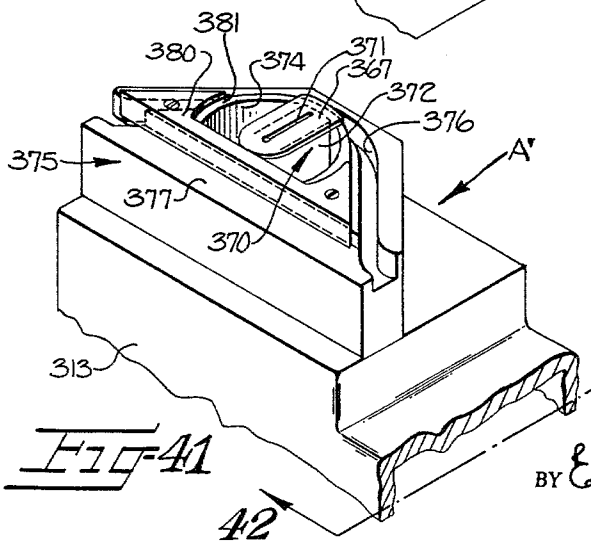


Fig-41

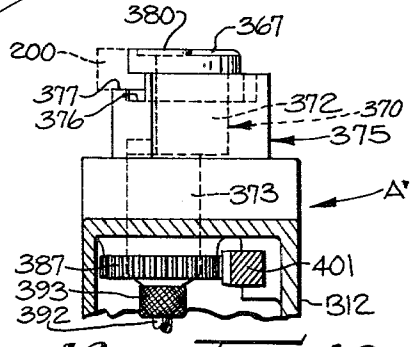


Fig-42

42

42

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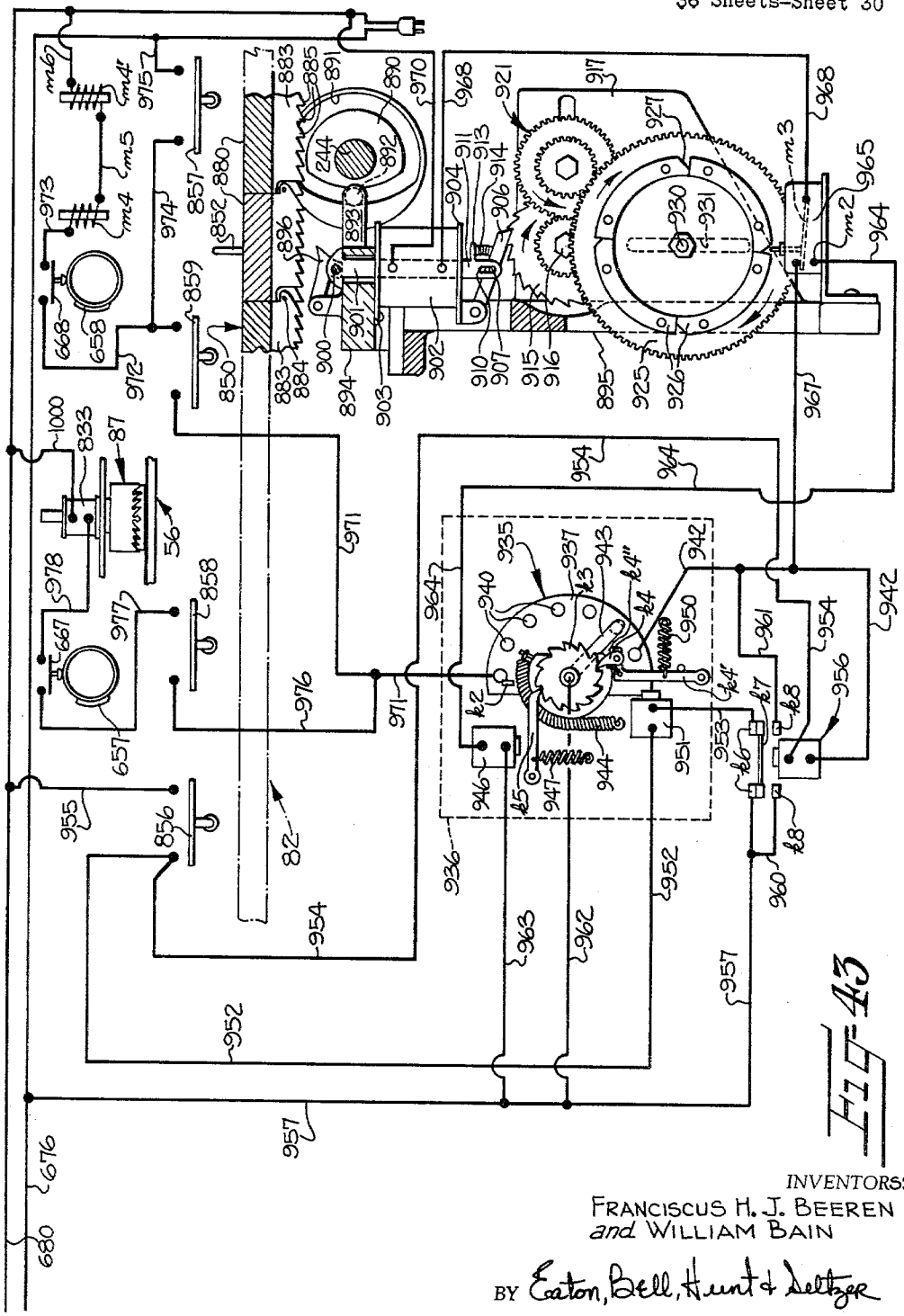


FIG. 43

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GARMENT CUTTING MACHINE AND METHOD

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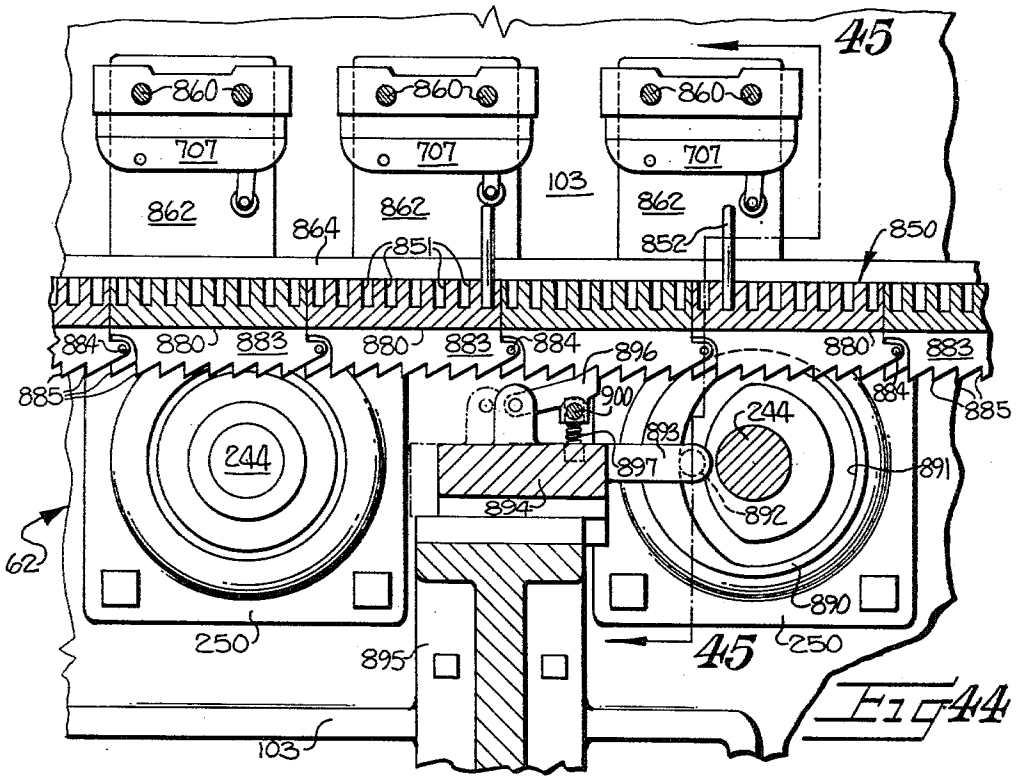


Fig 44

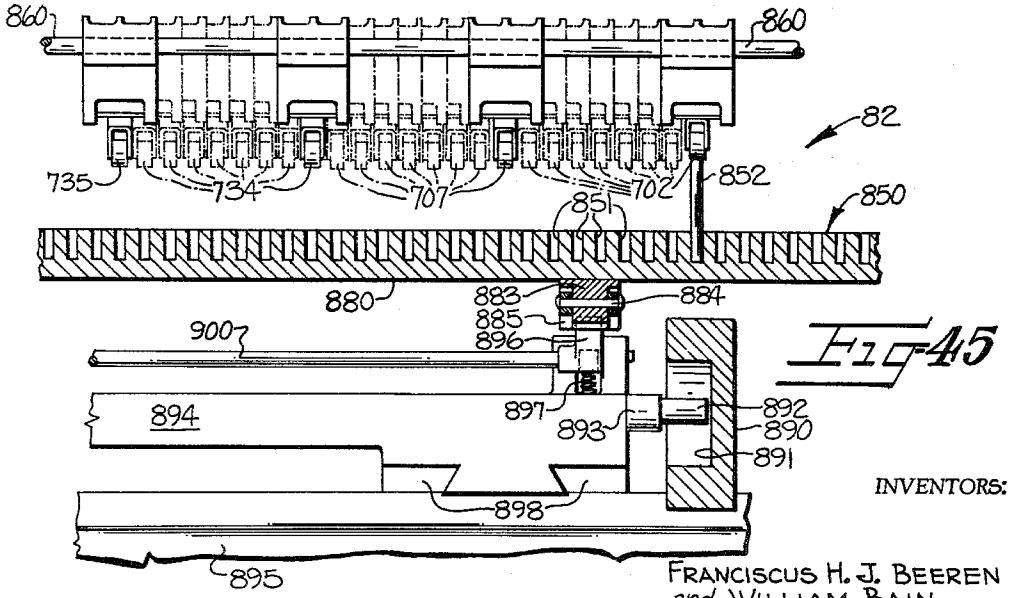


Fig 45

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GARMENT CUTTING MACHINE AND METHOD

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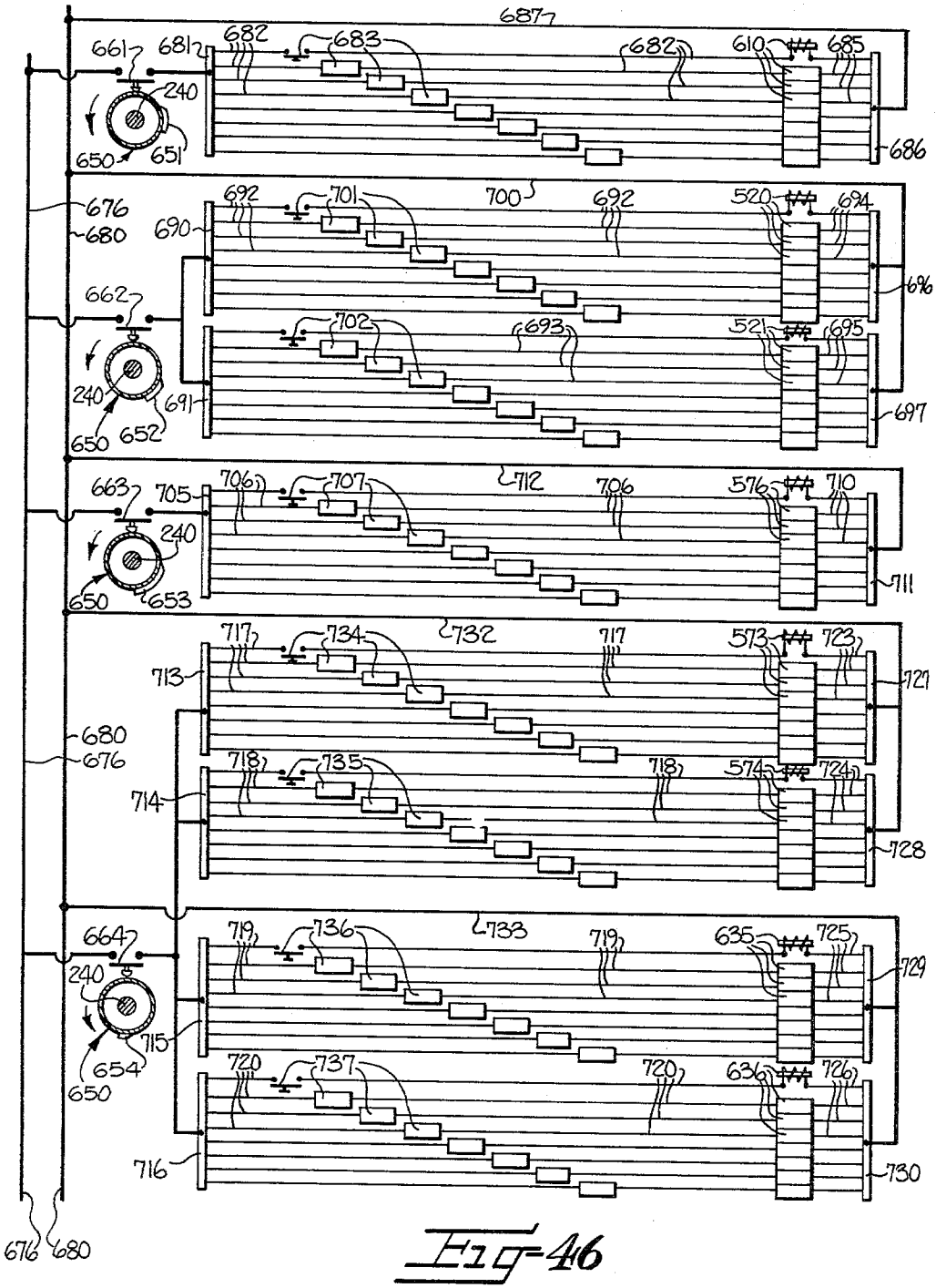


Fig-46

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GARMENT CUTTING MACHINE AND METHOD

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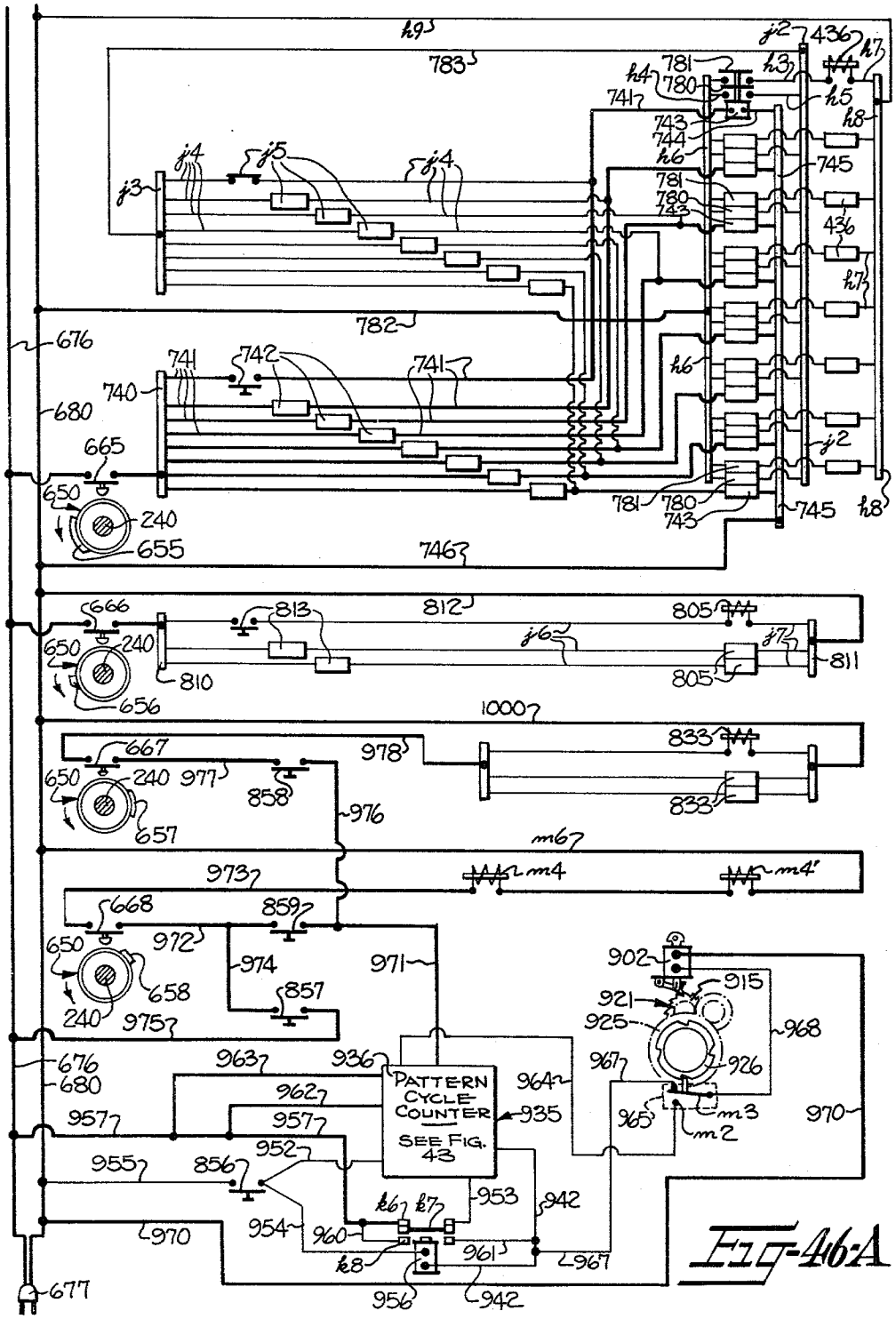


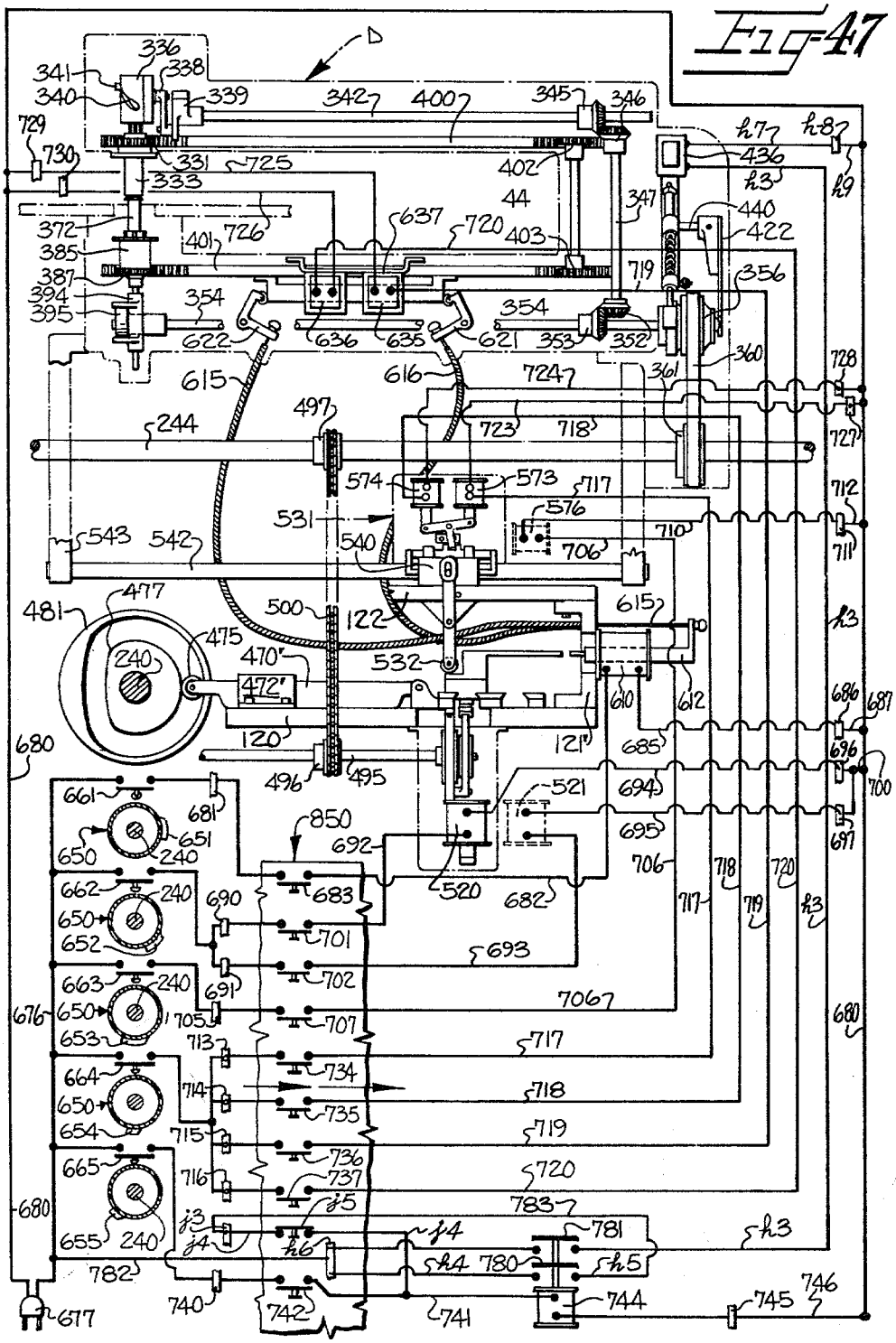
Fig-46A

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Fig-47



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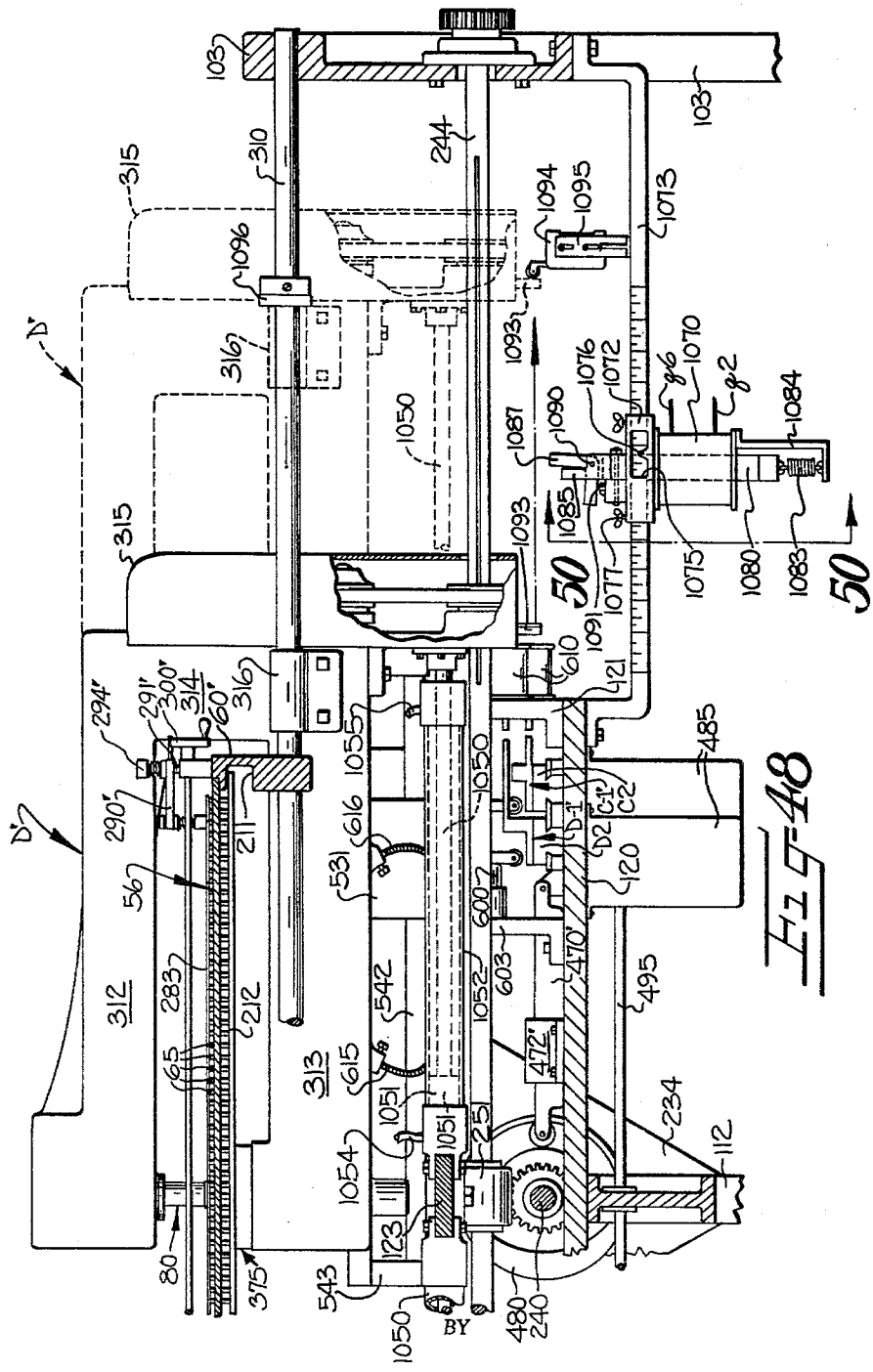


FIG-48

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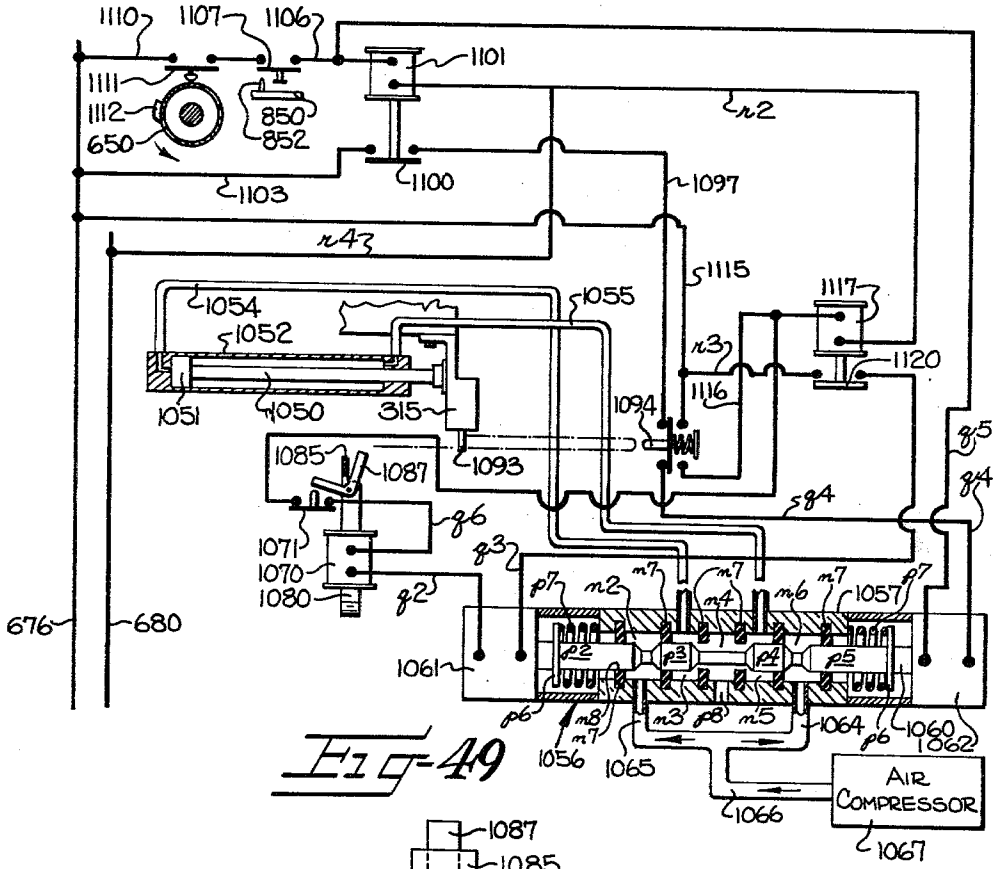


Fig-49

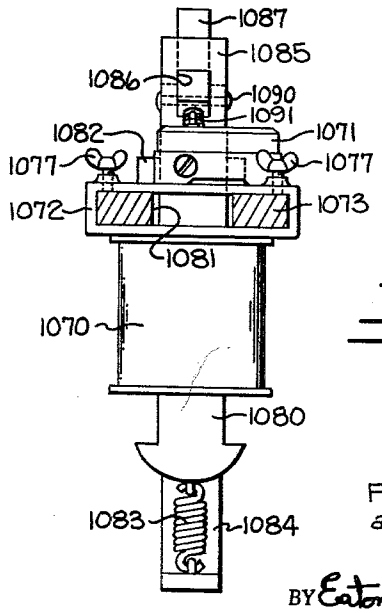


Fig-50

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United States Patent Office

3,184,158

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3,184,158

GARMENT CUTTING MACHINE AND METHOD

Franciscus H. J. Beeren, Gastonia, and William Bain, Charlotte, N.C.; said Bain assignor to said Beeren

Filed Dec. 18, 1961, Ser. No. 159,889
64 Claims. (Cl. 234—3)

This invention generally relates to the art of cutting out garments and other articles and is particularly concerned with a new and novel method and apparatus for automatically cutting out garment blanks and the like from pliable web materials, such as knitted and woven cloth and other fabrics, plastic sheets, leather, rubber, composition sheets, and the like.

In the cutting out of garments, it has been customary, heretofore, to lay many thicknesses of cloth along tables of considerable length. Patterns were then placed upon the top layer of cloth and outlines thereof were drawn with crayon, chalk or any other suitable hand-held marking device. Highly skilled operators would then follow the outlines thus drawn with a hand manipulated cutting instrument usually in the form of an electric jigsaw having a straight-edged reciprocating cutting blade or knife. Other methods have also involved substantially the same procedure.

Such prior methods have been expensive and time-consuming, the long tables have required considerable valuable floor space, and the various thicknesses of cloth would become relatively misaligned during cutting, particular in the cutting of tubular knit fabrics, so that many of the articles had to be discarded or resulted in an inferior finished product.

It is an object of this invention to provide a novel and improved method and apparatus for automatically cutting out articles of various shapes and sizes, which includes feeding a web while traversing one or more cutting devices laterally of the web and turning the blades of such cutting devices at angles corresponding to the angularity of the lines to be cut with respect to the path of travel of the web.

It is another object of this invention to provide a method of forming articles from pliable web material and apparatus for carrying out the method, which method comprises moving the web in a straight path, forming linear and circuitous lines of cut through the web by intermittently moving one or more relatively narrow contour cutter blades through the web while varying the position and angularity of each blade laterally of the web in accordance with the position and angularity of each successive cut to be made to trace a predetermined pattern through the web, repeating the patterned operation of the blade or blades at predetermined spaced intervals with respect to the moving web, and severing the web thus cut into predeterminated lengths to form primary web sections each embodying one of the said predetermined patterns.

It is still another object of this invention to provide a method and apparatus of the character last described in which panel blanks are stamped or die cut from the web at certain spaced intervals in secondary web sections interposed between selected adjacent pairs of said primary web sections.

Another object of the invention is to provide an apparatus including one or more pattern controlled cutting devices which are moved laterally of an intermittently movable web, each cutting device having a substantially vertically reciprocating and substantially triangular contour cutter blade provided with an inclined cutting edge. The blade is turned on its vertical axis to correspond with the angularity of the instant portion of the contour to be cut, and the length of stroke of the blade is varied in proportion to said angularity with consequent variation in the extent of penetration of the web by the blade, so the length of cut at each stroke of the blade is coincident with the angle of cut and with the distance the web is moved during each step in advancement of the web. The lateral positioning of the cutting devices and the angular positioning of the blades occur during advancement of the web and while the blades are withdrawn from the web, and the cutting actions of the blades occur in the intervals between successive advancements of the web.

The principal objects of the invention have been set forth above. Other objects of the invention include novel pattern mechanisms controlling the contour cutting devices; means for severing the web into predetermined lengths; means for cutting out relatively small auxiliary articles from the web, such as pocket facings; means for maintaining straight the opposed side edges of the web; a nest cooperating with each contour cutter blade of the devices to facilitate the cutting operations; and novel means for supporting the web during its passage through the machine.

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

FIGURE 1 is an isometric view looking at the top, front and left-hand side of a preferred embodiment of the machine, with some of the parts being omitted for purposes of clarity;

FIGURE 2 is an isometric view showing the top, front and right-hand side of the machine with the cutter head carriages occupying different positions from that of FIGURE 1;

FIGURE 3 is an isometric view of the frame of the machine shown in FIGURE 2;

FIGURE 4 is an enlarged side elevation looking at the lower side of FIGURE 1, with portions broken away;

FIGURE 5 is a view of the right-hand side of the machine, looking at the opposite side thereof from that shown in FIGURE 4;

FIGURE 6 is a front or egress end elevation of the machine looking at the right-hand side of FIGURE 5 with the main pattern chain broken away;

FIGURE 7 is a top plan view looking down along line 7—7 in FIGURE 4 with portions of the front and rear ends of the machine broken away, and wherein the cutter head carriages A–D, A'–D' occupy the same positions as they do in FIGURE 2;

FIGURES 8 and 8–A are, collectively, an enlarged longitudinal vertical sectional view through the machine taken substantially along line X—X in FIGURE 1;

FIGURE 9 is an enlarged, fragmentary vertical sectional view taken substantially along line 9—9 in FIGURE 7, longitudinally of the machine, and showing some details of the contour cutter heads;

FIGURE 10 is an enlarged fragmentary transverse vertical sectional view taken substantially along line 10—10 in FIGURE 9 and being taken longitudinally through one of the contour cutter head carriages;

FIGURES 11, 11–A and 11–B are, collectively, an enlarged transverse vertical sectional view through the machine taken substantially along line Y—Y in FIGURE 7, with parts broken away;

FIGURE 12 is a fragmentary elevation, partially in section, taken substantially along line 12—12 in FIGURE 10 and showing parts of the single action mechanism for vertically reciprocating one of the contour cutter blades and its respective presser head;

FIGURE 12–A is an enlarged fragmentary sectional plan view taken substantially along line 12–A—12–A in FIGURE 12;

FIGURE 13 is an enlarged exploded isometric view showing many of the essential elements of one of the

contour cutter heads and looking in the general direction of the arrow **13** in FIGURE 9;

FIGURE 14 is an exploded isometric view of essential elements associated with the presser head below the level of the cutter head shown in FIGURE 13;

FIGURE 15 is a fragmentary vertical sectional view taken substantially along line **15—15** in FIGURE 9, transversely of the machine, and showing some details of the cutter head lateral shifting mechanism, the cutter head carriage D being shown in a different position from that in which it appears in FIGURES 7 and 9;

FIGURE 16 is a fragmentary elevation, partially in section, taken substantially along line **16—16** in FIGURE 11–A and showing portions of all four contour cutter head carriages at the right-hand side of the machine;

FIGURE 17 is an enlarged plan view, partially in section and mostly in elevation, taken substantially along line **17—17** in FIGURE 4 and showing, in particular, one arrangement of the increment cams for controlling the lateral shifting movement of the contour cutting devices;

FIGURE 18 is a schematic view of the drive mechanisms of the machine taken as though looking at FIGURE 1;

FIGURE 19 is a fragmentary vertical sectional view taken substantially along line **19—19** in FIGURE 15 showing a cam locating device for determining the extent to which lateral shifting movement is imparted to the respective cutter head carriage;

FIGURE 20 is an enlarged view of an increment clutch mechanism shown in the upper central portion of FIGURE 15;

FIGURE 21 is a vertical sectional view taken along line **21—21** in FIGURE 20;

FIGURES 22 and 23 are fragmentary sectional plan views through the increment clutch mechanism taken substantially along lines **22—22** and **23—23** in FIGURE 20;

FIGURE 24 is an enlarged detail of an auxiliary, straight cross-cutting means located adjacent the ingress end of the machine and taken substantially along line **24—24** in FIGURE 8–A;

FIGURE 25 is a diagrammatic layout of sections of the web illustrating how one type of series of patterned blanks may be cut on the present machine;

FIGURES 26–31 are isometric views of some of the cutter increment cams shown in FIGURE 17, these cams serving to determine the extent of stepped lateral movement of the cutter head carriages and the extent of rotary movement of individual contour cutter blades;

FIGURE 32 is a chart setting forth typical dimensions of various cutter increment cams for effecting certain lateral and angular movements to the contour cutter blades;

FIGURE 33 is a diagram illustrating the length of cut which may be effected by each cutter blade penetrating the web, when occupying each of a plurality of angular positions with respect to the direction of movement of the web;

FIGURE 34 is a flow chart illustrating the sequence of operations of various parts of the machine with respect to movement of the web and main pattern chain in the course of a single step in movement of the web and a single reciprocation of any of the selected contour cutter blades;

FIGURE 35 is a schematic plan view of the main table shown in FIGURE 7, omitting all structure above the level of the table except the main presser plates, the latter being broken away;

FIGURE 36 is an enlarged transverse vertical sectional view taken substantially along line **36—36** in FIGURE 8, showing a group of tertiary or pocket cutter heads and also showing portions of the main table and web feed dogs;

FIGURE 37 is a partially vertically exploded isometric view, partially in section, looking in the general direction of the arrow **37** in FIGURE 36 adjacent the front of the machine, showing portions of the main table in exploded relation to the feed dogs and feed dog base;

FIGURE 38 is an enlarged fragmentary transverse vertical sectional view taken substantially along line **38—38** in FIGURE 8–A, showing parts of the mechanism for driving the web feed dogs, and also showing a main presser plate for applying pressure to the web against a respective row of feed dogs;

FIGURE 39 is a fragmentary top plan view of the structure shown in FIGURE 38, with portions broken away, and showing a presser head for one of the contour cutting devices in association therewith;

FIGURE 40 is an enlarged fragmentary isometric view, partially in section, looking in the general direction of the arrow **40** in FIGURE 39 and showing how gates or segments of the main table are displaced by the presser head of a corresponding contour cutter carriage;

FIGURE 41 is an isometric view looking at the opposite side of the presser head from that shown in the central portion of FIGURE 40;

FIGURE 42 is a fragmentary elevation, partially in section, showing the presser head fastened on a portion of a contour cutter head carriage and taken substantially along line **42—42** in FIGURE 41;

FIGURE 43 is a schematic wiring diagram of a pattern cycle counting circuit for controlling operation of the main pattern chain, with portions of the pattern chain stepping means being shown as though looking along line **43—43** in FIGURE 11;

FIGURE 44 is an enlarged fragmentary vertical sectional view taken substantially along line **44—44** in FIGURE 11 and showing portions of the main pattern chain stepping mechanism;

FIGURE 45 is a fragmentary transverse vertical sectional view taken substantially along line **45—45** in FIGURE 44, and showing one arrangement of the switches controlled by the main pattern chain;

FIGURES 46 and 46–A are, collectively, a schematic diagram of circuits associated with those switches controlled by the main pattern device shown in the left-hand portion of FIGURE 11, the upper end of FIGURE 46–A being an extension to the lower end of FIGURE 46, and showing the associated cycling cams;

FIGURE 47 is a schematic electrical diagram showing the electrical controls for a single contour cutter head and carriage;

FIGURE 48 is a fragmentary vertical sectional view, mostly in elevation, similar to combined FIGURES 11–A and 11–B, but showing means for returning each cutter head carriage to a predetermined starting position adjacent a longitudinal side edge of the main table following the cutting of each blank, such means being omitted in FIGURES 1 through 47 for purposes of clarity;

FIGURE 49 is a schematic diagram of electrical and fluid pressure circuits for controlling the return of the corresponding contour cutter head carriage to starting position utilizing the apparatus shown in FIGURE 48;

FIGURE 50 is a vertical sectional view, mostly in elevation, taken substantially along line **50—50** in FIGURE 48.

The specification is divided into chapters as follows:

I. Brief Synopsis of the Invention
II. The Frame
III. Web Spreader Feeding Devices
IV. The Main Table
V. Feed Dog Supporting and Operating Means
VI. Web Hold-Down Means
VII. Main or Contour Cutter Head Carriages
VIII. Contour Cutter Heads
IX. Contour Presser Heads
X. Clutch for Main Cutter Head and Presser Head
XI. Carriage Stepping and Blade-Angle Selecting Means
XII. Increment Cam Switching Means

XIII. Incremental Motion Transmitting Elements Between Cutter Increment Cams and Main Carriages
XIV. Means for Transmitting Angular Movement to Contour Cutter Blades from the Increment Cams
XV. Cycling Drum and Related Electrical Circuits
XVI. Secondary Cutter Heads
XVII. Tertiary or Pocket Cutter Heads
XVIII. Main Pattern Mechanism
XIX. Means for Cycling Operations of Pocket Cutter Heads
XX. Operation of Pocket Cutter Cycling Mechanism
XXI. Web Cutting-Off Device
XXII. Mechanism for Resetting Cutter Head Carriages
XXIII. Operation of Carriage Resetting Mechanism

I. BRIEF SYNOPSIS OF THE INVENTION

The novel machine for carrying out the present method is particularly devised for cutting out variantly shaped articles from a moving length of tubular knit material or web W (see FIGURE 25), although it will be apparent, as the description proceeds, that many different types of web materials may be cut into various types of articles on the present machine. Since the machine is particularly devised for cutting out articles from tubular knit material, the ingress end of the machine is provided with guiding and feeding means which may be of a type substantially as disclosed in U.S. Patent No. 2,228,001 granted to S. Cohn et al. on August 7, 1941.

Two such guiding and feeding means are shown in FIGURES 1, 2, 4 and 5, broadly designated at **50** and **51**, in the form of spreader feeders which are spaced one above the other and whose proximal front ends converge toward each other so that tubular webs fed by either of the devices **50** or **51**, or both, are directed to and between a pair of upper and lower feed rolls **52**, **53** which may be continuously or intermittently driven. Feed rolls **52**, **53** direct the web between a transverse web ingress presser plate **54** and a rear or ingress feed table plate **55** of a main web supporting table or platform, broadly designated at **56**, mounted upon a pair of laterally spaced, longitudinally extending side rails **60**, **60'**. Side rails **60**, **60'** are carried by a main frame broadly designated at **62** (FIGURES 3 through 7, 11–A, 16 and 35 through 39).

The web W is fed along the upper surface of main table **56** by any suitable means, which is embodied herein in the form of a plurality of transverse rows of forwardly and rearwardly extending serrated feed dogs which operate in the manner of the feed dog of a conventional sewing machine, for example. In FIGURES 8 and 8–A, there are four sets of feed dogs shown, including a transverse row of ingress feed dogs **64**, a plurality of transverse rows of main, intermediate, feed dogs **65**, a transverse row of pocket cutter feed dogs **66** of varying length (FIGURES 8 and 37), and a plurality of transverse rows of egress feed dogs **67**. The upper edges of feed dogs **64–67** are each serrated to form forwardly inclined teeth thereon (FIGURES 8, 8–A, 37 and 40), and are adapted to revolve in corresponding rectangular slots formed through the main table **56** so as to move upwardly against, and impart forward movement to, the web W in the interim between successive cutting strokes of cutter blades to be later described.

In the right-hand upper portion of FIGURE 8–A, it will be observed that the transverse ingress platform **55** of the main table **56** has slots **70** for the ingress feed dogs **64**. The slots formed in main table **56** and through which the intermediate transverse rows of feed dogs **65** are adapted to move are indicated at **71** (FIGURES 8–A, 35 and 37 through 40), the slots for the die base feed dogs **66** are indicated at **72** (FIGURES 35, 36 and 37), and the slots for the egress feed dogs **67** are indicated at **73**.

Mounted on each side of the machine is a plurality of spaced laterally movable contour cutter head carriages,

any desired number of which may be provided depending upon the character of the articles to be cut from the web W. In this instance, four cutter head carriages are shown at each side of the machine, the cutter head carriages at the right-hand side of the machine (FIGURE 5) being indicated at A–D, and the cutter head carriages at the left-hand side of the machine (FIGURE 4) being indicated at A'–D'.

The cutter head carriages and associated cutting mechanisms at one side of the machine in FIGURE 1 are substantially the same as those at the other side of the machine, except for various parts thereof being opposite hand and, since all the carriages A–D are identical, only carriage D will be described in detail later in this context, and the same reference characters will be applied to similar parts associated with each of the cutter head carriages A–D and A'–D'.

As best shown in FIGURE 9, each cutter head carriage includes a contour cutter head broadly designated at **80** and including a downwardly pointed right-triangularly-shaped contour cutter blade **81**, which is rotated about a vertical axis corresponding substantially to the perpendicular edge thereof, this rotation being effected to an extent determined by a main pattern mechanism broadly designated at **82** and intervening increment cams to be later described. During each advancement of the web W by the feed dogs **64–67**, all of the cutter blades **81** occupy the raised position above the level of the web W, as occupied by the blade **81** associated with carriage D in FIGURE 9. In the interim between successive advancements of the web, certain of the blades **81** move downwardly in accordance with the patterning of pattern device **82**.

Means are provided under control of the main pattern mechanism **82** for (1) moving each selected cutter head carriage laterally inwardly or laterally outwardly a predetermined distance; (2) causing each cutter blade **81** to occupy a predetermined angular position with respect to the direction of movement of the web; and (3) determining the extent to which each contour cutter blade **81** will penetrate the web, these three operations preferably occurring, for the most part, while a step in movement is being imparted to the web. It might be stated that the depth of penetration of the web by each contour cutter blade **81** determines the length of the slit or cut formed by the blade due to the angular or inclined cutting edge of the blade.

An active stroke of each selected contour cutter blade is preferably initiated while the web is moving, but is completed while the web is at a standstill; i.e., static, following each cycle of the three last-mentioned steps in control thereof. It should be noted that the active strokes of the contour cutter blades **81** are pattern controlled so that one or more of the contour cutter blades, all of the contour cutter blades, or none of the contour cutter blades may be actuated with certain advancements of the web W, depending upon the shape of the blank or blanks to be cut therefrom (FIGURE 25).

Although relatively short lateral cuts may be effected by the main contour cutter blades **81**, other means are preferably provided for effecting such relatively short lateral cuts, such lateral short cuts being effected by one or more pattern controlled and manually adjustable secondary cutter heads **85** (FIGURES 8–A and 24) which are located at a point between feed rolls **52** and **53** and the first pair of the main cutter head carriages A, A'. Each of the secondary cutter heads **85** comprises a normally raised, electromagnetically-operated straight cutter blade **86** which is normally spaced above the web and is lowered, momentarily, to penetrate and cut the web at selected intervals and in timed relation to actuation of the main contour cutter blades **81**. Heated wire-type cutters and/or printing press heads may be substituted for blades **86**, if desired.

Also, during certain static intervals between successive movements of the web, a plurality of tertiary or die cut-

ter heads 87 (FIGURES 1, 2, 4–8, 16 and 36) are actuated to momentarily move respective endless or die cutting blades 88 from a normally raised position, above the level of the web W and main table 56, downwardly through the web, for cutting individual blanks, such as pocket panels, pocket flaps, gussets or the like. In the present embodiment of the invention, the die cutting blades 88 are shown in the shape of pocket panels and, accordingly, the cutter heads 87 will be referred to hereinafter as pocket cutter heads, although it is to be distinctly understood that this is a generic term to include a cutter head capable of cutting out complete relatively small articles of any desired configuration. The pocket cutter heads 87 are preferably located forwardly of the foremost main cutter head carriages D, D' and may be operated at relatively infrequent intervals as compared to the main cutter heads 80 and secondary cutter heads 85, as will be later explained.

Following the cutting out of each set of one or more blanks from the web (FIGURE 25), and during a selected static interval in the movement of the web, the web is severed into the desired predetermined length by a web cutting-off or sundering device broadly designated at 95 (FIGURES 1, 2 and 4–8) which is shown in the form of an endless cutting blade or sharp-edged band 96 mounted on a pair of laterally spaced pulleys 97, 97' journaled in a tiltable frame 100. The pulley 97' is continuously driven, and pattern controlled means are provided for tilting the frame 100 so that the rear run of blade 96 momentarily moves downwardly in the aforesaid manner to penetrate and sever the web throughout its width.

In FIGURE 25, portions of the web W are shown upon which solid lines are superimposed to represent the various patterned lines of cut formed by the cutting devices heretofore described. In this instance, the web W of FIGURE 25 is cut into three different types of blanks which may be termed as a sleeve blank S–1, a shirt-body blank S–2 and a group of pocket panel blanks S–3. The web W is cut into two different sizes of web sections by sundering device 95, following the contour cutting and die cutting operations. The primary web section is indicated at W' and the secondary section is indicated at W2, the web W being severed at the junctures of these sections by the sundering device 95 along cut lines *c'*, *c2*.

The sleeve and shirt-body blanks S–1, S–2 are formed of each web section W' and the pocket panel blanks S–3 are formed of each intervening web section W2. Due to web W being tubular in this instance, two sleeve blanks S–1 are cut out simultaneously and six pocket panel blanks S–3 are cut out simultaneously. Thus, a secondary web section W2 is formed preferably following the formation of every series of six primary web sections W'. With the exception of relatively short lateral cut lines *c3*, *c4*, *c4'* at the rear central portion of sleeve blank S–1 and the front outermost edge portions of shirt-body blank S–2, the remaining cut lines are formed through each web section W' by the various main contour cutter blades 81, as will be later described in detail.

The relatively short straight lateral cut lines *c3*, *c4*, *c4'* may be formed by the blades 86 of the secondary cutting devices 85. Each sleeve blank S–1 is formed, in this instance, by opposed outwardly and rearwardly flared cut lines 2C, 2A' and opposed inwardly and rearwardly curved cut lines 2C2, 2A2 which terminate at the central lateral cut line *c3*. The lines 2C, 2C2 are cut by that blade 81 associated with cutter head carriage C and the lines 2A', 2A2 are cut by that blade 81 associated with cutter head carriage A'.

Each shirt-body blank is formed by laterally opposed inwardly and rearwardly curved neck-opening cut lines 2B, 2D' whose proximal ends terminate at the distal ends of opposed shoulder cut lines 2D, 2B'. A rearwardly extending arm-opening is formed at the juncture of cut lines 2D, 2B' and is defined by curved relatively convex cut lines 2A, 2C' which meet at their rearmost ends at a point P.

Cut lines 2A, 2B, 2D, 2B', 2C' and 2D' are cut by those blades 81 associated with the respective cutter head carriages A, B, D, B', C' and D'. Of course, the sequence of operation of the various cutter head carriages may be varied in accordance with the particular contours of blanks to be formed on each web section W'.

Referring to FIGURE 25, it will be observed that each of the cut lines 2A, 2B, 2C, 2C2, 2A', 2A2, 2C' and 2D' has a plurality of variantly spaced dots thereon. These dots are provided to indicate points along the respective cut lines at which the angles of cut of the corresponding contour cutter blades 81 are changed, although several cuts may be formed by the contour cutter blades 81 associated with the corresponding cutter head carriages between certain adjacent dots. The dash-and-dot lines extending across the web section W' of FIGURE 25 each represents the distance the web is advanced from right to left during eight reciprocations or cutting operations of the corresponding contour cutter blades, the distance between the latter dash-and-dot lines being one inch in this particular embodiment of the invention.

In cutting out the blanks S–1 and S–2 in FIGURE 25, the sequence of operation of the contour cutter blades 81 of the eight cutter head carriages may be substantially as follows:

(1) The contour cutter blade 81 of cutter head carriage A' completely forms cut line 2A' and forms most of cut line 2A2 whereupon the blade 81 of cutter head carriage C starts the formation of cut line 2C from left to right in FIGURE 25.

(2) Upon contour cutter blade 81 of carriage A' completing the formation of cut line 2A2, contour cutter blade 81 of cutter head carriage A starts the formation of cut line 2A.

(3) While cutter head carriage A is in the process of forming cut line 2A, cutter head carriage C is in the process of forming cut lines 2C and 2C2.

(4) Cut line 2A2 is completed by cutter 81 of carriage A', carriage A is forming cut line 2A, and cutter 81 of carriage C very nearly completes the formation of cut line 2C at the time that contour cutter blades 81 of cutter head carriages B, B' start the formation of respective cut lines 2B, 2B'. The latter cutter head carriages B, B' complete the formation of cut lines 2D, 2D' before cutter head carriage C completes the formation of cut line 2C.

(5) The blade 81 of cutter head carriage C then completes the formation of cut line 2C and also starts and completes the formation of cut line 2C2.

(6) When cut line 2A has been completed to a point within approximately ½ inch of the point P in FIGURE 25 by cutter head carriage A, cutter head C' starts formation of cut line 2C' and continues formation of the same after cutter head carriage A has ceased operation in the cutting of cut line 2A.

(7) In this instance, before cutter head carriage C' has half completed formation of cut line 2C', the leading or left-hand ends of cut lines 2D, 2D' will have reached a position in vertical alinement with the contour blades 81 of the respective carriages D, D'. Thereupon, the carriages D, D' start the formation of the respective cut lines 2D, 2D', the latter cut lines being completed while the contour cutter head carriage C' is still cutting along cut line 2C'.

(8) Thereafter, all the cutter head carriages, except carriage C', remain inactive or are moved to reset positions while the carriage C' completes the cut line 2C' to the point P on web section W' of FIGURE 25.

It is apparent from the foregoing description that certain of the contour cutter blades 81 perform cutting operations at the same time as others, and that certain blades 81 may be performing cutting operations at the same time that the secondary or tertiary cutter heads 85

or 87, or the web sundering device 95, are operating. In this instance, the pocket panel blanks S–3 are formed by the die cutter blades 88 of pocket cutter heads 87 in web sections W2 (FIGURE 25) at substantially the same time that cutter head carriage A completes formation of cut line 2A. Thus, in this instance, the cut lines 2C', 2D and 2D' are formed after a set of pocket panel blanks S–3 have been formed in a preceding web section W2. However, secondary web section W2 is not always formed between adjacent primary web sections W', as explained heretofore.

II. THE FRAME

Referring to FIGURES 1 through 8–A, in particular, the main frame 62 of the machine comprises a pair of front, upright side frames 102, 102', a pair of laterally spaced intermediate, upright, outside frames 103, 103', and a pair of rear, upright, side frames 104, 104'. The front, upright frames 102, 102' are closer together than the intermediate, upright, outside frames 103, 103' and are suitably secured to opposed ends of upper and lower transverse frame members 105, 106. The front edges of front upright frames 102, 102' are connected to opposite ends of upper and lower transverse frame members 110, 111.

A sampson 112, of lesser height than the intermediate, upright, outside frames 103, 103', is located approximately midway between the upright frames 103, 103' (FIGURES 3, 8 and 8–A), and a medial portion of lower transverse frame member 106 is suitably secured thereto. Upper and lower transverse frame members 113, 114 extend between and are connected to the rear portions of intermediate, upright, outside frames 103, 103', and a medial portion of transverse frame member 114 is connected to the front edge of sampson 112 (FIGURE 8). The rear, upright, side frames 104, 104' are spaced closer together than the intermediate, upright, outside frames 103, 103' and their front ends are suitably secured to the transverse frame members 113, 114. A transverse frame member 115 is suitably secured to and extends between the rear portions of rear side frames 104, 104'. The main table side rails 60, 60' are suitably secured to the upper surfaces of the transverse frame members 110, 105, 113.

A main, substantially rectangular, base 120 (FIGURES 3–6, 8, 8–A, 9, 11–A, 15 and 17) is suitably secured to the upper surface of sampson 112. Opposed side portions of main base 120 have respective rows of longitudinally spaced blocks 121, 121', suitably secured thereto, to the upper ends of which the outer ends of longitudinally spaced, transverse spars 122 are suitably secured. Spars 122 extend inwardly from blocks 121, 121' and their proximal ends are connected to a common longeron 123 whose front and rear ends are suitably secured to the transverse frame members 105, 113. It is apparent, by referring to FIGURE 3, that spars 122 and longeron 123 collectively form an open-frame intermediate base spaced between the main table 56 and the main base 120.

III. WEB SPREADER FEEDING DEVICES

(FIGURES 1, 2, 4, 5 and 7)

As heretofore stated, the present machine is particularly adapted for cutting out blanks from tubular knit web fabric and is, therefore, provided with the spreader feeding devices 50, 51 which are generally of the type disclosed in said U.S. Patent No. 2,228,001. The web spreader feeding devices 50, 51 may also include features such as are disclosed in U.S. Patents Nos. 2,190,860 and 2,222,794. Since both of the web spreader feeding devices 50, 51 are substantially the same, only one of them will be described and the same reference characters shall apply to both of them, in order to avoid repetitive description.

Each web spreader feeding device 50, 51 comprises a substantially U-shaped bow 130 about which the respective web is positioned, and opposed ends of which are connected to the rear ends of a pair of laterally spaced and laterally adjustable arms 131, 131'. The outer, rear, ends of arms 131, 131' are attached to respective brackets 132, 132'.

Each pair of brackets 132, 132' is threadedly penetrated by oppositely threaded opposed portions of an adjustment screw shaft 133. Opposed ends of each adjustment screw 133 are journaled in upper portions of rear upright side frames 104, 104'. A hand wheel 135 is provided on one end of each threaded shaft 133 (FIGURES, 1, 2, 4, 5 and 7) for adjusting the arms 131, 131' relative to each other to accommodate the desired width of tubular web material.

Each bracket 132, 132' has a shaft 136 journaled therein, on the upper end of which a pulley or external pressure roller 137 is fixedly mounted, and on the other end of which a bevel gear 140 is mounted. Each bevel gear 140 engages and normally rests against a corresponding bevel gear 142 (FIGURES 4 and 5), there being a pair of bevel gears associated with each the upper and the lower spreader feeding device 50, 51. Each pair of bevel gears 142 is keyed for axial movement on a corresponding shaft 143 journaled in the rear upright side frames 104, 104'.

The shafts 143 may be driven continuously or intermittently to feed the web to the feed rolls 52, 53 at a speed corresponding to the speed at which the web is moved by the feed dogs 64–67 heretofore described. In this instance, the shafts 143 are shown as being continuously driven by means of sprocket wheels 145. One of the sprocket wheels 145 is provided on one end of each shaft 143.

Each sprocket wheel 145 (FIGURES 4 and 7) is engaged by an endless sprocket chain 146, which sprocket chains converge and are mounted on a pair of sprocket wheels 147 (FIGURES 1 and 4) fixed on an output shaft 150 of a suitable variable speed transmission 151, the output speed of which may be adjusted relative to the input speed by any suitable means such as a hand-wheel 152. Since there are many different types of variable speed transmissions which may be used for the intended purpose, a detailed illustration and description thereof is deemed unnecessary.

The variable speed transmission 151 has an input shaft 153 projecting therefrom on which a sprocket wheel 154 is fixedly mounted. Sprocket wheel 154 is engaged by an endless sprocket chain 155 which also engages one of a pair of sprocket wheels 156. Sprocket wheels 156 are fixed on an input shaft 157 of a second variable speed transmission 160 which may be of the same type as variable speed transmission 151. The other sprocket wheel 156 on input shaft 157 has a sprocket chain 162 mounted thereon which is also mounted on a sprocket wheel 163. Sprocket wheel 163 is fixed on one end of a shaft 164 journaled in the front portions of rear upright side frames 104, 104'. Shaft 164 may be continuously driven in a manner to be later described.

As heretofore stated, the tubular web W is stretched into a flat state by the corresponding spreader feeding device 50 or 51, as the case may be, and is drawn off of the free forward ends of the corresponding arms 131, 131' by the feed rolls 52, 53. If so desired, each of the arms 131, 131' may have a plurality of grooved rollers 166 journaled therein. The grooved rollers 166 associated with each each arm 131, 131' may have an endless belt 167 entrained thereover to assist in advancing the tubular web W to the nip of feed rolls 52, 53.

Feed rolls 52, 53 are journaled in suitable bearings 170, 170' carried by the upper portions of respective rear side frames 104, 104'. One end of at least one of the feed rolls (the feed roll 52 in this instance) is connected to the output side of the variable speed transmission 160 and thus feeds the web onto the main table 56.

IV. THE MAIN TABLE

(FIGURES 8, 8–A, 9, 11–A and 35 through 40)

The main table **56** comprises a series of transverse plates, the rearmost of which is indicated at **55**, and which plates are provided with slots **70–73** (FIGURES 8, 8–A and 35) in which respective feed dogs **64–67** have forward and rearward reciprocating movement in somewhat rotary paths for advancing the web W in a step-by-step manner. Reading from the rear end to the front end of main table **56** (FIGURES 8, 8–A and 35), subsequent to the ingress feed table **55**, it will be noted that main table **56** includes a series of transverse plates **180–187**. Plate **180**, which is adjustably secured to the rails **60, 60'** for forward and rear adjustment, may be termed as a secondary cutter head base plate; the plates **181–185**, which are spaced apart from each other, may be termed as main cutter head straddle plates; the plate **186** which is contiguous to main cutter head straddle plate **185**, may be termed as a pocket cutter head base plate, and transverse plate **187** may be termed as an egress table plate.

The egress table plate **187** is spaced forwardly from pocket cutter head base plate **186** to accommodate a grooved band cutter base plate **188** therebetween. The band cutter base plate **188** is provided with a longitudinally extending groove **190** in the upper surface thereof, which extends throughout the width of table **56** and is adapted to receive the corresponding run of the endless blade **96** of sundering device **95** (FIGURE 8).

As heretofore stated, secondary cutter head base plate **180** is adjustably secured to side rails **60, 60'**. To this end, opposed ends of the plate **180** are provided with slots **193** (FIGURE 35) which are penetrated by adjustment screws **194** threadedly embedded in the side rails **60, 60'**. In order to permit the straight cutter blades **86** of the secondary cutter heads **85** to pass through the web W, the front edge of secondary cutter head base plate **55** is spaced from the rear edge of the rearmost main cutter head straddle plate **180**, thus forming a groove or slot **195** therebetween.

In order to accommodate the presser heads (FIGURES 35, 40, 41 and 42) associated with each opposed pair of cutter head carriages, to be later described, the main cutter head straddle plates are spaced from each other to form a transverse gate slot or gap **196**, extending throughout the width of the main table **56**, between each adjacent pair of said cutter head straddle plates **181–185**. In this instance, there are four such transverse gate slots **196** shown in FIGURE 35 to accommodate the eight carriages A–D and A'–D' at opposite sides of the machine.

The rear edge of each straddle plate **182–185** has a gate abutment bar **200** suitably secured thereto, or formed integral therewith, whose lower portion has a rearwardly projecting flange **201** thereon (FIGURE 40) which is provided with a plurality of notches **202** therein. Each of the notches **202** is adapted to receive a follower pin **203** projecting downwardly from the lower surface of, and disposed at the front end of, a corresponding movable gate element **204**, there being a transverse row of said gate elements **204** normally bridging each of the gaps **196** between said straddle plates **181–185**.

Each gate element **204** is preferably tapered downwardly and rearwardly at its upper surface and is guided for longitudinal sliding movement in a correspondingly tapered channel or cavity **205** (FIGURES 39 and 40) formed in the front edge of the corresponding straddle plate which front edge forms the rear boundary of the respective gap **196**. In other words, the front edge of each main cutter head straddle plate **181–184** is provided with the rearwardly extending channels **205** therein. The bottoms of the channels **205** may be closed by plates **206** (FIGURE 40) suitably secured to the lower surfaces of the straddle plates **181–184**.

It will be noted that there is preferably one of the gate elements **204** provided between each adjacent pair of feed dog slots **71** located adjacent the front edges of the straddle plates **181–184**, and those portions of the front edges of the latter plates which complement the cavities **205** are preferably tapered rearwardly from a sharp or feather edge, as best shown in FIGURES 9 and 40, so that the upper surfaces of the gate elements **204** may be substantially flush with the upper surfaces of the corresponding straddle plates **181–184**. The gate elements **204** are mounted in the aforesaid manner so that they may be moved rearwardly, to open position, and forwardly to closed position by a presser head housing in a manner to be later described.

V. FEED DOG SUPPORTING AND OPERATING MEANS

(FIGURES 8, 8–A, 9, 11–A, 36, 37, 38, 39 and 40)

The transverse rows of feed dogs **64, 65** are fixed to the upper surface of a movable fed dog platform **210** (FIGURES 8, 8–A and 11–A) whose opposed longitudinal side edge portions are loosely positioned in longitudinal grooves **211** formed in the proximal surfaces of the main table side rails **60, 60'**. In order to minimize the weight of support platform **210** and to also accommodate the contour presser head housings associated with carriages A–D and A'–D', the feed dog support platform **210** is provided with a series of transverse slots **212**, there being one of the latter slots between each adjacent pair of rows of feed dogs (FIGURES 8, 8–A, 9 and 37).

An egress feed dog support platform **213** is also provided for feed dogs **67**, the support platform **213** being of substantially the same construction as the support platform **210**. It will be observed in FIGURE 8 that support platform **210** is spaced rearwardly of support platform **213**, and the proximal portions of platforms **210, 213** are interconnected by an intervening feed dog support platform **214** positioned on a lower level than the platforms **210, 213** in order to accommodate the greater thickness of the pocket cutter head base plate **186** as compared to the thickness of the plates **55, 181–185** and **187** of the main table **56**.

The front and rear portions of said intervening feed dog support plate **214** (FIGURE 37) are each provided with a plurality of upwardly projecting spacer elements **215** which are, in turn, connected to the main and egress feed dog support platforms **210, 213** so that all the feed dog platforms **210, 213, 214** are movable in fixed relationship.

It will be observed in FIGURES 8, 8–A, 36 and 38 that the feed dog support platforms **210, 213, 214** are carried by rear and front pairs of cam follower blocks **220, 220'** and **221, 221'** whose arcuately grooved lower surfaces rest upon respective pairs of eccentric cam wheels **222, 222'** and **223, 223'**. In this instance, the cam follower blocks **220, 220'** are suitably secured to the lower surface of the rear portion of the main feed dog support platform **210** (FIGURES 8–A and 38) and the front cam follower blocks **221, 221'** are suitably secured to the lower surface of said intervening feed dog support platform **214** (FIGURES 8 and 36).

The cam wheels **222, 222'** are fixed on the rear auxiliary cam shaft **164** and the front cam wheels **223, 223'** are fixed on a front auxiliary cam shaft **164'** (FIGURES 17, 36 and 38). The auxiliary cam shafts **164, 164'** are journaled in respective pairs of bearings **225, 225', 226, 226'** suitably secured to the lower surfaces of main table side rails **60, 60'**. The rear and front auxiliary cam shafts **164, 164'** have respective bevel gears **230, 230'** fixed on medial portions thereof (FIGURES 18, 38 and 36) which engage respective bevel gears **231, 231'** fixed on the upper ends of respective substantially vertical stub shafts **232, 232'**.

As best shown in FIGURES 8–A and 8, the stub shafts **232, 232'** are journaled in respective brackets **233, 233'**.

The forwardly projecting stem of the rear bearing bracket **233** is suitably secured to a gusset plate **234** extending between and being suitably secured to the rear portion of sampson **112** and the upper transverse frame member **113**. The rearwardly projecting stem of bearing bracket **233'** is suitably secured to a front gusset plate **234'** (FIGURES 3 and 8) extending between and being suitably secured to the front edge of sampson **112** and the transverse frame member **105**.

The lower ends of stub shafts **232, 232'**, have respective bevel gears **236, 236'** fixed thereon which engage and mesh with respective bevel gears **237, 237'** fixed on the rear and front portions of a longitudinally extending main cam shaft **240** (FIGURES 8, 8–A, 11–A and 18). It will be observed in FIGURES 8 and 8–A that main cam shaft **240** loosely penetrates gusset plates **234, 234'** and is journaled in a pair of bearings **241, 241'** suitably secured to the outer surfaces of gusset plates **234, 234'**. A medial portion of shaft **240** is also journaled in a bearing block **243** (FIGURES 8–A and 17) suitably secured to the main base plate **120**.

In order to reciprocate the contour cutter blades **81** and their respective guides or presser heads, to be later described, a separate cutter drive shaft **244** is provided for each opposed pair of cutter head carriages. In other words, one of the cutter drive shafts **244** is spaced beneath carriages A, A', one of the shafts **244** is spaced beneath carriages B, B', one of the shafts **244** is spaced beneath carriages C, C', and one of the shafts **244** is spaced beneath carriages D, D'.

The cutter drive shafts **244** are suitably journaled in respective pairs of bearings **250, 250'** suitably secured to the respective outside upright frames **103, 103'** (FIGURES 5, 4, 11 and 11–B). Medial portions of all but the rearmost shafts **244** are journaled in bearings **251** fixed to the lower surface of longeron **123** (FIGURES 8, 8–A, 11–A, and 17). Referring to FIGURES 8–A, 17 and 18, it will be observed that the rearmost of the shafts **244** has a spiral gear **254** fixed thereon which meshes with a spiral gear **255** fixed on the main cam shaft **240**.

All of the cutter drive shafts **244** are driven in the same direction and at the same speed. In this instance, it will be observed in FIGURES 1, 4, 7 and 18 that the rearmost cutter drive shaft **244** is driven by an electric motor **256**, to which the latter shaft **244** is connected by pulleys **257** and **260** fixed on the rearmost shaft **244** and on the shaft of motor **256**, and which pulleys are engaged by an endless belt **261**. Electric motor **256** may be secured to a bracket **262** carried by the intermediate outside upright frame **103'** (FIGURES 1 and 4).

The four shafts **244** may be interconnected by a gear train which, as best shown in FIGURE 4, includes a gear **265** fixed on one end of each shaft **244**. A transmission gear **266** is provided between each adjacent pair of gears **265**. Each transmission gear **266** may be journaled on a stub shaft **267** suitably secured to and projecting outwardly from upright side frame **103'** of main frame **62**.

From the foregoing description, it is apparent that the rearmost cutter drive shaft **244** transmits rotation to main cam shaft **240** through the helical gears **254, 255**, and main cam shaft **240** transmits rotation to the auxiliary cam shafts **164, 164'**, the eccentric cams **222, 222'** (FIGURES 18, 38 and 8–A), and the eccentric cams **223, 223'** (FIGURES 8, 18 and 36).

The rear and front auxiliary cam shafts **164, 164'** rotate in a counterclockwise direction in respective FIGURES 8–A and 8 so that movements of the high points of cams **222, 223**, into engagement with cam follower blocks **220, 221**, imparts upward and forward movement to all the feed dogs **64–67**, during the course of which the feed dogs move upwardly through the respective slots **70–73** in main table **56** while moving forwardly in engagement with the lower surface of the web W, and to thereby advance the web a predetermined distance with each revolution of

the auxiliary cam shafts **164, 164'**. It is apparent that, as the low surfaces of the cams **222, 223** (FIGURES 8–A and 8) engage the respective cam follower blocks **220, 221**, this causes the feed dogs **64–67** to move downwardly and rearwardly preparatory to another advancing movement of the web being effected.

VI. WEB HOLD-DOWN MEANS

(FIGURES 4, 5, 7, 9, 11–A, 16, 35, 38 and 39)

In order to insure that the web W is maintained in a flat lightly tensioned state as it is advanced along the main table **56**, and to also insure that the web is properly engaged by the teeth on the feed dogs **64–67** to thereby advance the web a predetermined distance with each active movement thereof, means are provided for applying pressure at spaced points to the upper surface of the web to lightly but releasably clamp the web against the upper surface of the main table **56**, such means being embodied herein in web-holding presser plates which cooperate with the feed dogs **64–67** in a manner somewhat similar to the presserfeet of conventional sewing machines.

As heretofore stated, feed rolls **52, 53** direct the web W between transverse web ingress presser plate **54** and the ingress feed table plate **55** of main table **56** (FIGURES 7 and 8–A). The ingress presser plate **54** may be pivotally supported at its rear portion adjacent the bight of feed rolls **52, 53**. In this instance however, the rear portion of ingress presser plate **54** merely rests upon the cloth W as it is advanced by rolls **52, 53**.

Ingress presser plate **54** overlies ingress feed dogs **64** (FIGURE 8–A) and is urged toward the upper surface of the plate **55** of main table **56** by compression spring **276**, only one of which is shown in FIGURE 8–A. The lower ends of compression springs **276** bear against a suitable pivot block pivoted to the upper surface of the ingress presser plate **54**, adjacent the two front corners thereof, and the upper end of each compression spring **276** bears against an overlying portion of an inverted substantially L-shaped bracket **277** (FIGURES 7 and 8–A). It will be observed in FIGURES 4 and 5 that brackets **277** are suitably secured to the rear portion of main table side rails **60, 60'**.

It will be observed in FIGURES 8–A, 35, 38 and 39 that a relatively narrow, elongate presser plate (**282** or **283**) overlies each transverse row of main and egress feed dogs **65, 67** and extends substantially throughout the width of the main table **56**. There are eight pairs of said main presser plates provided, each of said pairs being separately supported. Accordingly, only one adjacent pair of said main presser plates and its associated supporting means will be described, and like reference characters shall apply to the remaining pairs of main presser plates and their respective supporting means, in order to avoid repetitive description.

As best shown in FIGURES 35, 38 and 39, the presser plates of each of said pairs are indicated at **282, 283**. Each main presser plate is preferably made from a narrow, elongate strip of sheet metal, plastic or other smooth, rigid material, the front and rear edges of which are turned upwardly as best shown in FIGURE 9. Opposite end portions of each main presser plate **282, 283** are pivotally connected to the lower portions of respective blocks **284, 284'** (FIGURES 9 and 38) fixed on the lower ends of headed pins **286, 286'** and whose upper surfaces are engaged by respective compression springs **287, 287'**.

The upper ends of the springs **287, 287'** associated with each pair of main presser plates **282, 283** bear aaginst the lower surfaces of main presser guide plates or brackets **290, 290'** which project outwardly and are guided for vertical sliding movement on respective pairs of guide posts **291, 291'** (FIGURES 9, 35, 38 and 39). The headed pins **286, 286'** are guided for vertical sliding movement in the presser guides **290, 290'**.

The presser guide plates **290, 290'** associated with each of said pairs of main presser plates **282, 283** are urged

downwardly by respective compression springs 293, 293' whose lower ends bear against the respective guide plates 290, 290' and whose upper ends bear against respective vertically adjustable cap plates 294, 294' which are adjustably mounted on respective pairs of posts 291, 291' by means of set screws 295, 295' (FIGURE 38).

As best shown in FIGURE 11–A, the presser guide plates 290, 290' have respective outwardly projecting follower pins 297, 297' thereon which engage the upper peripheral surfaces of respective hand-operated cams 300, 300' provided with respective crank handles 301, 301' thereon. Each pair of cams 300, 300' is eccentrically mounted on a transverse shaft 302 journaled in bearing blocks 303, 303' (FIGURES 9, 11–A, 38 and 39) fixed on the side rails 60, 60' of main table 56.

The cams 300, 300' are so formed that the main presser plates 282, 283 bear against and yieldably clamp the web W against the upper surfaces of the main table 56 and against the corresponding feed dogs when the latter are operated, under the influence of the springs 287, 287'. On the other hand, when the cams 300, 300' are rotated by means of handles 301, 301' to move the high surfaces of cams 300, 300' against the respective pins 297, 297', the corresponding presser guide plates 290, 290' are elevated sufficiently to engage the heads of headed pins 286, 286' and raise the main presser plates 282, 283 above and out of engagement with the web W.

The means for applying pressure against the upper surfaces of the web adjacent the pocket cutter heads (FIGURES 8 and 36) will be later described.

VII. MAIN OR CONTOUR CUTTER HEAD CARRIAGES

(FIGURES 1, 2, 4, 5, 7 through 12, 15 and 16)

As heretofore stated, since the cutter head carriages are all of substantially the same construction, only the cutter head carriage D will be described in detail and like reference characters shall apply to the parts associated with all of the cutter head carriages A–D and A'–D'. It should be noted, however, that laterally opposed pairs of cutter head carriages, such as D, D' are guided for lateral movement, with respect to the path of travel of the web W, on a common pair of transverse carriage tracks or guide rods 310, 311 (FIGURES 4, 5 and 9), opposed ends of which are fixed in the upright side frames 103, 103'. Further, as heretofore stated, one of the cutter drive shafts 244 is common to each laterally opposed pair of carriages.

Each cutter head carriage is in the form of a substantially C-shaped housing, and it will be observed in FIGURE 10 that the housing of carriage D includes upper and lower substantially horizontal hollow arms 312, 313 whose outer ends, with respect to main table 56, are interconnected by upright hollow arm or bridging portion 314. A transmission housing 315 is attached to the outer portions of the lower hollow arm and the upright arm 314 and extends substantially below the lower hollow arm 313. The corresponding cutter drive shaft 244 loosely extends through the lower portion of the transmission housing 315 for driving the corresponding cutter head in a manner to be later described.

It will be observed in FIGURES 8, 10, 11 and 12 that opposed sides of the outer portion of the lower hollow arm 313 of carriage D have track slide bearings 316, 317 fixed thereto which are penetrated by and adapted to slide along respective carriage tracks 310, 311. It will be noted that carriage tracks 310, 311 straddle the lower hollow arm 313 and the transmission housing 315.

VIII. CONTOUR CUTTER HEADS

(FIGURES 9, 10, 13 and 33)

Since all of the contour cutter heads 80 and the cooperating presser heads are of substantially the same construction, only the contour cutter heads and presser heads associated with one of the main cutter head carriages, such as carriage D, will be described in detail and like parts associated with the other contour cutter heads will bear the same reference characters, in order to avoid repetitive description.

Referring to FIGURES 9, 10 and 13, it will be observed that the blade 81 of each cutter head 80 has a needle 325 suitably secured thereto or formed integral therewith which extends along and defines the perpendicular edge of the triangularly-shaped blade 81. The point of needle 325 preferably extends downwardly beyond the lower extremity of the hypotenuse cutting edge of the blade 81 so as to penetrate the web immediately before the web is penetrated by the inclined cutting edge of blade 81 and thus insure penetration of the web by the cutting edge of blade 81.

Blade 81 is fixed to the lower end of an upright stem 326 with the needle 325 alined with the axis of stem 326. Stem 326 is keyed for vertical and axial movement in a cutter-angle rotor 327, journaled in the lower wall of the upper hollow arm 312 of the corresponding carriage D (FIGURE 10), and has a hub 330 projecting upwardly therefrom on which a gear or pinion 331 is fixedly mounted. Pinion 331 is rotatable against the upper surface of said bottom wall and the lower portion of rotor 327 has a collar 332 fixed thereon (FIGURES 9 and 13) whose upper surface is adapted to move in sliding engagement with the lower surface of the bottom wall of hollow arm 312.

Thus, pinion 331 and collar 332 prevent axial movement of rotor 327 relative to hollow arm 312. A shield, substantially U-shaped in plan, is formed integral with and depends from rotor 327 adjacent needle 325. Shield 333 also serves as a guide for the stem 326 and has a stripper plate 334 suitably secured thereto, as by welding. The lower surface of plate 334 is spaced above the normal path of travel of web W, as best shown in the left-hand central portion of FIGURE 9. Stripper 334 has a slot 335 therethrough which is slightly larger than blade 81 and its needle 325 so the blade 81 and needle 325 may pass freely through the slot 335 during vertical reciprocation thereof.

The upper end of stem 326 is guided for vertical sliding movement in a depth cam block 336, flanged opposite sides of which are guided for vertical movement between gibs 337 suitably secured to the proximal surfaces of the side walls of upper hollow horizontal arm 312 (FIGURES 9, 10 and 13). Cam block 336 has a radial, inverted, substantially U-shaped cam groove 340 in that side thereof facing toward the center of the machine, the apex of said cam groove being centrally located with respect to the inward and outward path of movement of the axis of stem 326 and needle 325 laterally of the machine.

The stem 326 of cutter blade 81 has a radially projecting follower pin 341 thereon which rides in the cam groove 340. Follower pin 341 extends at a right angle to the flat sides of blade 81 (FIGURES 9 and 13). The cam block 336 has a fixed range of vertical reciprocatory movement imparted thereto, by means to be presently described, and thus imparts corresponding vertical reciprocatory movement to cutter blade 81 and needle 325. However, cam groove 340 is so generated with respect to the length of stroke of blade 81 that, when the cutter blade 81, needle 325 and stem 326 are moved about their common vertical axis, follower pin 341 moves relative to cam block 336 and thus raises and lowers the cutter blade 81 relative to cam block 336 to cause blade 81 to subsequently penetrate the web to an extent which varies in direct proportion to the extent at which the blade is moved either side of its longitudinal position with respect to the direction of movement of the web.

The angle of the hypotenuse cutting edge of blade 81 corresponds to the rise and fall of each half of the cam groove 340 so that, when the blade 81 is parallel with the path of travel of the web and occupies its highest position

relative to block 336, the length of cut effected by its depth of penetration through the web should be substantially equal to or slightly greater than the distance the web W is advanced with each active movement of the feed dogs 64–67, this being the 0° position shown in the diagram of FIGURE 33.

Since the cutter blade 81 and its needle 325 should form a cut through the fabric which spans a length of fabric at least equal to the distance the web is advanced with each step thereof regardless of the angle of the line of cut being formed relative to the path of travel of the web, the blade 81 and its needle 325 should be rotated a maximum of approximately 75° either side of its longitudinal or 0° position so that successive cuts formed by the blade 81 may be alined with immediately preceding cuts formed thereby. Thus, when the follower pin 341 is positioned adjacent either of the lowermost portions of the cam groove 340, the extent of penetration of the web by the cutter blade 81 should be approximately four times greater (when the blade 81 extends at an approximately 75° angle with respect to the path of travel of the web) than it is when the blade 81 and pin 341 occupy zero of 0° position. Of course, the maximum angle at which blade 81 may extend, in order to form a line of cut which will embrace a length of web equivalent to a step in advancement of the web, will depend on the horizontal width of the blade 81.

The depth of penetration required in the particular type of blade 81 shown in the drawings is more clearly illustrated in FIGURE 33 wherein various angles to which the blade 81 may be moved relative to the zero position are represented by lines Y, the distance the web W is advanced following each of any downward penetrating strokes of cutter blade 81 is indicated at F, and the length of cut effected by varying the depth of cut in proportion to the varying angles occupied by the cutter blade 81 with respect to the direction of travel of the web W is indicated by a broken line G and is measured along the line identified by the angle of the blade. The means for varying the angular position of blade 81 and, thus, the range of respective vertical strokes thereof will be later described.

By observing the points at which any of the angle lines 0° to 75° cross the dash-dot line representing the distance F that the web W is advanced in FIGURE 35, it will be noted that the greater the angle of the blade 81, the greater the distance (E) the blade 81 and its carriage must be shifted laterally of web W in order that the next succeeding cut formed by that same blade 81 registers with the instant cut formed thereby. For example, following formation of a first cut of an angle of 70° in FIGURE 33, the corresponding contuor cutter blade must be shifted laterally .3439 inch (see FIGURE 32) in order to form the next succeeding cut in registration with the first cut when the web W has advanced ⅛ inch. Note that the chart of FIGURE 32 shows the distance E that a contour blade 81 must be shifted following formation of each angular cut diagrammatically illustrated in FIGURE 33. Although each cut of FIGURE 33 extends from the pivot point of each angle line 0° to 75° to broken line G, the web only moves distance F so that successive cuts may overlap each other.

Referring to FIGURES 10 and 13, it will be observed that cam block 336 has one end of a connecting rod 338 pivotally connected thereto, whose other end is pivotally connected to a crank 339 in eccentric relation to a shaft 342 on which crank 339 is fixedly mounted. Shaft 342 is journaled in bearings 343 (FIGURE 10) suitably mounted within the upper hollow arm 312 of the corresponding carriage D.

Shaft 342 has a bevel gear 345 fixed thereon adjacent its outer end. Bevel gear 345 meshes with a bevel gear 346 fixed on the upper end of an upright shaft 347 journaled in bearings 350 carried by projections 351 extending inwardly from the outer wall of the upright bridging portion 314 and the lower hollow arm 313 of the cutter head carriage D. The lower end of upright shaft 347 has a bevel gear 352 fixed thereon which meshes with a bevel gear 353 fixed on a medial portion of a presser head reciprocating shaft 354.

Shaft 354 extends longitudinally of and within lower hollow arm 313 and is journaled in bearings 355 suitably mounted in the lower hollow arm 313. Shaft 354 extends through the outer wall of hollow arm 313 and has a grooved pulley 356 loosely mounted thereon which is intermittently connected in fixed relation to shaft 354 by a single revolution clutch broadly designated at 357, of which pulley 356 is a part, and which will be later described in detail.

Pulley 356 has an endless belt 360 mounted thereon (FIGURE 10) which also engages a V-pulley 361 keyed on the corresponding cutter drive shaft 244 and whose hub is connected to the inner race of an anti-friction bearing or ball bearing 362. The outer race of ball bearing 362 is fixed in the inner wall of transmission housing 315, thus restraining V-pulley 361 from axial movement relative to the corresponding carriage while permitting the V-pulley 361 to move axially of and rotate with the corresponding cutter drive shaft 244. Thus, each time clutch 357 is engaged, a revolution is imparted to shafts 342, 347, 354 to impart a downward stroke and then an upward stroke to cutter blade 81 while also imparting an upward and then a downward stroke to a presser head plate 367 of a presser head 370 to be presently described in detail.

IX. CONTOUR PRESSER HEADS

(Figures 9, 10 and 14)

As best shown in FIGURE 14, presser head plate 367 is provided with a slot 371 which complements slot 335 in stripper plate 334. It will be observed in the upper central portion of FIGURE 9 and the left-hand portion of FIGURE 10 that, with downward movement of cutter blade 81, the respective presser head plate 367 moves upwardly and raises the web W against the lower surface of the corresponding stripper plate 334.

Since the presser head plate 367 must be turned in unison with the needle 325 and contour cutting blade 81, in each instance, each presser head 370 includes means for supporting and imparting rotary movement thereto as well as means for imparting vertical reciprocatory movement thereto. To this end, it will be observed in FIGURES 14, 40, 41 and 42 that each presser head plate 367 is suitably secured, as by welding, to the upper end of an upright tubular extension 372 of a splined shaft 373, with one end portion of the slot 371 being substantially alined with the axis of splined shaft 373.

The tubular extension 372 loosely extends substantially through a segmental circular cavity 374 whose inner peripheral wall extends through an arc of at least 180° and which is formed in a gate control block 375 fixedly mounted upon the inner end portion of the corresponding lower hollow arm 313 of each main cutter head carriage. The gate control block 375 is provided on each cutter head carriage in order to open and close the gates or gate elements 204 (FIGURES 9, 35, 39 and 40) during movement of the corresponding presser heads 370 along the gaps 196 provided in the main table 56.

To this end, the body of each gate control block 375 is preferably substantially frusto-triangular in plan and its upper surface has an arcuate, substantially U-shaped, cam groove 376 therein which is open at opposed sides for receiving those portions of the lower ends of the follower pins 203 of gates 204 which project below the flange 201 of the corresponding gate stop bar 200. It will be noted that the rear portion of the gate control block shown in FIGURES 40, 41 and 42 has a shoulder 377 thereon which is adapted to move beneath the corresponding gate stop bar 200 and its flange 201 to insure that successive follower pins 203 are led into the corre-

sponding open end of the cam groove 376, depending upon the direction of transverse movement of the corresponding gate control block 375.

Each gate control block also has a substantially triangular or U-shaped cap 380 fixed thereon whose upper surface is adapted to move in flush relationship to the upper surface of the corresponding gate stop bar 200; that is, flush with the mean upper surface of main table 56. The upper surface of gate block cap 380 is recessed, as at 381, to accommodate the corresponding presser head plate 367 so that, when the presser head plate 367 occupies lowered position, its upper surface is positioned on substantially the same level as the upper surface of main table 56.

It is apparent, by referring to FIGURE 40, that each successive gate 204 is moved to open position as its follower pin 203 rides in engagement with the corresponding cam groove 376 and is then returned to closed position with movement of the gate control block 375 past the same, thus insuring that each gap 196 is substantially closed either by the gates 204 or the cap of the corresponding gate control block 375 to provide adequate support for the web W.

As best shown in FIGURES 10 and 14, the splined shaft 373 is keyed for vertical movement in a presser head rotor or sleeve 385 journaled in the upper wall of the corresponding lower hollow arm 313, adjacent the inner end thereof. The presser head rotor 385 is restrained from axial movement by a collar or thrust washer 386 fixed on the upper end thereof and engaging the upper surface of the upper wall of lower hollow arm 313. The lower end of presser head rotor 385 has a gear or pinion 387 fixed thereon which engages the lower surface of said upper wall of the lower hollow arm 313, and through which the lower portion of splined shaft 373 projects.

Splined shaft 373 has a vertically extending bore or cavity 390 therein which is closed at its upper end, and in which a compression spring 391 and the enlarged upper portion of a follower cushioning shaft 392 are positioned. The lower end of splined shaft 373 is closed by a cap 393 which is loosely penetrated by the reduced lower portion of cushioning shaft 392. Spring 391 urges the lower end of cushioning shaft 392 against the upper surface of a follower yoke 394 whose interconnected arms straddle and engage upper and lower surfaces of an eccentric cam 395 fixed on the inner end of the corresponding shaft 354 (FIGURES 9, 10 and 14).

It is apparent that, each time each contour cutter blade 81 and its corresponding stripper 334 moves downwardly, the high surface of cam 395 moves upwardly to thus move the cushioning shaft 392 upwardly against spring 391 and to thus impart upward movement to the presser head plate 367 to cause the same to yieldably urge the corresponding portion of the web W against the lower surface of the corresponding stripper 334.

The pinions 331, 387 (FIGURES 10, 13 and 14) associated with each cutter head carriage engage respectively racks 400, 401 which extend longitudinally of the respective upper and lower hollow arms 312, 313 of the corresponding carriage, and which are guided for longitudinal movement along the front walls of said hollow arms 312, 313. The outer portions of racks 400, 401 engage respective gears or pinions 402, 403 fixed on upper and lower ends of an upright shaft 404 suitably journaled in the inner wall of the correspondiing upright bridging portion between hollow arms 312, 313 (FIGURE 10).

In order to releasably restrain the racks 400, 401 from unintentional movement, the lower surface of bottom rack 401 has a plurality of recesses 405 arranged longitudinally thereof and which are adapted to be engaged, one at a time, by a spring loaded detent or ball 406. Detent 406 is movable within a tubular detent guide 407 suitably secured to or formed integral with the front wall of the corresponding lower hollow arm 313. Tubular guide 407 has a compression spring 410 therein, whose upper end bears against detent 406, and whose lower end bears against an adjustment screw 411 threaded into the lower end of tubular guide 407.

Racks 400, 401 are shifted inwardly and outwardly, for varying the angle of the respective cutter blade 81, stripper 334 and presser head plate 367 by means which will be later described in conjunction with the means for imparting stepped inward and outward movement to the cutter head carriages A–D, A'–D' laterally of the longitudinal axis of the main table 56.

X. CLUTCH FOR MAIN CUTTER HEAD AND PRESSER HEAD

(FIGURES 10, 12, 12–A and 47)

As heretofore stated, the outer end of the main housing of each of the main cutter head carriages A–D, A'–D' has a transmission housing 315 thereon within which a single-revolution clutch 357 is provided for intermittently transmitting rotation from a continuously driven pulley 356 to the corresponding presser crank shaft 354 and, thus, to the corresponding cutter head crank shaft 342. Since the clutches 357 associated with the cutter head carriages are all of substantially the same construction, only the clutch 357 associated with carriage D will be described in detail, and like reference characters will apply to the parts associated with the remaining clutches 357.

The clutch 357 is best shown in FIGURES 10 and 12. With the exception of being electromagnetically operated, the clutch 357 may be of a type disclosed in FIGURES 2, 4 and 5 of U.S. Patent No. 2,511,367, granted to George W. Nelson on June 13, 1950.

It will be observed in FIGURE 10 that clutch 357 comprises a disk 415 fixed on the outer end of presser crank shaft 354. The proximal surfaces of disk 415 and pulley 356 have mating frusto-conical surfaces 416, 417 thereon which are normally urged out of engagement with each other by a compression spring 420 surrounding shaft 354 and engaging the proximal surfaces of disk 415 and pulley 356.

On its outer side, the pulley 356 engages, through a thrust bearing, a spherical-sector head 421 against which the wedge-shaped lower end of a lever 422 engages (FIGURES 12 and 12–A). Referring to FIGURE 12, it will be noted that the periphery of disk 415 is formed a uniform distance from the axis of the disk 415 through an arc of approximately 180°, and the remaining portion of the periphery is in the form of a cam surface 423 of gradually diminishing radii which terminates in a shoulder 424 which is adapted to engage a substantially radially movable and yieldably supported clutch dog 425.

Clutch dog 425 is fixed to or formed integral with the lower end of a rod 426 (FIGURE 12) which is mounted for vertical movement in a pair of arms 427, 428 of an actuating lever 431. A compression spring 432 is positioned between projections 427, 428 of actuating lever 431 and its lower end bears against a collar 433 fixed on the rod 426.

The clutch dog 425 is normally urged against disk 415 by a tension spring 434, one end of which is connected to the lower portion of actuating arm 431, and the other end of which is connected to the outer wall of upright bridging portion 314 of the corresponding cutter head carriage D. The action of clutch dog 425 is pattern controlled through the medium of a solenoid 436 carried by the outer wall of said upright bridging portion 314. The core or plunger of solenoid 436 engages the upper end of actuating lever 431. The electrical connections to the solenoid plunger 436 will be later described.

The plunger of solenoid 436 is so arranged that, upon energization of solenoid 436, the plunger moves lever 431 from the solid line to the broken line position against a stop 437 carried by the outer wall of said upright

bridging portion 314. In so doing, clutch dog 425 is moved out of engagement with shoulder 424, since a medial portion of actuating lever 431 is fixed on a pivot shaft 440 suitably journaled in the outer wall of said upright bridging portion 314.

The outer end of shaft 440 has the upper end of lever 420 fixed thereto, so that, when clutch dog 425 is moved from the solid to the broken line position by energization of solenoid 436, the wedge-shaped lower end of lever 422 (FIGURE 12–A) engages spherical-sector head 421 and moves pulley 356 axially inwardly to cause the frusto-conical surface 417 of pulley 356 (FIGURE 10) to engage the mating frusto-conical surface 416 of disk 415, to thus impart rotation to disk 415 and shafts 354, 347, 342. As heretofore stated, rotation of shafts 342, 354 causes upward and then downward movement to be imparted to the corresponding contour cutter blade 81, the needle 325 and the stripper 334 while imparting upward and then downward movement to the presser head plate 367.

Solenoid 436 is normally only energized momentarily so that, after clutch dog 425 moves out of engagement with shoulder 424 (FIGURE 12), the clutch dog 425 is maintained against the peripheral surface of disk 415 by spring 434. As disk 415 rotates, it is apparent that the cam surface 423 thereon leads the clutch dog 425 into position to engage the notch 424.

In order to prevent backward or reverse movement of clutch disk 415 and crank shaft 354 when clutch dog 425 is engaged by the shoulder 424, a locking latch 442, pivotally mounted in a suitable recess provided therefor in the periphery of the disk 415, is moved outwardly by a compression spring 443 to engage the upper surface of the tip of clutch dog 425 opposite from the surface thereof which engages the shoulder 424.

Spring 432 is provided to cushion the impact of the shoulder 424 against clutch dog 425 at the end of a clockwise movement of the disk 415. Since levers 431 and 422 move in unison, it will be noted that lever 422 moves to solid line position of FIGURE 12 whenever clutch dog 425 moves inwardly and is engaged by shoulder 424, thus permitting spring 420 (FIGURE 10) to move pulley 356 out of engagement with disk 415.

XI. CARRIAGE STEPPING AND BLADE-ANGLE SELECTING MEANS

(FIGURES 9, 10, 11–A, 14, 15, 16, 17, 19–23, 26–33 and 47)

Due to the complicated nature of the carriage and blade-angle selecting and shifting means, a general description thereof will first be given. Generally, each main carriage A–D, A'–D' is stepped or shifted laterally inwardly and outwardly predetermined distances by a corresponding set or group of one or more cutter increment cams. The increment cams are fixed on a pattern controlled longitudinally movable cam switching bed plate (FIGURES 9, 15 and 17). The sets of increment cams corresponding to the main carriages A–D, A'–D' are respectively broadly designated at A–1, B–1, C–1, D–1, A–1', B–1', C–1' and D–1' in FIGURE 17.

There are sixteen different types of such cutter increment cams, in this instance, which may be employed in various combinations for forming each set on each cam bed plate. The increment cams in sets B–1, B–1', D–1, D–1' differ in a common respect relative to the increment cams in sets A–1, A–1', C–1, C–1', as will be later described (see FIGURES 26, 27, 28 and 29, 30, 31, respectively). The increment cams of each set are serially arranged and are moved, one at a time, in succession, and under control of the main pattern mechanism 82, into an operative position with respect to motion transmitting elements which are then moved, by lateral reciprocatory movement of the corresponding cam switching bed plate and its cams, to laterally shift the corresponding carriage in either direction, which direction is also determined by the pattern mechanism 82.

The same increment cams which determine the distance each carriage is shifted in either direction also effect angular movement to the corresponding contour cutter blade 81 about its vertical axis in either direction, since the extent of lateral movement of each carriage is proportional to the angle of cut to be effected by each contour cutter blade 81. This is desirable so that each successive cut through the web is correctly positioned with respect to the immediately preceding cut, in each instance, as heretofore described.

The carriage increment and blade-angle selecting means will now be described in detail. Since each set of increment cams may include one or more cams of many different types; i.e., sixteen in this instance, all of those increment cams which may be used to make up the sets B–1, B–1', D–1, D–1' (FIGURE 17) are identified by the cam numbers 1 to 16 in the table of FIGURE 32 with only cams 1, 9 and 15 being shown in FIGURES 26, 27 and 28. Any increment cams which are used to make up sets A–1, A–1', C–1, C–1', and which correspond to the increment cams 1–16 shall, wherever they appear, bear the same reference characters with the small letter "*a*" added, it being noted that the cams 1–*a*, 9*a* and 15*a* of FIGURES 29, 30 and 31 will effect the same amount of movement to the carriages A, A', C, C' and their respective cutter blades 81 as the respective cams 1, 9 and 15 of FIGURES 26, 27 and 28 will impart to the carriages B, B', D, D' and the respective cutter blades 81.

The two different types of increment cams are provided because the sets of increment cams A–1, A–1', C–1, C–1' are positioned outwardly of the adjacent sets of increment cams B–1, B–1', D–1, D–1' in FIGURE 17. The sets of cams are staggered in the manner shown in FIGURE 17 so the outer and inner sets of cams at each side of the machine may move longitudinally of the machine in relatively overlapping relationship, thereby facilitating positioning the cutter head carriages at each side of the machine in close proximity to each other.

It will be noted that each of the cutter increment cams in FIGURES 26–31 has lines defining dimensions X and E which dimensions appear in vertical columns identified by these same reference characters in the chart of FIGURE 32. As heretofore stated, the letter E is also used in an exemplary manner in FIGURE 33 to illustrate the distance a cutter head carriage must move laterally, in either direction, following the formation of a cut of the respective contour cutter blade 81 at any given angle.

As heretofore stated, the cutter increment cams of FIGURES 26, 27 and 28 are representative of all the cams whose numbers appear in column V of FIGURE 32, and the cams of FIGURES 29, 30 and 31 are representative of cams which correspond to the respective cams 1–16 but which may be spaced outwardly of the cams 1–16 in FIGURE 17. In this instance, each dimension X in FIGURES 26–32 represents the length of that portion of the corresponding cam measured outwardly from a point at which the respective cutter blade 81 would occupy a 90° position or right-angular position with respect to the direction of movement of the web when based, for example, on the pinions 331, 387 (FIGURES 10, 13 and 14) having a pitch diameter of one and one-fourth inches and a pitch circle of 3.927 inches, and which requires that the racks 400, 401 move longitudinally .0545 inch in order to rotate the respective pinions 331, 387, contour cutter blades 81 and presser head plates 367 through an angle of 5° about their respective vertical axes.

The dimension E in each of FIGURES 26–32 represents the length of that portion of each cutter increment cam with respect to a zero point at which the corresponding cutter head carriage will remain stationary. The dimension F in FIGURE 33 is constant and represents the distance the web W is advanced with each step thereof.

By way of example, $F=\frac{1}{8}''$ and the lateral distance E a cutter blade **81** moves following formation of a 70° cut would be .3439 inch, but the cutter blade would only move a lateral distance $E=.0109''$ following a 5° cut, for example.

The increment cam bed plates which support the cams of sets A–1 through D–1 and A–1′ through D–1′ are respectively designated at A2 through D2 and A2′ through D2′ in FIGURE 17. Each increment cam is secured to the upper surface of the corresponding bed plate by a pair of laterally spaced screws **450** (FIGURE 15) and, assuming that the outermost screws **450** in the increment cam bed plates A2, C2, A2′, C2′ are spaced 1.625 inches outwardly of the longitudinal plane of the outermost screws **450** in the corresponding increment bed plates B2, B2′, D2, D2′, the stem **452** of each inner cutter increment cam, such as cams **1**, **9** and **15** in FIGURES 26–28, would be 1.625″ longer than the stems **452***a* of the corresponding outer cutter increment cams, such as cams **1**–*a*, **9***a* and **15***a* of FIGURES 29–31.

It will be noted that each of the inner cutter increment cams, such as cams **1**, **9** and **15** in FIGURES 26–28 includes an upright body **453**, from the lower portion of which a heel **454** extends in opposite relationship to the corresponding stem **452**. Each stem **452** extends outwardly from the upper portion of the corresponding body **453**. The body **453** and heel **454** of each inner cutter increment cam have corresponding countersunk holes **455** therethrough (FIGURES 26–28) for receiving the corresponding screws **450** in FIGURE 15. The parts associated with each of the outer cutter increment cams, such as cams **1**–*a*, **9***a* and **15***a* in FIGURES 29–31, shall bear the same reference characters as like parts shown in FIGURES 26–28, with the small letter "*a*" added. It will be noted, however, that the stem **452***a* of each outer cutter increment cam projects from the lower portion of the corresponding body **453***a* and the bodies **453***a* of the outer increment cams **1**–*a*, **9***a*, **15***a*, for example, are of lesser height than the bodies **453** of inner increment cams **1**, **9**, **15**. The cutter increment cams are arranged in the manner described so the stems **452** of any inner cutter increment cams positioned on the inner bed plates of FIGURE 17 may overlie the outer cutter increment cams.

Referring to FIGURES 15 and 17, it will be observed that dovetailed lower portions of the outer increment cam bed plates A2, C2 are guided for longitudinal movement between a pair of longitudinally extending gibs **460**, **461**, and the dovetailed lower portions of inner increment cam bed plates B2, D2 are guided for longitudinal movement between the gib **461** and another gib **462** spaced inwardly therefrom. The lower portions of the bed plates A2′, B2′, C2′, D2′ (FIGURE 17) are also guided between longitudinally extending gibs **460′**, **461′**, **462′**.

Gibs **460–462** and **460′–462′** may rest against and be moved laterally upon the main base **120** of the machine. Opposed rear and front portions of gibs **460–462** and **460′–462′** are suitably secured to respective pairs of lateral cam shifting blocks **464**, **465** and **464′**, **465′** suitably guided in respective dovetailed slots **466**, **467**, **466′**, **467′** formed in the main base **120** (FIGURES 16 and 17).

The inner ends of the lateral cam shifting blocks **464**, **465**, **464′**, **465′** have the outer ends of respective cam follower arms **470**, **471**, **470′**, **471′** connected thereto, whose medial portions are guided in corresponding guide blocks **472**, **473**, **472′**, **473′** suitably secured to the upper surface of main base **120**. The proximal ends of said follower arms **470**, **471**, **470′**, **471′** have respective rollers or followers **474**, **475**, **474′**, **475′** thereon which engage respective grooves **476**, **477**, **476′**, **477′** formed in opposed faces of rear and front main shogging cams **480**, **481** (FIGURES 8, 8–A, 11–A, 15, 16, 17 and 18).

The cams **480**, **481** are fixed on main cam shaft **240**, and the grooves in cams **480**, **481** are so formed as to impart an inward and then an outward stroke to each group of gibs **460–462** and **460′–462′** (FIGURE 17) during the initial portion of each cycle in the operation of selected contour cutter heads **80**, which cycle may be termed as a primary cycle. It might be stated that one of said cycles occurs with each revolution of each of the shafts **164**, **164′**, **240**, **244** of FIGURES 17 and 18, in this instance.

XII. INCREMENT CAM SWITCHING MEANS

(FIGURES 9, 15, 16 and 19)

As heretofore stated, the increment cams of each set A–1 through D–1, A–1′ through D–1′ are moved, one at a time and in succession, and under control of the main pattern mechanism **82**, into an operative position with respect to motion transmitting elements. The cam bed plates, upon which are mounted the increment cams of each set, may be shifted or switched in either direction longitudinally of the machine simultaneously or independently of each other. Since each of the increment cam bed plates A2–D2 and A2′–D2′ is switched longitudinally of the machine by substantially the same type of mechanism, only the switching device associated with increment cam bed plate D2 will be described, and like parts associated with the cam switching device for the other increment cam bed plates will bear the same reference characters in order to avoid repetitive description.

As best shown in FIGURES 9, 15 and 19, each cam switching device is disposed within a housing **485** secured to and depending from the lower surface of main base **120**, and whose open upper end communicates with an opening **486** formed through base **120** and over which extends one or more of the corresponding gibs **460–462** or **460′–462′**, as the case may be. In FIGURES 15 and 19, the gib **462** happens to be the gib which extends above and across the opening **486** shown in these figures.

It is apparent that adjacent housings **485** are disposed in staggered relationship longitudinally of the machine in order that the cam switching devices therein may be vertically alined with the corresponding increment cam bed plates A2–D2, A2′–D2′ (FIGURE 17).

Referring again to FIGURES 9, 15 and 19, it will be observed that gib **462** has a bracket or upright plate **487** suitably secured thereto and depending therefrom, and in which the hub of a double-flanged switching or stepping cam wheel **490** is journaled and suitably restrained from relative axial movement. The corresponding end of a laterally extending switching cam shaft **495** is keyed or splined with respect to the switching cam **490** and its hub so that the position of shaft **495** may remain fixed during inward and outward movement of the gib **462**. It follows that bracket **487** and switching cam **490** also move inwardly and outwardly with gib **462**.

By referring to FIGURE 11–A, it is apparent that the shaft **495** corresponding to cutter head carriage D is also common to the opposite cutter head D′. Thus, the machine is equipped with four stepping cam shafts **495**, there being one of the stepping cam shafts **495** spaced below and rearwardly of each of the cutter drive shafts **244**. The medial portions of the cam shafts **495** may be journaled in the upper forwardly and rearwardly extending portion of sampson **112** (FIGURE 11–A).

Each of the switching cam shafts **495** is driven at the same speed as the cutter drive shafts **244** by means of sprocket wheels **496**, **497**, fixedly mounted on the corresponding shafts **495**, **244** and over which a corresponding endless sprocket chain **500** is entrained. The main base **120** has an opening **501** therethrough through which each sprocket chain **500** extends (FIGURES 15 and 17).

It will be observed in FIGURE 19 that substantially diametrically opposed surfaces of the periphery of stepping cam **490** are engaged by the medial portions of pawl-carrying arms **503**, **504** which are urged against the periphery of the corresponding stepping cam **490** by a ten-

sion spring 505 extending between and connected to the pawl-carrying arms 503. The upper portions of pawl-carrying arms 503, 504 have respective feed pawls 506, 507 thereon whose bifurcated proximal portions are pivotally connected to the arms 503, 504.

The depth of the birfucation of each of the pawls 506, 507 is such that it serves as a stop to limit upward movement of the corresponding pawl. The pawls 506, 507 are normally urged upwardly to the limits permitted by the bifurcations thereof by suitable leaf springs 510, 511 secured to the distal surfaces of pawl-carrying arms 503, 504 and bearing against the lower surfaces of pawls 506, 507. The flanges on the stepping cam 490 engage inner and outer surfaces of the pawl-carrying arms 503, 504 so that the pawl-carrying arms 503, 504 and pawls 510, 511 are also shifted inwardly and outwardly with the corresponding gibs 460–462.

The lower ends of the pawl-carrying arms 503, 504 are mounted on stub shafts 512, 513 which loosely extend through vertically extending slots 514 provided in bracket 487, and whose ends opposite from the pawl-carrying arms 503, 504 have the upper ends of respective tension springs 515 connected thereto. The lower ends of springs 515 are connected to the bottom wall of the corresponding housing 485. The stub shafts 512, 513 may be shouldered or otherwise suitably restrained from longitudinal movement relative to the bracket 487, as best shown in FIGURE 15.

The springs 515 normally urge the lower ends of pawl-carrying arms 503, 504 against the upper surfaces of the plungers of respective solenoids 520, 521 whose coils are attached to the corresponding bracket 487. The solenoids 520, 521 are energized in alternation so that only one of the corresponding pawl-carrying arms 503, 504 occupies elevated position, at one time, such as to cause the corresponding pawl to engage spaced teeth 522 provided on the lower surface of the corresponding increment cam bed plate D2.

The periphery of stepping cam 490 is so formed as to move each pawl-carrying arm 503, 504 from the solid line to the broken line position and back to the solid line position twice during each cycle of the machine. This is desirable in order to insure that either of the pawls 506 or 507 may be activated by the corresponding solenoid during the first half of each cycle and a step will be imparted to the corresponding increment cam bed plate D2 equal to the width of one of the cutter increment cams, it being noted that all of the cams shown in FIGURES 26–31, and other increment cams identified in the chart of FIGURE 32 are of the same width. Solenoids 520, 521 are selectively energized by the main pattern mechanism 82 during the first half of each cycle, as will be later described. It is thus seen that each increment cam base plate A2–D2, A2'–D2' may be stepped longitudinally of the machine in either direction at selected intervals determined by the pattern mechanism 82 and during which each of the increment cam base plates is moved a step equal in length to the width of a single cutter increment cam.

XIII. INCREMENTAL MOTION TRANSMITTING ELEMENTS BETWEEN CUTTER INCREMENT CAMS AND MAIN CARRIAGES

(FIGURES 9, 15, 16, 17, 20, 21, 22 and 23)

In order to transmit motion from the cutter increment cams of each set A–1 through D–1 and A–1' through D–1' (FIGURE 17), to the respective cutter head carriages A–D, A'–D', a novel overriding carriage increment clutch 530 is interposed between each set of cutter increment cams and the corresponding cutter head carriage (FIGURES 9, 15 and 20–23). With the exception that the carriage increment clutches 530 at each side of the machine are disposed in staggered relationship; corresponding to the staggered relationship of the sets of increment cams A–1 through D–1 and A–1' through D–1', all of the carriage increment clutches 530 are identical. Thus, only

the carriage increment clutch 530 associated with carriage D will be described in detail and like reference characters will apply to like parts associated with all of the carriage increment clutches, where applicable, in order to avoid repetitive description.

Each carriage increment clutch 530 is substantially enclosed within an inverted cup-shaped housing 531 whose opposed side walls (FIGURE 15) terminate above the level of the opposed front and rear walls thereof and are suitably secured to the corresponding spar 122. As best shown in FIGURE 9, opposed front and rear walls of each housing 531 straddle the corresponding spar 122, in spaced relation thereto, and terminate immediately above the level of the corresponding cutter increment cams such as cam 15 in FIGURE 9.

As best shown in FIGURE 15, each carriage increment clutch 530 includes an increment cam follower which is spaced inwardly of and adapted to be engaged by any of the cutter increment cams which happen to be alined therewith. Thus, as the corresponding set of increment cams (D–1 in this instance) is moved inwardly in the manner heretofore described, the corresponding increment cam moves inwardly a predetermined distance, say .625", during which it imparts inward movement to the corresponding follower 532 a distance equal to the distance E indicated for that particular cam in the chart of FIGURE 32.

In other words, if a cam 15 happens to be alined with the follower 532, this cam will move inwardly .1585", then it will engage follower 532 and impart .4665" of inward movement thereto (.1585+.4665"=.625"), the extent of such inward movement of increment cam follower 532 being equal to the movement it will transmit to the corresponding carriage through the medium of the carriage increment clutch 530, in either direction, as will be presently described.

Each follower 532 is mounted in the lower end of a carriage shifting lever 533 (FIGURES 9, 15, 20 and 21) fixed on a shaft 534 and journaled in bosses 535 depending from the corresponding spar 122. Opposed ends of each shaft 534 have shifting cranks 536 fixed thereon whose slotted upper portions are loosely penetrated by yoke pins 537 suitably secured to and projecting outwardly from front and rear surfaces of a carriage transition tube 540 which is suitably guided for longitudinal movement with respect to the corresponding spar 122 and laterally of the longitudinal axis of the machine.

The carriage transition tube 540 is provided with a longitudinally extending substantially rectangular chamber 541 through which a carriage transition bar 542 loosely extends. As best shown in FIGURES 9, 15 and 16, bar 542 extends in substantially parallel relation to the tracks 310, 311 and cutter drive shafts 244. Opposed ends of carriage transition bar 542 are mounted in brackets 543 fixed to and extending rearwardly and downwardly from the lower hollow arm 313 of the corresponding carriage D.

It should be noted that carriage D occupies substantially the innermost position to which it may be moved in FIGURE 15 and, conversely, the cutter head carriage D occupies the outermost position to which it may be moved in FIGURES 2, 6, 7, 9, 10, 11 and 11–A for purposes of comparison and to also better illustrate the relationship between the carriage D, the cutter increment cams, and intervening elements in FIGURE 15.

Referring to FIGURE 23, it will be observed that opposed side walls of the chamber 541 are tapered or formed with angular surfaces 545, 546 adjacent opposite ends of the transition tube 540. The surfaces 545, 546 are engaged by corresponding balls or rollers 550, 551. The balls 550, 551 are urged toward the angular surfaces 545, 546 by respective compression springs 552, 553 whose proximal ends engage projections 554 projecting inwardly from opposite side walls of the chamber 541 and straddling the corresponding carriage transition bar 542.

It is apparent that the surfaces 545, 546 cause the re-

spective balls 550, 551 to tightly engage opposite sides of the carriage transition bar 542 in FIGURE 2 whenever the balls are permitted to engage the carriage transition bar 542 under the influence of the corresponding springs 552, 553. The beveled proximal ends of spaced clutch coupler fork arms 555, 556 are adapted to either simultaneously or alternately engage the respective sets or pairs of balls 550, 551 to move the same inwardly toward the projections 554 and out of engagement with the side surfaces of the carriage transition bar 542. In FIGURE 23, for example, it will be noted that the fork arms 555 are positioned within the chamber 541 to a greater extent than the arms 556 and have, therefore, moved the balls 550 inwardly and away from the carriage transition bar 542. On the other hand, since the fork arms 556 are then spaced outwardly of the balls 551, the balls 551 tightly engage the corresponding side surfaces of the carriage transition bar 542.

It will be observed in FIGURES 20 and 21 that the fork arms 555, 556 are substantially L-shaped and their upper ends are connected to or formed integral with opposed substantially T-shaped ends of a clutch coupler thrust bar 557 mounted for inward and outward shifting movement upon the carriage transition tube 540 (FIGURE 21) and extending through spaced guide blocks 560 secured to the upper surface of carriage transition tube 540. Each of the guide blocks 560 has an inverted cup-shaped housing 561 fixed thereon in which compression springs 562 and balls or detents 563 are positioned. Each detent 563 is adapted to engage three spaced cavities or recesses 564, one at a time, formed in the upper surface of the corresponding portion of thrust bar 557. The central portion of thrust bar 557 has a pair of spaced upwardly projecting abutments 567 on the central portion thereof which engage opposed sides of a substantially vertical leg of a substantially T-shaped clutch control lever 570.

It will be observed in FIGURES 20 and 21 that the medial portion of clutch control lever 570 is pivotally mounted, as at 571, on an angle bracket 572 suitably secured to the carriage transition tube 540 and whose upper flanged portion overlies the clutch control lever 570 and has the coils of a pair of spaced carriage directional solenoids 573, 574 fixed thereon. Solenoid 573 serves as a carriage advancing solenoid and solenoid 574 serves as a carriage retracting solenoid with respect to the central portion of the machine.

The plungers of solenoids 573, 574 loosely penetrate the flanged upper portion of angle bracket 572 and are pivotally connected to opposed ends of the substantially horizontal arm of T-shaped clutch control lever 570. It is thus seen that, when carriage advancing solenoid 573 is energized, which energization is effected by the main pattern mechanism 82 in a manner to be later described, the clutch coupler thrust bar and its fork arms 555, 556 occupy the position shown in FIGURES 20, 22 and 23 so that, upon inward movement being imparted to the carriage transition tube 540 (left to right in FIGURE 23) by means to be presently described, inward movement is imparted to the carriage transition bar 542.

Conversely, when carriage retracting solenoid 574 is energized and carriage advancing solenoid 573 is deenergized, clutch control lever 570 is moved in a counterclockwise direction in FIGURE 20 to shift clutch coupler thrust bar 557 and its fork arms 555, 556 from left to right in FIGURES 20, 22 and 23. It is apparent that, upon a forward stroke being imparted to the clutch coupler thrust bar 557, from left to right in FIGURES 20 and 22, the fork arms 555 release or move out of engagement wtih the balls 550 and the fork arms 556 move into engagement with the balls 551, so that, upon subsequent movement being imparted to the carriage transition tube 540 from right to left in FIGURE 22, corresponding right to left or outward movement will be imparted to the carriage transition bar 542.

In order to facilitate moving each contour cutter head carriage inwardly or outwardly independently of the corresponding carriage transition tube 540, such as for the purpose of positioning the contour cutter head carriages in an initial starting position for cutting out a given pattern in the web W, an increment clutch neutralizing means is provided and comprises an upright guide plate 575 (FIGURES 20, 21 and 22) which is positioned closely adjacent and to one side of the vertical leg of T-shaped clutch control lever 570. The plate 575 is a portion of a solenoid coil, the solenoid being generally designated at 576. The coil of solenoid 576 extends through an opening 577 formed in the upright portion of angle bracket 572. The coil of solenoid 576 is positioned between the plate 575 and a plate 580 which is suitably secured to the outer surface of the corresponding wall of carriage transition tube 540 (FIGURE 21).

A solenoid plunger 582 is positioned within the coil of solenoid 576 and has a pair of spring-pressed neutralizing or lock pins 583, 584 slidably mounted therein and normally urged toward and through plate 575 by respective springs 585. Solenoid plunger 582 is normally urged outwardly, away from control lever 570, by a compression spring 587 (FIGURE 22). The coil of solenoid 576 may be energized manually or by the pattern mechanism 82, as will be later described.

The pins 583, 584 are so spaced so that they may straddle the clutch control lever 570 when it occupies a vertical or neutral position. Assuming that clutch control lever 570 occupies the position of FIGURE 20, and the clutch control lever 570 is to be moved to and held in neutral position, before energizing the carriage retracting solenoid 574, the coil of solenoid 576 is energized to cause plunger 582 to move toward the bottom of the drawing in FIGURE 22. In so doing, pin 584 moves into the horizontal plane of the substantially vertical portion of lever 570 while pin 583 merely moves against the control lever 570. Thus, solenoid plunger 582 moves relative to neutralizing pin 583.

The carriage retracting solenoid 574 is then energized so that the vertical portion of clutch control lever 570 moves against neutralizing pin 584 and permits pin 583 to move toward the bottom of the drawing in FIGURE 22 so that both of the pins 583, 584 straddle the substantially vertical portion of clutch control lever 570. When the clutch control lever 570 occupies neutral position, fork arms 555 and 556 both engage and maintain the respective balls 550, 551 out of engagement with the carriage transition bar 542 so that the carriage transition bar 542 and the corresponding contour cutter head carriage may be moved independently of the transition tube 540.

It is apparent that the pin 583 moves inwardly prior to the pin 584 when the clutch control lever 570 is moved to neutral position in the opposite direction from that last described. Once any one of the solenoids 573, 574 or 576 has operated in the manner described, the detents 563 (FIGURE 20) engage the corresponding recesses 564 to maintain the coupler thrust bar 557 in the position to which it was last moved, so that the corresponding solenoids 573, 574 or 576, as the case may be, may then be deenergized. In other words, the latter solenoids need only be momentarily energized to produce their intended functions.

Referring now to FIGURE 15, assuming that the fork arms 555, 556 of the carriage increment clutch 530 associated with carriage D occupy the position shown in FIGURE 23, upon the cutter increment cam 15 of FIGURE 15 engaging follower 532 and moving lever 533 and cranks 536 in a counterclockwise direction, the carriage transition tube 540 moves a predetermined distance from right to left (outwardly) in FIGURES 15, 20, 22 and 23. However, the carriage transition bar 542 remains stationary during this outward movement of transition tube 540 because balls 550 are held out of engagement

with transition bar 542 and the angled surfaces 546 are moved away from balls 551.

Thus, it can be seen that it is necessary to return the carriage shifting lever 533, the cranks 536 and the transition tube 540 to their original position in order to impart an incremental step in movement to the transition bar 542 and, thus, to the carriage D to cause carriage D to move a predetermined distance toward the opposite side of the machine. To this end, the inner surface of each carriage shifting lever 533, opposite from the cutter increment cams, is engaged by a yieldable carriage shifting plunger 600 which is shown in FIGURE 15 as being substantially cup-shaped and which is urged toward the corresponding shifting lever 533 by a relatively heavy compression spring 601 positioned in a suitably perforated housing 602 within which the plunger 600 has substantially horizontal sliding movement. Each housing 602 is carried by a bracket 603 suitably secured to the main base 120.

It is thus seen that, as the carriage shifting lever 533 and shifting cranks 536 are moved in a counterclockwise direction in FIGURE 15, plunger 600 is depressed within housing 602. Thus, as the corresponding cutter increment cam (cam 15 in this instance) is moved outwardly, plunger 600 moves lever 533 and cranks 536 in a clockwise direction to cause carriage transition tube 540 to move inwardly or from left to right in FIGURES 15, 20, 22 and 23.

The surfaces 546 (FIGURE 23) then cause the respective balls 551 to tightly engage and impart inward movement to the corresponding carriage transition bar to thus impart a step in movement to the carriage D equal to the distance the corresponding follower 532 (FIGURE 15) was previously moved by increment cam 15, it being noted that the axes of cam follower 532 and yoke pin 537 in FIGURE 15 are spaced equidistantly with respect to the pivot shaft 534. Outward movement of each follower 532 and its corresponding carriage shifting lever 533 is limited by an abutment or stop pin 604 projecting from the corresponding spar 122.

All of the abutments 604 should be accurately positioned with respect to the shifting cranks 536 engaged thereby so that the followers 532 associated with all the cutter head carriages occupy the same position with respect to the corresponding sets of increment cams and to thus insure that any of the increment cams will cause the corresponding contour cutter head carriages to move the distance specified for the respective cams in the chart of FIGURE 32.

It should be noted that, when he fork arms 555, 556 of FIGURE 23 occupy reverse position; that is, occupy positions so that the balls 551 are moved inwardly and the balls 550 are released, the right to left or outward movement of the corresponding carriage transition tube 540, which is effected by inward movement of cam 15 of FIGURE 15, for example, causes the corresponding carriage transition bar 542 and carriage D to move outwardly a predetermined distance. Thus, as the cam 15 returns to the outward position shown in FIGURE 15, plunger 600 returns the shifting lever 533 and transition tube 540 to the position shown, during which the transition tube moves from left to right in FIGURE 23, but does not impart inward movement to the transition bar 542 because the balls 551 are then held out of engagement with the transition bar 542 and the angled surfaces 545 are moving away from the balls 550.

During each advancement of the web, selected cutter increment cam groups or sets A–1 through D–1 and A–1′ through D–1′ (FIGURE 17) may be moved one step (see cycle chart of FIGURE 34), during which the increment cams and the various movable parts of each respective overriding carriage increment clutch 530 occupy substantially the position shown in FIGURE 15, although the corresponding clutch coupler thrust bar 557 may then occupy any one of the three positions heretofore described. Either of the directional solenoids 573 or 574 may then be energized to condition the corresponding increment clutch 530 for effecting subsequent movement to the corresponding carriage in the desired direction. At a predetermined instant thereafter, all the increment cam groups or sets are moved inwardly and then outwardly so that any increment cams then alined with corresponding followers 532 (FIGURE 15) impart inward movement thereto for a distance determined by the then corresponding dimensions E (FIGURES 26–32), and also resulting in the corresponding plunger 600 returning the shifting lever 533 to its normal or static position. It is thus seen that selected cutter head carriages may be moved inwardly or outwardly predetermined distances during selected cycles in the operation of the machine and the carriages A–D and A′–D′ may be moved independently of the corresponding carriage increment clutches 530.

Means will be described later in this context for returning each carriage to a predetermined start position following each main pattern cycle of the machine.

XIV. MEANS FOR TRANSMITTING ANGULAR MOVEMENT TO CONTOUR CUTTER BLADES FROM THE INCREMENT CAMS

(FIGURES 10, 11–A, 14, 15, 16, 17 and 47)

The intervening elements between the cutter increment cams and the racks 400, 401 in each corresponding cutter head carriage, for transmitting predetermined angular movement to the corresponding contour cutter blade 81 and the presser head 370 will be described with respect to the contour cutter head carriage D, and corresponding elements associated with the other contour cutter head carriages A, B, C and A′ through D′ will bear the same reference characters in order to avoid repetitive description. However, it should be noted in FIGURES 15 and 16 that there is a cutter neutralizing solenoid 610 fixed to a block 121 and located beneath and outwardly of the housing 531 of each carriage increment clutch 530 and that the cutter neutralizing solenoids 610 associated with cutter head carriages B, D and corresponding elements carried thereby, are positioned on a higher level than the cutter neutralizing solenoids 610 corresponding to the cutter head carriages A, C. Solenoids 610 will be later described.

It is apparent that the cutter neutralizing solenoids 610 for adjacent carriages are arranged in staggered relationship so that cam reading elements or fingers 611 thereof (FIGURE 15) may be horizontally alined outwardly of the stems 452, 452*a* (FIGURES 26–31) of any corresponding inner and outer cutter increment cams which may be moved into alinement therewith as the increment cam groups A–1 through D–1 and A–1′ through D–1′ are stepped past the cam followers 532 corresponding to the respective cutter head carriages A–D and A′–D′ (FIGURE 17).

The manner in which the cutter head carriage D is stepped inwardly and outwardly predetermined distances has been described heretofore and, by referring to the chart of FIGURE 34 and comparing the dimensions X and E in the chart of FIGURE 32, it is apparent that the carriage D is stepped said predetermined distances following respective penetrations of the web by the corresponding cutter blade 81 and needle 325 (FIGURE 13) so that the carriage D is moved inwardly or outwardly a distance corresponding to that portion E of the width of the web embraced by the angle and length of cut effected by the immediately preceding cutting operation of blade 81 and needle 325.

Accordingly, in order to position the contour cutter blade 81 and the presser head plate 367 at any of the angles indicated in FIGURE 33 either side of the zero degree position following each cutting operation of the blade 81, and at an angle corresponding to the distance the cutter head carriage is to be moved or stepped fol-

lowing said cutting operation, the free end of each cam reading element **611** (FIGURE 15) is positioned a predetermined distance outwardly of the path of movement of the stems **452** or **452***a* of cams, such as cams **1** and **1**–*a* in FIGURES 26 and 29, which may be mounted on the corresponding increment cam bases, such as D2 and C2 in FIGURE 15. Each selected cam reading element **611** (FIGURE 15) is moved inwardly, by means to be presently described, to engage the outer end of the stem of the corresponding cutter increment cam, which cutter increment cam then occupies its outermost position with respect to the longitudinal axis of the machine.

The extent to which said cam reading element **611** may move inwardly before it engages and is stopped by the tail of the corresponding cutter increment cam, such as cam **15** in FIGURE 15, determines the extent to which the racks **400**, **401** and pinions **332**, **387** of FIGURE 10 may move in either direction, thus determining the angle Y at which the corresponding cutter blade **81** (FIGURE 13) is moved in either direction from said zero degree position.

As stated heretofore in Chapter XI, racks **400**, **401** (FIGURE 10) must move .0545 inch to rotate blade **81** through a 5° angle, in this embodiment of the invention. Since each reading element **611** moves the same distance as racks **400**, **401**, and rotation of each blade always starts from the zero position (FIGURE 33), each reading element **611** must move inwardly .0545 inch for each increase of 5° in the angle of its respective contour cutter blade **81**. Thus, the distance from the outer surface of the body **453***a* of each increment cam **1**–*a* to **15***a*, or from a corresponding point on the stem **452** of each cam **1**–**15**, to the end of the respective reading element **611**, is .9810 inch. If such an increment cam was used, the reading element **611** could then move inwardly .9810 inch to move the respective contour blade through an arc of 90°. Thus, dimension X of cam **1** in FIGURE 32 is derived by substracting .0545 inch from .9810 inch, which equals .9265 inch. It follows that dimension X of cam **2** is equal to .9810 minus (2×.0545) or .8720 inch. Thus, the X dimension for each cam **1** through **15** (or **1**–*a* through **15***a*) is determined by the formula; .9810—(number of 5° increments×.0545).

It will be observed in FIGURE 15 that each cutter angle cam reading element **611** is fixed on the inner end of a solenoid plunger **612** which extends through the coil of the corresponding solenoid **610**, which coil is suitably secured to the corresponding block **121**. Each block **121** has an opening therethrough through which the corresponding solenoid plunger **612** and its blade angle reading element **611** loosely extends.

Each solenoid plunger **612** has an upwardly extending portion **613** thereon through which the movable or wire elements of a pair of Bowden wires **615**, **616** loosely extend and which have respective abutments or caps **617**, **618** (FIGURES 15 and 16) fixed on the free ends thereof and normally engaging the outer surface of the arm **613** of the corresponding solenoid plunger **612**. The outer ends of the flexible casings of Bowden wires **615**, **616** adjacent the corresponding solenoid **610**, are suitably secured in the corresponding block **121**. The Bowden wires **615**, **616** extend inwardly from the block **121** and the casings thereof may be attached to various parts of the machine, with sufficient slack being provided in each of the Bowden wires **615**, **616** so that their other ends may move inwardly and outwardly with the corresponding carriage D.

It will be observed in FIGURES 10, 11–A, 15 and 47 that the ends of the casings of Bowden wires **615**, **616** opposite from the corresponding block **121** are suitably attached to the bottom wall of the lower hollow arm **313** of the corresponding carriage D, and the wire elements of these Bowden wires **615**, **616** loosely extend through said bottom wall of hollow arm **313** and also loosely extend through the lower arms of respective bell cranks **621**, **622**. Bell cranks **621**, **622** are oscillatably mounted intermediate their ends, as at **623**, **624**, on one of the side walls of the corresponding lower hollow arm **313**.

The arms of bell cranks **621**, **622**, remote from those arms to which Bowden wires **615**, **616** are connected, have respective followers or rollers **625**, **626** thereon (FIGURES 10 and 14) which engage inner and outer ends of respective solenoid plungers **630**, **631**. Solenoid plungers **630**, **631** are interconnected by a suitable insulation bar **632** so that the magnetic fields of the coils **633**, **634** of a pair of blade angle selecting solenoids **635**, **636** may act upon the respective solenoid plungers **630**, **631** independently of each other. As best shown in FIGURES 10 and 14, the solenoids **635**, **636** are disposed in closely spaced relationship and are suitably secured to a common bracket **637** fixed to the lower surface of the top wall of the corresponding lower hollow arm **313**.

The distal ends of solenoid plungers **630**, **631** are suitably secured to lower rack **401**, as by angle brackets **640**, **641**. The ends of the movable or internal wire elements of the flexible cables or Bowden wires **615**, **616** have respective abutments or caps **642**, **643** fixed thereon and adapted to engage the upper surfaces of the lower arms of the respective bell cranks **621**, **622**.

Referring to FIGURE 34, it will be noted that each contour cutter blade **81** is returned to the zero position at the initiation of each blade reciprocation cycle in the operation of each cutter head carriage. The returning of each contour cutter blade **81** to zero position is effected by energization of the coil of the corresponding solenoid **610** (FIGURES 15 and 16), which causes its solenoid plunger **612** and its cam reading element **611** to move outwardly to the position shown in FIGURE 15.

In so doing, the abutments **617**, **618** are both engaged and moved outwardly by the corresponding arm **613**. At this particular instant, the coils **633**, **634** of both of the corresponding solenoids **635**, **636** are de-energized; that is, no current is flowing through them, so the abutments **642**, **643** engage and move the corresponding arms of the respective bell cranks **621**, **622** downwardly in FIGURES 10 and 14, causing the rollers **625**, **626** to move toward each other, or one toward the other, so the plungers **630**, **631** occupy the neutral position shown in FIGURES 10 and 14.

When the plungers **630**, **631** occupy the latter position, the corresponding contour cutter blade **81** occupies zero position parallel to the path of travel of the web W (see FIGURE 33). Thereafter, the increment cam blocks A2 through D2 and A2′ through D2′ may be independently advanced one step and, prior to subsequent inward movement of the increment cam bed plate and, if called for by the main pattern mechanism **82**, one or the other of the solenoid coils **633**, **634** of the corresponding cutter head carriage (FIGURES 10 and 14) is then energized, causing the corresponding plunger **630** or **631** to be drawn thereinto. It is apparent that both of the plungers **630**, **631** move unitarily and thus impart movement to the racks **401** and **400** in the corresponding direction.

Assuming, for example, that coil **633** of solenoid **635** is energized, during which time no current is flowing through the coil of solenoid **610** (FIGURE 15), this causes solenoid plungers **630**, **631** to move from right to left or inwardly in FIGURES 10 and 14. Thus, plunger **631** moves bell crank **622** in a counterclockwise direction in FIGURE 10, moving the core of Bowden wire **616** longitudinally within its housing, and thus imparting inward movement to the abutment **618** on the other end of the corresponding Bowden wire **616** (FIGURE 16).

By referring to FIGURE 15, it is apparent that inward movement of either abutment **617** or **618** causes like inward movement to be imparted to the corresponding arm **613**, solenoid plunger **612** and cam reading element **611** until the corresponding reading element **611** engages the stem **452** or **452***a*, as the case may be, of the corresponding cutter increment cam. Thereupon, the cutter increment

cam stops further inward movement of the corresponding reading element **611** and prevents further movement of the plungers **630**, **631** of the corresponding cutter head carriage D under the influence of the current flowing through coil **633**.

As heretofore stated, with movement of the racks **400**, **401** from right to left in FIGURES 10, 13 and 14, the corresponding contour cutter blade **81** and presser head plate **367** are moved inwardly a predetermined distance toward the center of the machine about their common axis. For example, if the upper cam reading element **611** in FIGURE 15 has engaged the stem **482** of cutter increment cam **15**, the latter reading element **611** will have moved inwardly .8175 inch (see chart of FIGURE 32),which will have caused the corresponding contour cutter blade **81** to occupy a 75° angular position with respect to the path of travel of web W, with the edge of the contour cutter blade **81** opposite from the corresponding needle **325** (FIGURE 13) extending inwardly from needle **325** with respect to the direction of travel of the web W. The latter .8175 inch is derived by substracting the .1635 inch dimension in column X (FIGURE 32) from .9810 inch, which is the distance the reading element **611** may move inwardly when $X=0$ (see cam **16** in FIGURE 32) and blade **81** is to occupy a 90° or right-angular position relative to the direction of travel of web W.

Now, if the cutter blade **81** is to be swung in the opposite direction to extend outwardly at an angle of 75° with respect to the direction of travel of web W, the corresponding reading element **611** is returned to the neutral position by momentary energization of the coil of solenoid **610** and, thereafter, the coil **634** of FIGURES 10 and 14 is energized instead of coil **633**, thus causing the racks **401** and **400** to move from left to right in FIGURES 10 and 14 for the distance permitted by the stem **452** of the corresponding inner cutter increment cam, such as cam **15** in FIGURES 15, 28 and 32. Of course, if any contour cutter head blade **81** is to remain in the zero or neutral position parallel to the path of travel of the web following energization of the corresponding solenoid **610**, neither of the coils **633**, **634** is energized.

Although means may be provided for delaying advancement of web W for intervals of greater extent than the intervals permitted by continuous rectilinear movement of the feed dogs **64–67** (FIGURES 8 and 8–A), such as by the interposition of pattern controlled clutch means in each of the shafts **232**, **232'** in FIGURES 8–A and 8, respectively, the present embodiment of the machine advances the web W at uniform distances at equally spaced intervals throughout the operation of the machine. Accordingly, if successive lines of cut through the web are to be coextensive, a 90° cutting operation may be effected by any one of the contour cutter blades **81** only at the terminal end of any series of cuts of other angles effected thereby. Thus, by comparing the dimensions X and E of cam **16** in FIGURE 32, when one of such cams **16** is alined laterally of the machine with respect to one of the reading elements **611**, such as that shown opposite the stem of cam **15** in FIGURE 15, energization of either of the coils **633**, **634** of solenoids **635**, **636** will cause the corresponding reading element **611** to move to its maximum inward position, which would be .9810 inch in this instance. However, after the immediately succeeding 90° cut is effected by a single reciprocatory movement of the corresponding contour cutter blade **81**, no later inward or outward movement need normally be imparted to the corresponding cutter head carriage D because the next web advancement following the 90° angular cut would position such 90° angular cut forwardly of the corresponding contour cutter blade **81**. Therefore, since the E dimension for cutter increment cam **16** in FIGURE 32 is zero inches, if this particular cam is moved inwardly toward the corresponding follower **532** in FIGURE 15, it may engage follower **532**, but will not impart inward movement thereto.

XV. CYCLING DRUM AND RELATED ELECTRICAL CIRCUITS

(FIGURES 4, 5, 8, 16, 18, 43, 46, 46–A and 47)

Referring to the cycling or flow chart of FIGURE 34, it will be noted that operations of all of the mechanisms determining the lateral positions of each cutter head carriage, the angles of the corresponding contour cutter blades **81** and the steps in advancement of the web W must occur in a predetermined sequence and in timed relation to each vertical reciprocation cycle of any of the contour cutter blades **81**, regardless of whether or not the patterning on the main pattern mechanism **82** calls for the actuation of any particular elements controlled thereby, and all of such operations must be effected during the course of a single revolution of each of the cutter drive shafts **244**.

For purposes of description, it shall be assumed that each cutter reciprocation cycle in the operation of the machine starts (1) about midway of a step in advancement of the web W, (2) simultaneously with the initiation of downward movement of any cutter blades **81** which may be called for actuation by the main pattern mechanism **82**, and (3) at the instant at which any of the cutter blades **81**, which may have previously occupied an angle other than zero position, start returning to said zero position with respect to the path of travel of web W. It should be noted that all of the contour cutter blades **81** must occupy zero position; i.e., parallel to the longitudinal axis of the machine and the web, preceding each change in the angle thereof in order to permit the corresponding cutter increment cam or cams to move longitudinally of the machine past the reading elements **611** (FIGURE 15) without colliding therewith.

Although the main pattern mechanism **82** determines which of certain of the operations listed in FIGURE 34 shall be effected, the sequence of these operations is determined by a primary cycling mechanism embodied in a cycling or pattern drum generally designated at **650** (FIGURES 4, 5, 8, 16, 18, 43, 46, 46–A and 47) which is fixed on the front end of main cam shaft **240** and, thus, rotates a complete revolution during each cutting cycle of the contour cutter heads **80** (FIGURES 10 and 13).

Cycling drum **650** has a plurality of axially arranged segmental cams **651** through **658** fixed on the periphery thereof which are adapted to engage and close respective normal open cycling switches **661–668** (FIGURES 8, 46, 46–A and 47). The housings of switches **661–668** are suitably secured, above drum **650**, to a plate **675** (FIGURE 8) suitably secured to and projecting rearwardly from the front upper transverse frame member **110**. Corresponding sides of cycling switches **661–668** are connected to a common positive lead conductor **676** extending from one side of a source of current embodied in a plug **677**. The other side of plug **677** has a negative lead conductor **680** extending therefrom.

Switch **661** controls the cycling of all of the cutter neutralizing solenoids **610** (FIGURES 11–A, 15, 17, 46 and 47). Thus, there being eight contour cutter heads, the side of switch **661** opposite from conductor **676** is connected to a junction box or contact bar **681** from which eight conductors **682** extend to corresponding sides of the respective solenoids **610**. Each conductor **682** has a separate pattern controlled, normally open switch **683** interposed therein.

Referring to FIGURE 46, it is apparent that eight conductors **682** and eight switches **683** are provided to accommodate the eight cutter neutralizing solenoids **610** associated with the eight cutter head carriages A–D, A'–D'. Only one of the conductors **682** and corresponding switches **683** are shown in FIGURE 47, since the circuit of FIGURE 47 relates to a single cutter head carriage D.

The side of each solenoid **610** opposite from the respective conductor **682** has a conductor **685** extending therefrom to a junction box or contact bar **686** from which a conductor **687** leads to the lead conductor **680**.

Thus, anytime any of the switches 683 are closed by the main pattern mechanism 82, in a manner to be later described, subsequent closing of cycling switch 661 causes the corresponding solenoids 610 to be energized to cause corresponding contour cutter blades 81 to occupy the zero or neutral position in the manner heretofore described.

Switch 662 controls the cycling of the increment cam switching solenoids 520, 521. Thus, switch 662 is also connected to a pair of junction boxes or contact bars 690, 691 (FIGURES 46 and 47) which have corresponding ends of respective groups of eight conductors 692, 693 connected thereto which lead to corresponding sides of the respective cam switching solenoids 520, 521, there being one of the solenoids 520 and one of the solenoids 521 for each of the cutter head carriages, as heretofore explained.

The sides of solenoids 520, 521 opposite from the conductors 692, 693 have respective conductors 694, 695 which lead to respective junction boxes or contact bars 696, 697. The latter are connected to lead conductor 680 by a conductor 700. Each conductor 692 has a normally open, pattern controlled switch 701 interposed therein, and each conductor 693 has a normally open, pattern controlled switch 702 interposed therein. Switches 701, 702 are arranged in the same manner as switches 683 with respect to the pattern mechanism 82, to be later described.

It is thus seen that, upon any of the switches 701, 702 being closed by the pattern mechanism 82 and cam 652 subsequently closing the switch 662, respective solenoids 520 or 521 are energized to effect a step in switching movement to the corresponding group of increment cams (FIGURE 17) in the direction determined by whichever one of the solenoids 520 or 521 associated with a particular carriage is energized, as heretofore explained.

Cam 653 and its switch 663 control the cycling of the clutch neutralizing solenoid 576 (FIGURE 22) of each increment clutch 531. Thus, switch 663, opposite from lead conductor 676, is connected to a junction box or contact bar 705 to which corresponding ends of a group of eight conductors 706 are connected. The other ends of conductors 706 are connected to one side of the coils of the respective clutch neutralizing solenoids 576.

Each conductor 706 has a normally open pattern controlled switch 707 interposed therein, the closing of which is controlled by the main pattern mechanism 82, as will be later described. The other side of the coil of each solenoid 576 has a conductor 710 leading therefrom to a common junction box or contact bar 711, from which a conductor 712 extends to lead conductor 680.

It is thus seen that, upon any one or more of the switches 707 being closed by the main pattern mechanism 82, subsequent closing of cycling switch 663 by cam 653 energizes the corresponding clutch neutralizing solenoids 576 to cause the clutch coupler thrust bars 557 to subsequently occupy a neutral position (FIGURES 20–23 and 47), as heretofore explained.

The closing of switch 664 by cycling cam 654 controls the cycling of the carriage directional solenoids 573, 574 of the carriage shifting increment clutches 531, and also controls the cycling of the blade angle selecting solenoids 635, 636 associated with all of the cutter head carriages. Thus, the side of cycling switch 664 opposite from lead conductor 676 is connected to four junction boxes or contact bars 713–716 which have corresponding ends of respective groups of eight conductors 717–720 connected thereto. The ends of conductors 717–720 opposite from contact bars 713–716 are connected to corresponding sides of the coils of the respective solenoids 574, 573, 635, 636. The other sides of solenoids 574, 573, 635, 636 have respective conductors 723–726 leading therefrom to respective junction boxes or contact bars 727–730 (FIGURES 46 and 47). Contact bars 727, 728 are connected to lead conductor 680 by means of a conductor 732. Contact bars 729, 730 are connected to lead conductor 680 by means of a conductor 733.

Each conductor 717 has a normally open, pattern controlled switch 734 interposed therein, each conductor 718 has a normally open, pattern controlled switch 735 interposed therein, each conductor 719 has a normally open pattern controlled switch 736 interposed therein, and each conductor 720 has a normally open, pattern controlled switch 737 interposed therein. Switches 734–737 are selectively closed by the pattern mechanism 82, in a manner to be later described. Upon any one or more of the switches 734–737 being closed, with subsequent closing of cycling switch 664, corresponding solenoids 574, 573, 635, 636 are energized to determine the direction in which the corresponding cutter head carriage or carriages will subsequently be moved by lateral movement of the corresponding increment cams, and to also effect and determine the direction in which the corresponding contour blades 81 are moved about their vertical axes.

It should be noted that the chart of FIGURE 34 shows that angular movement is imparted to each selected contour cutter blade 81 after the increment cams have been switched in either direction longitudinally of the machine and at some time prior to either inward or outward movement being imparted to any of the main carriages. It follows, therefore, that the cutter increment cams are in stationary, outward, positions at the time of energization of either of the contour blade angle selecting solenoids 635 or 636 of any of the carriages.

The cycling cam 655 and switch 665 control the cycling of the contour blade reciprocating clutch solenoid 436 (FIGURES 12, 46–A and 47). To this end, the side of cycling switch 665 opposite from lead conductor 676 is connected to a junction box or contact bar 740, to corresponding ends of which a group of conductors 741 are connected. Each conductor 741 has a pattern controlled normally open switch 742 interposed therein. The end of each conductor 741 opposite from contact bar 740 is connected to one side of the coil of a respective electromagnetic relay 743, from the other side of which a conductor 744 leads to a junction box or contact bar 745.

Contact bar 745 is common to all the conductors 744 and is connected to lead conductor 680 by a conductor 746. Each relay 743 has two normally open switch bars 780, 781 which, when closed, establish contact between respective pairs of conductors *h2*, *h3*, and *h4*, *h5*. Corresponding ends of all the conductors *h2*–*h4*, opposite from the respective switch bars 781, 780, are connected to a common junction box or contact bar *h6*. Contact bar *h6* is connected to lead conductor 676 by a conductor 782.

The end of each conductor *h3*, opposite from the corresponding switch bar 781, is connected to one end of a separate one of the coils of one of the solenoids 436. The other side of the coil of each blade reciprocating clutch solenoid 436 has a conductor *h7* leading to a junction box or contact bar *h8* which is common to all the conductors *h7*. Conductor bar *h8* is connected to lead conductor 680 by means of a conductor *h9*.

The ends of conductors *h5* opposite from switch bars 780 are connected to a common junction box or contact bar *j2*. A conductor 783 leads from contact bar *j2* to a contact bar or junction box *j3*. Since there are eight contour cutter blade carriages, contact bar *j3* has corresponding ends of eight conductors *j4* connected thereto, whose other ends are connected to the conductors 741. It will be noted in FIGURES 46–A and 47 that one of the conductors *j4* is connected to a corresponding one of the conductors 741 at a point between the corresponding switch 742 and the coil of the corresponding relay 743.

Each conductor *j4* has a normally closed, pattern controlled switch *j5* interposed therein. The switches 742 are selectively closed by the main pattern mechanism 82, in a manner to be later described, and those switches *j5* corresponding to any of the switches 742 which may have been closed by the pattern mechanism 82 are moved to open position by the pattern mechanism at a predetermined period following the closing of any selected switches 742. Thus, when the pattern mechanism 82 closes any

one or more of the switches 742, the switch *j5* corresponding thereto is closed at that time, and cycling cam 655 then momentarily closes switch 665 to energize the coil of the respective relay 743 to move switch bars 780, 781 to closed position.

Since the closing of switch 665 by cycling cam 655 is of relatively short duration, switch *j5* subsequently then holds the circuit to the coil of the respective relay 743. Also, substantially simultaneously with the initial enegization of the coil of any relays 743, respective switch bars 781 cause energization of the coils of corresponding blade reciprocating clutch solenoids 436 whereby one or more vertical reciprocations are imparted to the corresponding contour blades and the corresponding presser head plates 367, depending upon how many identical successive cuts are to be made by the corresponding contour blades 81.

Regardless of whether the contour cutter blade or blades 81 are to form a single cut or several cuts while occupying a given angle with respect to the direction of movement of the web W, upon completion of any such cuts or series of straight and/or serpentine lines of cuts by a particular contour cutter blade 81, the main pattern mechanism 82 opens the corresponding stop switch *j5* and, since the corresponding start switch 742 is then opened, this breaks the circuit to the coil of solenoid 743, releases contact bars 780, 781 and breaks the circuit to the coil of the corresponding solenoid 436 before the shoulder 424 (FIGURE 12) on the disk 415 of the corresponding clutch 357 reaches the radial plane of the clutch dog 425 in that particular cycle. Thus, the corresponding contour cutter blade 81 comes to rest in raised position and the corresponding presser head plate 367 comes to rest in fully lowered position.

It will be observed in FIGURE 34 that a step in movement of the pattern chain of the main pattern mechanism 82 terminates before initiation of each energization of the blade reciprocating clutch solenoid 436 of the corresponding cutter head carriage. In this particular figure, the duration of energization of the blade reciprocating clutch solenoid 436 is shown as being less than a complete cycle in reciprocation of the corresponding contour blade 81. However, it is apparent from the foregoing description that the reciprocating clutch solenoid 436 remains energized throughout each cycle of a particular contour cutter head carriage when a cycle succeeds a preceding cycle without interruption.

Referring to FIGURES 12 and 34, it should be noted that whenever vertical reciprocation of the contour cutter blade 81 (FIGURE 13) associated with any particular cutter head carriage is to be initiated, the corresponding switch 742 (FIGURES 46–A and 47) is closed as the pattern chain of the main pattern mechanism 82 approaches the end of a step in movement thereof (FIGURE 34). However, when vertical reciprocation of the corresponding contour cutter blade 81 is to be terminated, whether it be at the end of a series of cutting operations or following a single cutting operation, the corresponding switch *j5* (FIGURES 46–A and 47) must be opened, sometime before the corresponding step of said pattern chain approaches completion, so that the circuit to the corresponding solenoid 436 is broken and spring 434 may move clutch dog 425 (FIGURE 12), into engagement with disk 415 or its latch 442 before the shoulder 424 on disk 415 reaches clutch dog 425. Although the wedge-shaped lever 422 then gradually moves from the broken line to the solid line position in FIGURE 12, the momentum of disk 415 and parts rotated therewith is such that disk 415 will continue to rotate until the shoulder 424 engages the clutch dog 425. By way of comparison, it will be noted in FIGURE 34 that the blade reciprocating clutch solenoid 436 is de-energized upon approximately two-thirds of a step in movement of the pattern chain of pattern mechanism 82 being completed in that particular cycle. This completes the description of the cutter head carriages A–D, A'–D', their associated contour cutter heads 80 and presser heads 370, and the various devices for cyclically operating the same.

XVI. SECONDARY CUTTER HEADS

(FIGURES 8–A and 24)

As heretofore stated, the secondary cutter heads 85 (FIGURES 8–A and 24) are provided for forming relatively short lateral cuts in the web W at predetermined intervals and, therefore, each secondary cutter head 85 is provided with an electromagnetically operated straight cutter blade 86. It should be distinctly understood, however, that heated wire elements may be substituted for one or more of the cutter blades 86 for forming notches or predeterminately shaped relatively short cuts in the web W by burning the web along predetermined lines. Further, it is to be understood that one or more printing devices may be substituted for one or more of the straight cutter blades 86 for printing indicia on the web W, without departing from the spirit of the invention.

In this instance, three of the secondary cutter heads 85 are arranged in spaced parallel relationship laterally of the machine in FIGURE 7, and each of them comprises a solenoid whose housing 800 is mounted for lateral adjustment above the slot 195 in main table 56 (FIGURE 35). The solenoid housings 800 of the secondary cutter heads 85 are mounted for lateral adjustment, with respect to the axis or travel of the web W, on a pair of rods 801 which overlie the slot 195 in the main table 56 and are mounted in brackets 802 (FIGURES 1, 2, 4, 5, 7, 8–A and 16) suitably secured to and extending upwardly from side rails 60, 60' of main table 56.

A solenoid plunger 804 is guided for vertical sliding movement in each bracket or housing 800 and its upper portion is surrounded by a solenoid coil 805. Each blade 86 is suitably secured to the lower end of the corresponding solenoid plunger 804.

Plungers 804 are normally urged upwardly, to normally maintain the blades 86 in spaced relation above the web W, by a tension spring 806 (FIGURE 24). The lower end of each tension spring 806 is connected to the corresponding plunger 804 and the upper end thereof is connected to a spring standard 807 of substantially inverted L-shaped form and whose lower end is suitably secured to the corresponding housing 800.

Referring to FIGURE 46–A, it will be observed that each solenoid 805 has a pair of conductors *j6*, *j7* connected to opposite ends thereof. The ends of conductors *j6* remote from solenoid coils 805 are connected to a junction box or contact bar 810, and the ends of conductors *j7* opposite the coils 805 are connected to a common junction box or contact bar 811. Contact bar 811 is connected to negative lead conductor 680 by means of a conductor 812.

Since there are three secondary cutter heads 85 provided in FIGURE 7, it will be noted that there are three sets of conductors *j6*, *j7* shown in FIGURE 46–A. Each conductor *j6* has a normally open, pattern controlled switch 813 interposed therein. Switches 813 are closed at predetermined intervals by the main pattern mechanism 82. Contact bar 810 is connected to one side of cycling switch 666, the other side of which is connected to the positive lead conductor 676.

It is thus seen that, upon any one of the switches 813 being closed by pattern mechanism 82, and the switch 666 being closed a predetermined interval thereafter by cycling cam 656, the corresponding solenoid coil 805 is energized and imparts a downward stroke to its solenoid plunger 804 and blade 86 of the corresponding secondary cutter head 85. As the latter blade 86 moves downwardly, it penetrates the web W and passes into slot 195 to form a line of cut equal to the length of the cutting blade 86. Each cutting blade 86 is preferably removably connected to the lower end of the corresponding solenoid plunger 804 so that blades of varying length, heated wires or printing

heads may be used in accordance with the particular blank to be formed from the web W.

XVII. TERTIARY OR POCKET CUTTER HEADS
(FIGURES 1, 2, 4–8, 16, 35, 36 and 37)

As heretofore stated, the pocket cutter heads are located forwardly of the foremost main cutter head carriages D, D' and each cutter head **87**, of which three are shown in the present drawings, includes an endless blade **88** of substantially rectangular form, whose rear portion is substantially V-shaped so as to form pocket panels, such as the panels S–3 of FIGURE 25, with each actuation thereof. The blades **88** are normally spaced above the web W and are moved downwardly through the web and into respective cooperating endless grooves **820** (FIGURES 8, 35, 36 and 37) formed in the pocket cutter head base plate **186** of main table **56**. The grooves **820** are of substantially the same configuration as the cutting edges of the pocket cutter blades **88** to thereby assist the pocket cutter blades **88** in cutting the web W.

It will be noted in FIGURES 35 and 37 that three of the feed dog slots **72** appear within the confines of each of the endless grooves **820** and four of the grooves **72** are arranged to straddle the rear portions of the endless grooves **820**. As best shown in FIGURES 8 and 36, a relatively thin, elongate, forwardly and rearwardly extending presserfoot **821** overlies each of the latter four feed dog slots **72**, and each presserfoot **821** is normally urged against the upper surface of the corresponding pocket cutter head base plate **186** by a spring **822**.

The upper ends of springs **822** bear against a cross bar **823** spaced above the base plate **186**, and the lower end of each compression spring **822** bears against a collar **824** fixed on an upright shaft or post **825**. The lower end of each post **825** has the corresponding presserfoot **821** pivotally connected thereto, and the upper portion of each post **825** is guided for vertical sliding movement in the cross bar **823**. The front and rear ends of the presserfeet **821** are turned upwardly in the same manner as the main presser plates **282, 283**, heretoforce described.

It will be observed in FIGURE 36 that cross bar **823** is secured to a pair of standards **827, 827'** fixed to the main table side rails **60, 60'** of main frame **62**. In this instance, posts **827, 827'** have corresponding vertically extending slots **830** therein penetrated by adjustment screws **831** threaded into corresponding ends of cross bar **823**. Cross bar **823** supports a plurality of solenoid coils **833**, there being three of the solenoid coils **833** shown in FIGURE 36 and each of which is a part of the corresponding pocket cutter head **87**.

The solenoid coils **833** are preferably centrally located above the three endless grooves **820**. Each coil **833** has a solenoid plunger **834** extending therethrough whose upper end is connected to a spring **835**. The springs **835** extend upwardly and are connected to a cross rod **836** which extends laterally of the machine and is suitably mounted in the upper ends of the standards **827, 827'**.

Each solenoid plunger **834** preferably has a stop pin or abutment **837** projecting outwardly therefrom which is adapted to engage the upper end of the corresponding solenoid coil **833** to limit downward movement of the corresponding endless cutter blade **88** during vertical adjustment of cross bar **823**, for example. The solenoid plungers **834** are guided for vertical sliding movement in cross bar **823** and the lower ends thereof each has a blade support **840** suitably secured thereto. Blade support **840** is preferably of the same configuration as the corresponding endless blade **88** and has the upper portion of the endless blade **88** suitably secured thereto.

A presser block or stripper block **841** fits snugly within, and is of substantially the same configuration as, each endless cutting blade **88**. Each stripper block **841** is urged downwardly against the web W or against the upper surface of the plate **186** of main table **56**, by a pair of compression springs **843**.

Each compression spring **843** surrounds a corresponding vertical guide pin or rod **844** whose lower end is suitably secured to the corresponding stripper block **841** and whose upper portion loosely penetrates the blade support **840**. Each pin **844** is preferably provided with a head **845** on its upper end so as to limit downward movement of the presser block **841**. A yieldable cushioning member or washer **846** is provided between the proximal surfaces of the cross bar **823** and each blade support **840**.

It is apparent that the upper and lower ends of the springs **843** bear against the proximal surfaces of the blade support **840** and the corresponding stripper block **841**. As best shown in FIGURE 8, the front and rear ends of each stripper block **841** are rounded so as to facilitate the passage of the web W between the stripper blocks **841** and the main table **56**. The stripper blocks **841** not only serve as guides for the respective pocket cutter blades **88**, but they also strip the web from the cutter blades whenever the solenoids **833** are de-energized and the blades **88** move upwardly to the position shown in FIGURE 36. Further, the stripper blocks **841** maintain the web W in contact with corresponding feed dogs **66** during each upward and forward movement thereof to insure that the pocket panels cut from the web W by cutter blades **88** are advanced with the web W as each advancing stroke is imparted to the feed dogs **66**.

The solenoid coils **833** of the pocket cutter heads **87** are preferably momentarily energized subsequent to every sixth primary web section W' being formed with a shirt body blank S–2 and sleeve blanks S–1, for example. This is desirable because of the web being of double thickness and six pocket panels S–3 thus being formed with each actuation of the pocket cutter heads **87**. Accordingly, the electrical circuit for controlling actuation of the pocket cutter heads **87** is closely integrated with the main pattern mechanism **82** and will be described following the description of the main pattern mechanism **82**, to be presently described.

XVIII. MAIN PATTERN MECHANISM
(FIGURES 1, 2, 4, 5, 7, 11 and 43–45)

The main pattern mechanism **82** is in the form of an endless pattern belt or chain **850** having a plurality of transverse rows of cavities or pattern pin receiving holes **851**, therein (FIGURES 43, 44 and 45) in which pattern pins **852** may be positioned, these pins being arranged to operate selected switches **683, 701, 702, 707, 734, 735, 736 737** (FIGURES 46 and 47), *j5*, **742** and **813** (FIGURE 46–A) heretofore described, and switches **856–859** (FIGURES 43 and 46–A) in accordance with a predetermined pattern. The pattern controlled switches are arranged in eight transverse rows or banks, there being a row of ten switches, including switches **683, 701, 702, 707, 734–737**, *j5* and **742** (FIGURES 11, 46, 47–A and 47), for each of the cutter head carriages A–D, A'–D'. In addition, three of said rows of switches may each include one of the switches **813** for operating the secondary cutter heads **85**, and the switches **856–859** may be distributed among two or more such rows. Switches **856–859** control the pocket cutter heads **87** and sundering device **95** through a pattern cycle counter to be later described.

Only one row or bank of said switches is shown in FIGURE 11 although it may be observed in FIGURE 45 that the switches in adjacent rows are staggered so that adjacent switches may be disposed in closely spaced lateral relationship in adjacent rows, even though adjacent switches in individual rows may be spaced substantially from each other. The switches in each row heretofore described may be suspended on a pair of rods **860** (FIGURES 5, 11, 43, 44 and 45) along which corresponding switches may be adjusted. Each pair of rods **860** is supported in spaced relationship above the upper run of endless pattern chain **850** so as to insure that the switches are engaged and actuated by any corresponding pattern pins **852**.

To this end, it will be observed in FIGURE 11 that opposed ends of rods 860 shown therein are suitably secured to brackets 862 supported upon and being suitably secured to track guide plates 863, 864. Track guide plates 863, 864 are suitably secured to the upper surfaces of respective linear pattern tracks 866, 867 which are adapted to support and guide the upper run of endless pattern chain 850.

Opposed ends of the linear pattern tracks 866, 867 are suitably secured to pairs of rear and front arcuate or substantially semi-circular pattern tracks 870, 871 (FIGURES 3, 5 and 11) adjustably secured on respective lateral shafts 872, 873. The inner ends of shafts 872, 873 are secured to brackets 874, 875 (FIGURE 5) which are, in turn, adjustably secured to the right-hand outside upright frame 103 of main frame 62.

In the present embodiment, pattern chain 850 comprises a plurality of relatively narrow laterally extending pattern bars 880 in which the pattern pin receiving holes 851 are formed. Opposed end portions of adjacent pattern bars 880 are secured to link racks 883 which are pivotally interconnected, as at 884, (FIGURE 43). Each link rack 883 has a row of ratchet teeth 885 on the inner or lower surface thereof.

In this instance, the points of adjacent ratchet teeth 885 are spaced apart a distance equal to the distance between adjacent transverse rows of pattern pin receiving holes 851 in pattern chain 850, with the exception of those holes which accommodate those pattern pins 855 for controlling the blade reciprocating stop switches *j5*, it already having been stated that the switches *j5* must be closed and then opened during a step in movement of the pattern chain 850 and before completion thereof (see FIGURE 34). The pattern chain 850 is moved the equivalent of the length of one tooth 885 with each step thereof.

Means are provided for advancing the pattern chain 850 one step during each contour blade reciprocating cycle (FIGURE 34). In order to advance the main pattern chain 850 of main pattern mechanism 82 a single step with each revolution of any of the carriage drive shafts 244, one of the carriage drive shafts 244, which happens to be the foremost carriage drive shaft in this instance (see FIGURE 18), extends outwardly beyond the upright side frame 103 of main frame 62 and has a pair of face cams 890 fixed thereon (FIGURE 11), only the innermost of which is shown in FIGURES 43, 44 and 45.

Each face cam 890 has an irregularly-shaped cam groove 891 therein which is engaged by a follower 892 on the front end of a follower arm 893. The follower arms 893 extend rearwardly and are connected to a transverse pawl carrier bar 894, opposed ends of which are mounted for forward and rearward reciprocatory movement on a bracket 895 projecting outwardly from and being suitably secured to upright frame 103 (FIGURES 11 and 43). Pawl carrier bar 894 may be guided for horizontal reciprocatory movement on bracket 895 by means of dovetail connections 898.

The pawl carrier bar 894 has a pair of spaced feed pawls 896 pivotally mounted thereon and extending forwardly therefrom, whose free ends are normally urged upwardly against the teeth 885 of the corresponding links 883 by corresponding compression springs 897, only one of which is shown in FIGURE 44.

The grooves 891 in face cams 890 are so formed that a forward or active stroke is imparted to the pawls 896 during approximately one-fourth of a revolution of the corresponding carriage drive shaft 244, so that pattern chain 850 is advanced one step during the interval designated in FIGURE 34 and which step occurs subsequent to the cutting operation of any of the contour cutter blades which may be called for in that particular cycle, and during which certain of the pattern pins 852 will move out of engagement with corresponding switches and then certain other pattern pins will move into engagement

with corresponding switches, such as the switches shown in the left-hand portion of FIGURE 11.

XIX. MEANS FOR CYCLING OPERATIONS OF POCKET CUTTER HEADS

(FIGURES 11 and 43)

In the present embodiment of the invention, it is desirable that one set of sleeve blanks S–1 and a body blank S–2 is formed with each complete or secondary cycle of the main pattern chain 850, which includes a large number of cycles of the feed dogs 64–67 and the contour cutter blades. Assume, for example, that the web W is advanced one-eighth inch with each cycle in the operation of the feed dogs 65–67, and the web W is advanced 332 steps (41½") during one complete cycle of the main pattern chain 850, a sleeve blank S–1 (FIGURE 25) being formed from each of the two thicknesses of the web W, along with a tubular shirt body blank S–2, during each normal or secondary pattern cycle.

Assume further that the center-to-center distance between the contour cutter blades 81 of adjacent cutter head carriages, longitudinally of the machine, is equal to 42 advancing steps of web W or 5¼", that the center to-center distance between the contour cutter blade 81 of carriage D and the pocket cutter blades 88 is equal to 74 advancing steps of web W or 9¼", and the distance from the center of the pocket cutter blades 88 to the cutting rear run of endless blade 96 of sundering device 95 is equal to 40 advancing steps of web W or 5".

Now, since two sleeve blanks S–1 and a single body blank S–2 are formed during each normal cycle of the pattern chain 850, and since there are three pocket cutter heads 87 provided on this particular machine, it is apparent that the pocket cutter heads 87 need operate only upon every sixth set of blanks S–1 and S–2 being formed; that is, following the formation of every sixth web section W'. It should be noted that, although three pocket cutter heads 87 are provided, these cutter heads sever a double thickness of the web section W2 so that six pocket panel blanks S–3 are formed with each actuation of the pocket cutter heads 87.

Means are provided to form a secondary web section W2 (FIGURE 25) and corresponding pocket panel blanks S–3 following every sixth complete cycle of the main pattern chain 850. The latter means includes means for (1) stopping step-by-step movement of the main pattern chain, (2) advancing the web W the equivalent of the length of a web section W2 (56 steps or 7", for example), (3) resuming the step-by-step movement of pattern chain 850 while continuing the step-by-step advancement of the web W, (4) energizing the solenoids 833 to actuate the pocket cutter heads 87 when the lateral center of the web section W2 becomes centrally positioned with respect to the pocket cutter heads 87, (5) actuating the sundering device 95 out of its normal turn upon a predetermined number of additional advancements of the web W following actuation of the pocket cutter heads, and (6) then resuming normal cycling of the machine to complete that cycle of the main pattern chain which was initiated upon completion of the advancing of the web W the equivalent of the length of a web section W2 (56 steps).

In order to carry out the above sequence of steps, a primary counter or step switch is provided for counting the desired number of cycles of the main pattern chain which are to be completed before a secondary web section W2 is formed, and a secondary counter causes a certain number of active strokes to be imparted to the web feed dogs 65–67 while the main pattern chain 850 is inactive to provide the required length of web material from which a web section W2 may subsequently be formed.

It will be observed in FIGURES 11, 43, 44 and 45 that the feed pawls 896 are connected to opposed ends of a shaft 900, to a medial portion of which the upper end of

a solenoid plunger 901 is pivotally connected. Solenoid plunger 901 extends into a solenoid coil 902 supported between a pair of plates 903, 904 (FIGURE 43).

Plate 904 is suitably secured to the lower surface of pawl carrying bar 894 and the bottom plate 903 has a ratchet pawl 906 pivotally connected thereto and extending forwardly therefrom. The medial portion of ratchet pawl 906 is provided with a lateral pin 907 which works in a slot 910 provided in the lower portion of a plunger extension 911 insulatably attached to the lower end of a solenoid plunger 901.

Plunger extension 911 has an ear or abutment 913 projecting therefrom which is engaged by one end of a compression spring 914. The lower end of compression spring 914 bears against and normally urges pawl 906 downwardly, the extent of downward movement thereof being limited by the slot 910. When solenoid coil 902 is energized, in a manner to be later described, plunger 901 moves pawls 896 out of engagement with rack links 883 to the position shown in FIGURE 43. In so doing, the ratchet pawl 906, which is a part of a secondary counter, is caused to resiliently engage the periphery of a ratchet wheel 915 journaled on a stud 916 projecting from a flange 917 integral with bracket 895 (FIGURES 11 and 43). If desired, a spring-loaded hold-back pawl (not shown) may be provided to prevent reverse rotation of ratchet wheel 915.

As best shown in FIGURE 43, ratchet wheel 915 is connected by a change gear train 921 to a cam disk 925 which is shown in the form of a gear. One face of disk 925 has a circular series of cams 926 fixed thereon. The proximal ends of adjacent cams 926 abut each other and the proximal ends of adjacent cams 926 are provided with a notch or recess 927 therebetween. Disk 925 is mounted on a stud or shoulder bolt 930 mounted for vertical adjustment in a slot 931 provided in the flange 917 of bracket 895. The number of cams 926 and the length of each cam 926 determine the number of steps the web W may advance while pattern chain 850 is at a standstill and, thus the length of the cams depends upon the desired length of each secondary web section W2, as will be later described.

The ratchet pawl 906, ratchet wheel 915, gear train 921, disk 925 and cams 926 are parts of the secondary counting device which determines the number of advancing steps to be imparted to the web W by feed dogs 64–67 whenever step-by-step movement of main pattern chain 850 is stopped by a primary pattern cycle counter or step switch 935 (FIGURE 43). The pattern cycle counter 935 comprises a substantially rectangular fixed housing 936 which is shown in broken lines in FIGURE 43, since it may be suitably secured to any fixed part of the machine.

Housing 936 has a plate 937 suitably secured therein, which plate is preferably made from insulation material and has a series of arcuately arranged, spaced contacts 940 thereon. Any one of the contacts 940 may have a conductor 942 connected thereto, depending upon the number of cycles of the main pattern chain 850 which are to be completed before each actuation of the pocket cutter heads 87. In this instance, conductor 942 is connected to the last of the series of contact points 940.

The contact points 940 are adapted to be successively engaged by a contact brush 943 which is normally urged toward a stop *k2* by any suitable means, such as a spring 944. In order to advance brush 943 from one contact point 940 to the next succeeding contact point 940 with completion of each normal cycle of the main pattern chain 850, brush 943 is insulatably attached to a ratchet wheel *k3* which is normally engaged by a ratchet feed pawl *k4* and a ratchet hold-back pawl *k5*.

Hold-back pawl *k5* extends past and closely adjacent to the coil of an electromagnet 946, and is normally urged away from said electromagnet 946, into engagement with ratchet wheel *k3*, by a tension spring 947.

Feed pawl *k4* is yieldably and pivotally mounted on a pivotal extension *k4'* and is normally urged away from or out of engagement with ratchet wheel *k3* by a tension spring 950. The spring 950 is connected to extension *k4'*, which extension extends past an electromagnet 951 whose coil has a pair of conductors 952, 953 connected to opposite ends thereof.

Electromagnet 951 is positioned in close proximity to the extension *k4'* of feed pawl *k4* so that energization of electromagnet 951 imparts an active stroke to pawl *k4* to thus advance ratchet wheel *k3* and cause brush 943 to move out of engagement with stop *k2* and into engagement with the second of the series of contact points 940 or out of engagement with one contact point 940 and into engagement with the next succeeding contact point 940. The pivotal feed pawl *k4* may be yieldably urged, in a clockwise direction in FIGURE 43, against a stop *k4''* carried by extension *k4'* so that said tip may move downwardly as spring 950 moves the extension *k4'* of feed pawl *k4* away from electromagnet 951.

The end of conductor 952 opposite from electromagnet 951 is connected to one side of pattern controlled switch 856, to which side one end of a conductor 954 is also connected. The other side of switch 856 has a conductor 955 leading therefrom to negative lead conductor 680.

The end of conductor 953 opposite from the coil of electromagnet 951 is connected to one of a pair of spaced contacts *k6* which are normally interconnected by an armature *k7* of an electromagnetic relay 956. The other contact *k6* of said pair has a conductor 957 leading therefrom to positive lead conductor 676. Relay 956 also has a pair of normally open contacts *k8* to which respective conductors 960, 961 are connected.

Conductor 960 leads to conductor 957. Conductor 961 is connected to conductor 942 whose end opposite from the last contact point 940 is connected to one side of the coil of relay 956. The other side of the latter coil has the conductor 954 connected thereto.

When brush 943 engages the last of the series of contacts 940, it establishes contact between conductor 942 and a conductor 962 leading from the pivot point of brush 943 to the conductor 957. A conductor 963 leads from conductor 957 to one end of the coil of electromagnet 946. The other side of electromagnet 946 has a conductor 964 leading therefrom to a contact point *m2* of a double-throw push button switch 965. Switch 965 includes a switch arm *m3* which normally establishes contact between a pair of conductors 967, 968, at which time the plunger of switch 965 is positioned in registration with one of the notches 927 in the cams 926.

When the cams 926 are advanced in a clockwise direction in FIGURE 43, the plunger of switch 965 is depressed to move switch arm *m3* into engagement with contact *m2*, thus breaking the circuit between conductors 967, 968 and establishing the circuit between conductors 964, 968. The end of conductor 968 opposite from switch 965 is connected to one side of solenoid coil 902, and the side of solenoid coil 902 has a conductor 970 leading therefrom to lead conductor 680.

The first or uppermost of the contacts 940 in FIGURE 43 has a conductor 971 leading therefrom to one side of pattern controlled switch 859, from the other side of which a conductor 972 leads to one side of cycling switch 668. A conductor 973 connects the other side of cycling switch 668 to one end of the coil of a solenoid *m4*, the other end of the latter coil being connected, by a conductor *m5*, to one end of the coil of a solenoid *m4'*. The other end of the latter coil is connected to lead conductor 680 by a conductor *m6*. The solenoids *m4*, *m4'* are provided for actuating the sundering device 95, as will be later described.

The pattern controlled switch 857 has a pair of con-

ductors 974, 975 connected to opposite sides thereof and leading to the respective conductors 972 and 676.

Switch 858 has a pair of conductors 976, 977 connected to opposite sides thereof and leading to the conductor 971 and one side of cycling switch 667, respectively. The other side of switch 667 has a conductor 978 leading therefrom to corresponding ends of the coils of all of the solenoids 883 associated with the pocket cutter heads 87, only one of the solenoids 883 being shown in FIGURE 43. The other ends of the coils of solenoids 883 have a common conductor 1000 leading therefrom to the lead conductor 680.

XX. OPERATION OF POCKET CUTTER CYCLING MECHANISM

It has already been described how the main pattern chain 850 is advanced a single step during each revolution of the cutter head drive shafts 244, and that the main pattern chain 850 is advanced through a complete cycle or revolution during the formation of each web section W' and its corresponding blanks S–1, S–2 (FIGURE 25). Although the number of lateral rows of pattern pin receiving holes 851 (FIGURES 44 and 45) may be increased or decreased for varying the length of pattern to be cut from the web W and for varying the length of the web sections W', for purposes of description it is to be assumed that each primary web section W' is to be of a length equal to 332 steps in advancement of the web (41½ inches long) and the final cut in each normal cycle of the machine is formed at the end of cut line 2C' (FIGURE 25) by that contour cutter blade 81 associated with the cutter head carriage C' and at the point identified at P on each web section W'. At the instant that this final cut is formed at point P, a pattern pin 852 moves into engagement with and closes switch 856 (FIGURE 43), it being apparent that this occurs with each pattern cycle.

Thus, the coil of electromagnet 951 is energized to impart a step in rotation to ratchet wheel *k*3 and brush 943. With the next succeeding step of the main pattern chain 850, the corresponding pattern pin 852 moves out of engagement with switch 856, permitting the same to open and break the circuit to the coil of electromagnet 951.

During each normal pattern cycle and at a predetermined interval following the momentary closing of switch 856, another pattern pin 852 engages and closes switch 857. In this instance, the web W is advanced 160 steps or 20 inches in order to position the portion of the web at which the cut line *c*2 is to be formed in the same position at which point P was positioned at the time that a pattern pin 852 last engaged the switch 856.

However, since the rear run of the endless cutting blade 96 of sundering device 95 is spaced 19½ inches forwardly of the center of the contour cutter blade 81 of carriage C', for example, the web W must advance and additional 152 steps (19½ inches) so that the portion of the web W in which the line of cut *c*2 is to be made (FIGURE 25) is positioned in alinement with the rear run of the endless cutting blade 96 of sundering device 95. In other words, pattern chain 850 must advance 312 steps from the time a pin 852 thereon is moved out of engagement with switch 856 and another of the pins 852 is moved into engagement with and closes switch 857.

It is apparent by referring to the upper right-hand portion in FIGURE 43 that, upon switch 857 being closed and cycling switch 668 subsequently being closed by cycling cam 658, the coils of solenoids *m*4, *m*4' are energized to move the rear run of the endless cutter blade 96 of sundering device 95 into engagement with and through the web W to form the cut line *c*2. Of course, although the web W is advanced 312 steps from the time the web is cut at point P (FIGURE 25) until the sundering device 95 is actuated, it is apparent that one or more or all of the contour cutter heads 80 will have been actuated during this interval because of all the cutter head carriages A–D, A'–D' being positioned rearwardly of the sundering device 95. Actually, the first contour cutting operations involved in forming each sleeve blank S–1 are performed by the contour cutter blade 81 of carriage A' and they normally commence following 76 advancing steps of point P beyond the center of the contour cutter blade 81 of carriage C'.

During normal cycles of the machine; that is, during those cycles of the machine in which successive primary web sections W' are formed without any intervening secondary web sections W2, certain of the pattern pins 852 engage and close respective pattern controlled switches 858, 859, but no operations are then effected by the closing of switches 858, 859, because the brush 943 of primary counter 935 is then in engagement with one of the contact points 940 other than the first and last of these contact points during such normal pattern cycles of the machine, as will be presently explained.

Since it has been assumed that five successive primary web sections W' (FIGURE 25) will be formed between each successive pair of secondary web sections W2 in this instance, brush 943 (FIGURE 3) will occupy the position shown in FIGURE 43 during the formation of the fifth primary web section W' in each series and will thus be in engagement with the second last contact point 940 in the series shown in FIGURE 43.

Since a pattern pin 852 closes switch 856 with each cycle of the main pattern chain 850, as the cut is formed at point P on each web section W', it follows that switch 856 is also closed as point P is formed by the cutter blade 81 associated with cutter head carriage C' to complete the series of cuts forming the fifth web section W' in the corresponding series. In so doing, the pattern chain is stopped in a manner which will now be described.

Upon switch 856 being closed by a pattern pin 852 and with the completion of the contour cutting operations in the formation of the fifth web section W', brush 943 (FIGURE 43) is moved into engagement with the lowermost or last contact point 940 on plate 937, through energization of the coil of electromagnet 951 in the manner heretofore described. At this instant, solenoid coil 902 is energized to cause the plunger 901, pattern feed pawls 896 and ratchet pawl 906 to move downwardly, and to thereby move feed pawls 896 out of engagement with the link racks 883 and move ratchet pawl 906 into engagement with ratchet wheel 915.

Thus, further reciprocation of pawl carrier bar 894 does not impart further movement to the pattern chain 850, but does impart step-by-step rotation to the ratchet wheel 915 and, thus, to the disk 925 and its cams 926. It is thus seen that switch 856 remains closed until such time as step-by-step movement of the main pattern chain 850 is resumed, as will be later described.

Movement of brush 943 into engagement with the last contact point 940 causes energization of solenoid coil 902, because current then flows from negative lead conductor 680, through conductor 970, coil 902, conductor 968, switch arm *m*3 and conductors 967, 942 to the lowermost contact point 940 of stepping switch 935. Current then flows through brush 943 and conductors 962, 957 to positive lead conductor 676 to complete the circuit to solenoid coil 902.

Now, at the instant that the circuit to solenoid coil 902 is initially completed by movement of brush 943 into engagement with the lowermost contact point 940 on stepping switch 935, the coil of relay 956 is energized, to lower armature *k*7, break the circuit to the coil of electromagnet 951, and thus release feed pawl *k*4. Although feed pawl *k*4 is released, the brush 943 and ratchet wheel *k*3 remain in the latter position momentarily, because of hold-back pawl *k*5.

The coil of relay 956 is energized at this instant because of current flowing from negative lead conductor 680, through conductor 955, pattern controlled switch 856 and conductor 954 to one end of the coil of relay 956. Current flows through relay 956 and conductor 942,

through brush 943 and conductors 962, 957 to the positive lead conductor 676. A holding circuit is then effected for the coil of relay 956 because initial energization thereof caused the armature *k*7 to move out of engagement with contacts *k*6 and into engagement with contacts *k*8, as heretofore stated, and current then may flow through either conductor 961 or conductor 942. However, brush 943 may subsequently move out of engagement with the lowermost contact 940 of stepping switch 935. It will be noted that, when current flows through conductor 961, it flows through contacts *k*8 and armature *k*7, through conductor 960 and 957 to the lead conductor 676.

All the functions of the electrical circuit of FIGURE 43 heretofore described as resulting from movement of brush 943 into engagement with the lowermost contact 940 of stepping switch 935 occur upon initial engagement and closing of switch 856 by a pattern pin 852 and while the pawl-carrying bar 894 is moving in an inactive stroke or dwelling in its rearmost position.

With the next succeeding active stroke of pawl-carrying arm 894, during which pawls 896 are held out of engagement with the corresponding link racks 883 and pawl 906 is in engagement with ratchet wheel 915, the cams 926 are moved in a clockwise direction in FIGURE 43 to move the corresponding notch 927 out of registration with the plunger of switch 965. This causes one of the cams 926 to move the latter plunger downwardly to thereby break the connection between conductors 967, 968 and make the connection between conductors 964, 968. Downward movement of switch arm *m*3 effected in this manner still maintains the flow of current through solenoid 902 and also causes current to flow through the coil of electromagnet 946, since current then flows from negative lead wire 680, through conductor 970, coil 902, conductor 968, switch arm *m*3, conductor 964, the coil of electromagnet 946, and conductors 963, 957 to lead conductor 676.

With energization of the coil of electromagnet 946, hold-back pawl *k*5 is moved upwardly out of engagement with ratchet wheel *k*3 so that spring 944 then rotates the ratchet wheel *k*3 and brush 943 to move the brush against stop *k*2 and into engagement with the first contact point 940 of stepping switch 935. It might be stated that, at this instant, there are no pattern pins 852 in engagement with switches 858, 859, and the main pattern chain 850 is a a standstill. Also, the circuit to the coil of electromagnet 951 still remains broken because relay 956 is still energized.

The latter condition of the circuit of FIGURE 43 is maintained for a predetermined succeeding number of reciprocations of feed pawl 906, it being noted that the feed pawl 906 advances cam disk 925 and cams 926 one step with each step in advancement of the web W. As heretofore stated, each secondary web section W2 may be of a length equivalent to 56 steps in advancement of web W (seven inches long) and, accordingly, each cam 926, in this instance, is advanced 56 steps before the next succeeding notch 927 between adjacent cams 926 registers with the plunger of switch 965.

At the instant that said succeeding notch 927 registers with the plunger of switch 965 and permits the switch arm *m*3 to return to the position shown in FIGURE 43, it is apparent that this breaks the circuit to the coil of electromagnet 946 associated with stepping switch 935 to permit hold-back pawl *k*5 to move into engagement with ratchet wheel *k*3, and this also breaks the circuit to the solenoid coil 902 associated with pawls 896 and 906, since brush 943 is then out of engagement with the lowermost contact 940 and in engagement with the uppermost contact 940.

At this instant, although pattern controlled switch 856 is still closed, current cannot flow through the feed pawl actuating electromagnet 951, because switch 856 also maintains energization of the coil of relay 956 at the same time and, thus armature *k*7 will still be in engagement with contacts *k*8.

With the next succeeding active stroke of pawl-carrying bar 894, pawls 896 will have then moved upwardly into engagement with the corresponding link racks 883 and pawl 906 will have been raised out of engagement with ratchet wheel 915, so that an initial step is imparted to the pattern chain 850. In so doing, the pattern pin 852 last in engagement with pattern controlled switch 856 will move out of engagement therewith to break the circuit to the coil of relay 956 so the latter coil may be energized upon completion of the now initiated cycle of the main pattern chain 850.

The two pattern pins 852 which engage and close switches 858, 859 do so in succession at substantially spaced apart intervals and prior to a pattern pin engaging and closing switch 857. In order to form the particular web sections W', W2 shown in FIGURE 25, the pattern chain 850 and web W advance 248 steps (31 inches of web W), following the instant that switch 856 is permitted to open, in order to position the lateral center of web section W2 in vertical alinement with the lateral centers of the pocket cutter heads 87, it being apparent that the said 56 steps that the web was advanced beyond point P (FIGURE 25) is cumulative at the trailing end of the corresponding primary web section W' to initially define the secondary web section W2 as an extension to the trailing end of the immediately preceding primary web section W'.

While the web was being advanced said 248 steps, the main pattern chain 850 was also advanced an equal number of steps so that a pattern pin positioned at this particular point on the pattern chain engages and closes the switch 858 at precisely the moment that the lateral center of the corresponding web section W2 becomes vertically alined with the lateral centers of the pocket cutter heads 87.

Referring now to FIGURE 43, since brush 943 is in engagement with the first of the contacts 940 of stepping switch 935, the closing of switch 858 and subsequent closing of cycling switch 667 causes current to flow through the coils 833 of the pocket cutter heads 87. In so doing, current flows from lead conductor 680, through conductor 1000, through coils 833, through conductor 978, cycling switch 667, conductor 977, pattern control switch 858, conductors 976, 971, through brush 943 of stepping switch 935, and through conductors 962, 957 to lead conductor 676.

With energization of coils 833, the pocket cutter blades 88 are moved downwardly in FIGURE 36 into the slots 820 to cut out the pocket panel blanks S–3 (FIGURE 25). When the cycling cam 657 (FIGURE 43) subsequently moves out of engagement with switch 667, the circuit to coils 833 is broken and springs 835 (FIGURE 36) then return the pocket cutter blades 88 to the raised position shown. Before cycling cam 657 again engages and closes cycling switch 667, the pattern pin 852 corresponding to switch 858 will have moved out of engagement therewith due to a succeeding advancement by the pattern chain 850.

Since each secondary web section W2 is seven inches long, and the distance from the center of the pocket cutter blades 88 to the cutting run of the endless blade 96 of sundering device 95 is five inches, it follows that the web must advance 1½ inches or twelve steps in order for the sundering device to sever the web W along a line located 3½ inches forwardly of the center of the previously formed secondary web section W2. It follows, therefore, that the pattern chain 850 is also advanced twelve steps from the time a pattern pin 852 moves out of engagement with switch 858 to the time another pattern pin 852 moves into engagement with and closes switch 859.

When switch 859 is closed, cycling cam 658 subsequently closes cycling switch 668 to complete the circuit

to the coils of solenoids *m4*, *m4'* and move the rear run of the cutting blade **96** of sundering device **95** through the web to sever the same. It will be noted in FIGURE 43 that the circuit is completed to the coils of solenoids *m4*, *m4'* in the latter instance, because current flows from lead conductor **680**, through conductor *m6*, through the coil of solenoid *m4'*, through conductor *m5*, through the coil of solenoid *m4*, and through conductor **973** to switch **668**. Current then flows through cycling switch **668**, conductor **972**, pattern controlled switch **859** and conductor **971** to stepping switch **935**.

Since brush **943** is still occupying a position in engagement with the first of the contact points **940**, it is apparent that current then flows through brush **943** and conductors **962**, **957** to lead conductor **676**.

The pattern pin **852** which closes switch **857** during each normal pattern cycle has automatically become delayed 56 steps due to the previously described operations of the cams **926** effected through the medium of the primary counter **935**. It follows, therefore, that the pattern pin **852** which closed switch **859** is relatively located 56 steps in advance of the pattern pin which engages and closes switch **857**. Accordingly, the normal operation of the sundering device **95**, which occurs as the juncture of two adjacent web sections W' move into vertical alinement or registration with the rear run of the blade **96** of sundering device **95**, is also effective in cutting off the relatively small secondary web section W2 from the leading edge of the next succeeding primary web section W'. In other words, the web W is advanced 56 steps or seven inches from the time the sundering device **95** is actuated by switch **859** of FIGURE 43 until it is again actuated by switch **857**.

As heretofore stated, certain of the contour cutter heads **80** may be brought into operation prior to actuation of the pocket cutter heads **87** and the special operation of the sundering device **95** to thereby be in the process of formation of the blanks of a succeeding primary web section W'. Actually, the cutting blades **81** associated with carriages A, B, C and A' will have then completed formation of the corresponding contour cut lines 2A, 2B, 2C, 2C2, 2A' and 2A2 of a succeeding primary web section W'.

Following the formation of each secondary web section W2, those elements of the machine which are not particularly involved in the formation of each web section W2 are operated in the same manner in which they are operated during any normal cycle of the main pattern mechanism **82**. The pattern pins **852** which close switches **858**, **859** in FIGURE 43 do so sometime ofter switch **856** is engaged and closed by its pattern pin **852**. Therefore, when the final cut is formed at point P in any primary web section W' which immediately follows the formation of a secondary web section W2, switch **856** of FIGURE 43 is again closed to impart a step in rotation to the ratchet wheel *k3* and brush **943** (FIGURE 43) so that brush **943** is then in engagement with the second contact point **940** when switches **858**, **859** are subsequently engaged and closed by respective pattern pins **852** in the corresponding cycle of the main pattern mechanism **82**. Thus, the latter switches **858**, **859** remain ineffective during this particular cycle and during the next succeeding four cycles of the main pattern mechanism **82** insofar as operation of the pocket cutter heads **87** and sundering device **95** is concerned.

This completes the description of a tertiary cycle in the operation of the pocket cutter heads **87**.

XXI. WEB CUTTING-OFF DEVICE

(*FIGURES 1, 2, 4–8 and 46–A*)

As heretofore stated, following the cutting out of each set of one or more blanks from the web (FIGURE 25) to form a web section W' or W2, and during selected static intervals in the movement of the web, the web

is severed into the desired predetermined length by the endless cutting blade **96** of the web cutting-off or sundering device **95**. The web cutting-off device **95** may be of a general type such as is broadly designated at **194** in U.S. Patent No. 2,738,746 granted to John T. MacIsaac, Jr. et al. on March 29, 1956. The cutting-off device **95** may also be of a type such as disclosed in Pfeiffer's U.S. Patent No. 2,551,762 dated May 8, 1951. Accordingly, only a general description of the present web cutting-off device **95** has been given and further details will be limited to the means for mounting, driving and tilting the web cutting-off device **95** of the present invention.

It will be observed in FIGURES 1, 4, 6 and 18 that the end of the foremost of the carriage drive shafts **244** opposite from the pattern mechanism **82** has a pulley **1005** fixed thereon and engaged by an endless belt **1006** which extends forwardly and is mounted on a pulley **1007**. Pulley **1007** is fixed on a lateral shaft **1010** (FIGURES 6 and 18) journaled in an outboard frame member **1011** extending between upright frame **103'** and transverse frame member **110**. Shaft **1010** is also journaled in front upright frame member **102'** and its inner end has a bevel gear **1012** fixed thereon which meshes with a bevel gear **1013** (FIGURE 6) fixed to the lower end of an upright shaft **1014**.

Upright shaft **1014** is journaled in a bearing **1015** carried by front upper transverse frame member **110**. The upper end of shaft **1014** is connected to a shaft **1016** by a universal joint **1017**. Shaft **1016** (FIGURE 7) is journaled in a bifurcated bracket **1020** which is a part of frame **100**. Pulley **97'** is fixed on shaft **1016** in the bifurcation of bracket **1020**. At the other side of the machine, another bifurcated bracket **1021** is provided, which is also a part of frame **100** and straddles the pulley **97**. Pulley **97** is fixed on a shaft **1022** journaled in the bifurcated bracket **1021**.

The distal ends of bifurcated brackets **1021**, **1020** have respective shafts **1023**, **1023'** projecting outwardly therefrom which are journaled in upstanding bearing portions **1024**, **1024'** (FIGURES 6 and 7) on the front ends of front side frames **102**, **102'**. The distal ends of shafts **1023**, **1023'** have respective cranks **1025**, **1025'** fixed thereon and extending rearwardly therefrom. The rear ends of cranks **1025**, **1025'** are connected to the upper ends of the plungers of solenoids *m4*, *m4'* (FIGURES 1, 2, 4, 5, 7, 8 and 43), the coils of which are attached to the respective front side frames **102**, **102'**. Each crank **1025**, **1025'** is normally urged upwardly by a spring-loaded detent or plunger **1027**, as best shown in FIGURES 4, 5 and 8.

The frame **100** of sundering device **95** includes a pair of wheeel casings **1030**, **1030'** secured in the bifurcations of respective bifurcated brackets **1021**, **1020** and enclosing the wheels **97**, **97'** therein. The front run of cutting blade **96** is enclosed in a rectangular tube **1031** extending between and being suitably secured to casings **1030**, **1030'** (FIGURES 7 and 8). The rear run of endless cutting blade **96** is positioned within an open-bottom channel **1032** which is yieldably supported at opposite ends thereof so that it may recede relative to the blade **96** when frame **100** is tilted downwardly at its rear portion by energization of solenoids *m4*, *m4'*, in the manner heretofore described, to thus clamp the web W between the proximal surfaces of channel **1032** and plate **183** during the sundering of the web W.

It will be observed in FIGURE 6 and 8 that each end of channel **1032** has a rod **1034** fixed thereto and projecting upwardly therefrom, which rod penetrates the horizontal upper portion of a substantially Z-shaped bracket **1035** and has a stop collar **1036** fixed on the upper end thereof. A spring **1037** surrounds each rod **1034** and engages proximal surfaces of each bracket **1035** and channel **1032**. The Z-shaped brackets **1035** are suitably secured to the casings **1030**, **1030'**.

Upward movement of the rear portion of the sundering

device **95** may be limited by any suitable means such as a bracket **1040** (FIGURE 6) suitably secured to the front surface of bearing portion **1024** and projecting inwardly and upwardly so as to be engaged by the front portion of casing **1030**.

XXII. MECHANISM FOR RESETTING CUTTER HEAD CARRIAGES

(FIGURES 48, 49 and 50)

Following each pattern cycle of each cutter head carriage A–D, A'–D', as effected by the main pattern mechanism **82**, each cutter head carriage must be returned to a predetermined starting position in order to subsequently commence its cutting cycle at the proper point with respect to the web to form the corresponding contour lines of cut in proper relationship to each other and to the web W. Each cutter head carriage could be reset by reversing its cycle of operation following each cutting cycle thereof while the corresponding vertically reciprocating contour cutter blades **81** remained in raised position. However, resetting the cutter head carriages in this manner would involve substantially the same number of pattern controlled switches and corresponding additional conductors as are shown in FIGURES 46, 46–A and 47, notwithstanding the fact that additional means would also have to be provided for stopping the feeding of the web during the resetting of the cutter head carriages.

In order to obviate the necessity of providing the large number of additional pattern controlled switches and conductors mentioned above and to also permit the intermittent feeding of the web W to continue during the resetting of each cutter head carriage, means are provided for moving each cutter head carriage with a single uninterrupted outward movement thereof, and then inwardly to a predetermined reset position. The resetting mechanism has purposely been omitted from all but FIGURES 48, 49 and 50 for purposes of clarity and is shown in the latter figures only in association with the cutter head carriage D', although it is to be distinctly understood that an identical resetting apparatus may be provided for each of the cutter head carriages A–D, A'–D'.

Referring to FIGURE 48, it will be observed that the inner wall of transmission housing **315**; i.e., below hollow arm **313** of cutter head carriage D', has one end of a piston rod **1050** attached thereto and extending inwardly therefrom to a piston **1051** mounted for longitudinal sliding movement in a fluid pressure cylinder **1052**. The inner end of cylinder **1052** is connected to longeron **123**.

Referring to FIGURE 49, it will be noted that cylinder **1052** is in the form of a double-acting ram and has conduits **1054**, **1055** connected to opposite ends thereof. The ends of conduits **1054**, **1055** remote from cylinder **1052** are connected to an electrically operated or solenoid operated valve assembly **1056**, of conventional or other construction. In this instance, valve assembly **1056** is shown as being of a type substantially as disclosed in J. R. Long et al. Patent No. 2,890,841 dated June 16, 1959 and may be of the type such as is manufactured by Westinghouse Air Brake Company, Wilmerding, Pennsylvania, and which is described by said company as a type "D" Pilotair valve.

Valve assembly **1056** comprises a main substantially tubular body or housing **1057** which is divided into a plurality of coaxial compartments or chambers *n2* to *n6* inclusive by means of a plurality of resilient partitions, each of which is indicated at *n7*. Each partition *n7* is provided with a hole *n8* therethrough. The holes *n8* are adapted to receive corresponding longitudinally spaced enlarged portions *p2* to *p5*, inclusive, of a valve core or plunger **1060**.

Plunger **1060** extends out of opposite ends of housing **1057** and each enlarged end portion *p2*, *p5* thereof has a flange *p6* affixed thereto which bears against the outer end of a corresponding spring *p7*. The proximal ends of springs *p7* engage opposite ends of the tubular body **1057**. Thus, springs *p7* normally urge the plunger **1060** to a balanced or neutral position relative to housing **1057**. Opposed ends of plunger **1060** are in the form of solenoid plungers which are encircled by the coils of solenoids **1061**, **1062**.

The conduits **1054**, **1055** are connected to tubular housing **1057** for communication with respective chambers *n3*, *n5*. The housing **1057** has an air discharge or breather passageway *p8* therein communicating with chamber *n4*. A pair of branch conduits **1064**, **1065** are connected with housing **1057** for communication with respective chambers *n2*, *n6*. Branch conduits **1064**, **1065** are connected to a common conduit **1066** leading from a suitable source of fluid pressure **1067** shown in the form of a legend identified as an air compressor.

It will be noted that the coils of solenoids **1060**, **1061** are secured in fixed relation to housing **1057** of valve assembly **1056**. Thus, upon either solenoid being energized the plunger **1060** is moved in the corresponding direction to permit fluid pressure to flow from conduit **1064** through conduit **1055** or from conduit **1065** through conduit **1054**, as the case may be. Of course, when the plunger **1060** occupies the neutral position shown in FIGURE 49, fluid pressure or air may be exhausted from or enter either end of cylinder **1052**, since conduits **1054**, **1055** then communicate with the atmosphere through passageway *p8* in housing **1057**.

The coils of solenoid **1061**, **1062** have respective pairs of conductors *q2*, *q3* and *q4*, *q5* connected to opposite ends thereof. Conductor *q2* is connected to one side of the coil of a carriage resetting solenoid **1070**, to the other side of which a conductor *q6* is connected. Conductor *q6* leads from the coil of resetting solenoid **1070** to one side of a normally closed pushbutton switch **1071**, from the other side of which a conductor *q7* leads to the coil of a relay to be later described.

Referring to FIGURE 48, it will be observed that the upper end plate of the coil of solenoid **1070** is attached to a tubular guide **1072** mounted for inward and outward sliding movement on a graduated bar **1073**. The inner end of graduated bar **1073** is secured to the corresponding edge of main base **120** and the outer end of bar **1073** is suitably secured to outside upright frame **103**.

Guide tube **1072** is provided with an opening **1075** in one side thereof in which a pointer **1076** is provided. The pointer registers with graduations on graduated bar **1073** to thereby serve as a visual reference of the position of resetting solenoid **1070**, tubular guide **1072** and the parts carried thereby with respect to the main table **56** or any other fixed part of the machine. Tubular guide **1072** is locked in adjusted position by thumb screws **1077**.

The plunger of solenoid **1070** is indicated at **1080** and loosely penetrates a slot **1081** extending longitudinally of graduated bar **1073**. Plunger **1080** also loosely extends through the upper and lower walls of tubular guide **1072** and a medial portion thereof has a block **1082** fixed thereon which is adapted to engage the upper surface of tubular guide **1072** to limit downward movement of solenoid plunger **1080**. It will be noted that the lower end of plunger **1080** has the upper end of a spring **1083** connected thereto, whose lower end is connected to an angle bracket **1084** depending from and being suitably secured to the coil of solenoid **1070** (FIGURES 48 and 50).

The upper end of plunger **1080** has an offset portion **1085** thereon which has an opening **1086** therethrough through which the horizontal arm of a switch operating bell crank **1087** loosely extends. Bell crank **1087** is pivotally mounted, as at **1090**, on the upper portion of plunger **1080**. The substantially horizontal arm of bell crank **1080** overlies the plunger of switch **1071**, the housing of switch **1071** being suitably secured to the inner surface of the upper portion of plunger **1080**. A spring **1091** normally

holds the substantially horizontal arm of bell crank 1087 out of engagement with the plunger of switch 1071.

It will be observed in FIGURE 48 that the lower end of the transmission housing 315 has a downwardly projecting abutment 1093 thereon which terminates above the normal level of the upper end of the substantially upright arm of bell crank 1087. In the course of outward movement of carriage D', which is effected by admission of fluid pressure to the inner end of cylinder 1052 in a manner to be later described, the abutment 1093 engages the actuator or plunger of a double-pole, double-throw switch 1094.

The housing of switch 1094 is adjustably mounted on a bracket 1095 carried by and projecting upwardly from graduated bar 1073 (FIGURE 48). In order to avoid damaging switch 1094 as the plunger thereof is engaged by abutment 1093, a cushion block 1096 may be adjustably secured on the guide rod or track 310 so as to be engaged by the corresponding block 316 as the carriage D' reaches the outermost or dotted line position shown in FIGURE 48.

Referring to FIGURE 49, it will be observed that switch 1094 normally maintains contact between conductor *q*4 and a conductor 1097 whose other end is connected to one side of a normally open switch bar 1100 of an electromagnetic relay 1101. The other side of switch bar 1100 has a conductor 1103 leading therefrom to lead conductor 676.

One end of a conductor *r*2 is connected to one end of the coil of relay 1101 and the other end of the latter coil has the corresponding end of a conductor 1106 connected thereto. The end of conductor *q*5 remote from valve solenoid 1062 is connected to conductor 1106. The end of conductor 1105 opposite from the coil of relay 1101 is connected to one side of a normally open pattern controlled switch 1107 which may be mounted on any one of the pairs of rods 850 (FIGURES 11, 44 and 45) so as to be engaged and closed by a corresponding pattern pin 852. It is apparent that the latter pattern pin 852 should be so positioned as to close the switch 1107 following completion of a series of cutting operations by the contour cutter blade 81 carried by the corresponding carriage D'.

The side of pattern controlled switch 1107 opposite from conductor 1105 has a conductor 1110 leading therefrom to lead conductor 676, and the latter conductor has a cycling switch 1111 interposed therein which is operated by a corresponding cam 1112 carried by the cycling drum 650. It should be noted that lead conductor 680 has a conductor *r*4 leading therefrom to a medial portion of conductor *r*2.

When the plunger of switch 1094 is engaged and depressed by abutment 1093 (FIGURE 48), this breaks the circuit between conductors *q*4 and 1097 and establishes contact between a pair of conductors 1115, 1116 to energize the coil of an electromagnetic relay 1117. Relay 1117 is provided with a normally open switch bar 1120. Conductor 1115 leads from one side of switch 1094 to lead conductor 676, and conductor 1116 leads from the other side of switch 1094 to one end of the coil of relay 1117. The other end of the latter coil has conductor *r*2 connected thereto.

The end of conductor *q*3 opposite from solenoid 1061 is connected to one side of the normally open switch bar 1120 of relay 1117. The other side of the latter switch bar has a conductor *r*3 extending therefrom to a medial portion of conductor 1115. The end of conductor *q*7 opposite from switch 1071 is connected to a medial portion of conductor 1116. This completes the description of the various elements of the mechanism for returning the corresponding carriage D' to reset or starting position.

XXIII. OPERATION OF CARRIAGE RESETTING MECHANISM

Referring to FIGURE 25, since the web W moves from right to left, it is apparent that the cut line 2D' is started at the left-hand end thereof and is completed at the right-hand end thereof closely adjacent the corresponding edge of the blank; that is, at its juncture with the cut line C4'. Accordingly, in this instance, the cutter head carriage D' must be reset at a position spaced inwardly of the position occupied thereby upon terminating the formation of the cut line 2D' of FIGURE 25. It should be noted that the cutter head carriage D' occupies a position inwardly of the broken line position shown in FIGURE 48 upon the final cut being formed in the cut line 2D' of FIGURE 25.

In order to reset the cutter head carriage D', the ram, comprising piston rod 1050, piston 1051 and cylinder 1052, is used for laterally shifting the corresponding cutter head carriage D' in either direction. Now, if the clutch coupler thrust bar 557, for the corresponding cutter head carriage D', has not previously been moved to neutral position (FIGURES 20–23), two of the pattern pins 852 on pattern chain 850 must then be so positioned as to engage and close a corresponding pair of pattern controlled switches 734 or 735 and 707 (FIGURE 46). The cycling cam 653 is located on the cycling drum 650 in substantially the same longitudinal plane as the cycling cam 654, but is of greater length than the cycling cam 654 so that cam 653 engages and closes cycling switch 663 before and after cam 654 engages and closes cycling switch 664.

As cam 653 closes cycling switch 663, clutch neutralizing coil 576 (FIGURES 21 and 22) is energized, causing plunger 582 to move toward plate 575. Assuming that carriage retracting solenoid 574 (FIGURES 20 and 21) was the last of the two directional solenoids 573, 574 to be energized when the contour cutter blade 81 of the corresponding cutter head carriage D' made the final cut in the formation of cut line 2D' (FIGURE 25), it follows that inward movement of solenoid plunger 582 caused the stop pin 583 to project from plate 575 while pin 584 yieldably engaged the clutch control lever 570. Therefore, in this instance, the corresponding carriage advancing solenoid 573 must then be energized and, thus, the corresponding switch 735 (FIGURE 46) is the switch which was closed by a pattern pin 852 at the same time that switch 707 was closed.

Thus, after switch 663 is closed by cycling cam 653, switch 664 is closed by cycling cam 654 to energize carriage advancing solenoid 573. In so doing, clutch control lever 570 is moved in a clockwise direction in FIGURE 20 until its downwardly depending portion engages the pin 583. The detent 563 will then hold the clutch coupler thrust bar in the neutral position even though the carriage advancing solenoid 573 and neutralizing solenoid 576 may be de-energized as cams 653, 654 leave switches 663, 664 (FIGURE 46) and at the next advancing movement of pattern chain 850. As heretofore stated, when clutch coupler thrust bar 557 occupies neutral position, all of the balls 550, 551 are held out of engagement with the corresponding carriage transition bar of cutter head carriage D', so the transition bar may be moved in either direction independently of the corresponding carriage transition tube 540.

After the carriage increment clutch 530 associated with carriage D' has been neutralized in the manner heretofore described, a pattern pin 852 on pattern chain 850 engages and closes switch 1107 (FIGURE 49), after which cycling cam 1112 on drum 650 engages and closes cycling switch 1111 and current flows from negative lead conductor 680, through conductors *r*4, *r*2, through the coil of relay 1101, through conductor 1106, pattern controlled switch 1107, cycling switch 1111, and conductor 1110 to positive lead conductor 676. This energized relay 1101 to move switch bar 1100 into engagement with conductors 1097, 1103.

At substantially the time the circuit is initially completed to the coil of relay 1101 in the manner last de-

scribed, cycling cam 1112 moves out of engagement with cycling switch 1111 to break the electrical connection between lead conductor 676 and pattern controlled switch 1107. However, switch bar 1100 then serves to complete a holding circuit for the coil of relay 1101 since current then flows from negative lead conductor 680, through conductors *r*4, *r*2, coil of relay 1101, conductor *q*5, valve solenoid 1062, conductor *q*4, switch 1094, conductor 1097, switch bar 1100 and conductor 1103 to positive lead conductor 676.

In addition to establishing a holding circuit for the coil of relay 1101, it is apparent that movement of switch bar 1100 into engagement with conductors 1097, 1103 also energizes the coil of valve solenoid 1062 and causes the valve core 1060 to move from left to right in FIGURE 49. Thus, enlarged portion *p*3 moves out of engagement with the partition *n*7 between chambers *n*2, *n*3 and into engagement with partition *n*7 between chambers *n*3, *n*4 while enlarged portion *p*4 remains in engagement with the partition *n*7 between chambers *n*5, *n*6. Thereupon, fluid pressure flows from source 1067, through conduits 1066 and 1065 into chamber *n*2. Fluid pressure flows from chamber *n*2, into chamber *n*3, through conduit 1054 to the inner end of cylinder 1052.

Thus, the carriage D' moves outwardly until abutment 1093 thereon engages and moves the plunger of switch 1094 outwardly to break the connection between conductors *q*4, 1097 and to make the connection between conductors 1115, 1116. In so doing, the circuits to the coil of relay 1101 and the valve solenoid 1062 are broken. This results in switch bar 1100 moving out of engagement with conductors 1097, 1103 and also results in the core 1060 of valve 1057 being moved to neutral position by springs *p*7.

When switch 1094 is moved into engagement with conductors 1115, 1116, this causes current to flow from negative lead conductor 680 through conductors *r*4, *r*2, through the coil of relay 1117, through conductor 1116, switch 1094 and conductor 1115 to the positive lead conductor 676. It is apparent that this energizes the coil of relay 1117 which then moves switch bar 1120 to closed position. Thus, current then flows from negative lead conductor 680, through the coil 1117 and, although current may continue to flow through the switch 1094 for a relatively short interval of time, it is subsequently open and, therefore, it shall be considered that current flows from the upper end of the coil of relay 1117, through conductors 1116 and *q*7, through switch 1071, conductor *q*6, the coil of soilenoid 1070, through conductor *q*2, through the coil of valve solenoid 1061, and through conductor *q*3, to one side of switch bar 1120.

Current then flows through switch bar 1120, through conductors *r*3, 1115 and to the lead conductor 676. It is thus seen that the coils of solenoids 1070, 1071 are energized simultaneously and cause solenoid plunger 1080 to move upwardly and valve core 1060 to move from right to left in FIGURE 49.

With energization of the coil of solenoid 1061 and consequent right to left movement of core 1060, it is apparent that enlarged portion *p*4 of core 1060 moves out of engagement with the partition *n*7 between chambers *n*5, *n*6 and into engagement with that partition *n*7 between chambers *n*4, *n*5. In so doing, this permits fluid pressure to flow from the source 1067, through conduits 1066, 1064, and into chambers *n*6 and *n*5. Thus, fluid pressure enters the right-hand or outer end of cylinder 1052 through the conduit 1055 as compressed air or fluid pressure is exhausted from the conduit 1054. This causes carriage D' to move inwardly from right to left in FIGURE 48 until the abutment 1033 thereon engages the bell crank 1087 which is then in its path due to energization of the coil of solenoid 1070.

When the abutment 1093 engages the outer or right-hand surface of the vertical arm of bell crank 1087 in FIGURES 48 and 49, the substantially horizontal arm of bell crank 1087 is moved into engagement with and opens normally closed switch 1071. It is apparent that the opening of switch 1071 de-energizes relay 1117 and solenoids 1061, 1070 so that switch bar 1120 moves out of engagement with conductors *q*3, *r*3; core 1060 returns to the neutral position, shown in FIGURE 49; and spring 1083 returns the plunger 1080 of solenoid 1070 and bell crank 1087 to the lowered position shown in FIGURE 48.

The solenoid 1070 will have previously been so positioned along graduated bar 1073 that, when abutment 1093 engaged bell crank 1087 and thus interrupted further movement of carriage D', the latter carriage was then reset so that the next succeeding cut formed by its corresponding contour cutter blade 81 would be formed at a point spaced a predetermined distance inwardly from the corresponding edge of the web W to start the formation of another cut line 2D' when the next succeeding web section W' is subsequently properly positioned with respect to the cutter head carriage D'.

It is apparent that all the cutter head carriages A–D, A'–D' are reset in exactly the same manner as that described with respect to the cutter head carriage D' although, of course, each corresponding solenoid 1070 (FIGURE 48) would be so adjusted as to cause the cutter head carriages to occupy a predetermined reset position.

For example, it will be observed in FIGURE 25 that the two cut lines 2C and 2A' start at points spaced approximately the same distance inwardly from the corresponding edges of the web W as the two corresponding cut lines 2B and 2B'. However, since the cutter head carriages C, A' form both pairs of the cut lines 2C, 2C2 and 2A', 2A2 in FIGURE 25, it is apparent that the final cuts formed by the contour cutter blades of the latter carriages are formed very near the longitudinal center of the web W, for example.

Thus, the cutter head carriages C, A' would be reset starting from a substantially greater distance inwardly of the corresponding edge of the web W than the cutter head carriages B and D'. It will be noted that the left-hand ends of cut lines 2A and 2C', which are formed by the contour cutter blades of cutter head carriages A, C', are disposed in closer relationship to the longitudinal center of web W than the terminal ends of the cut lines 2C2, 2A2 while the cut lines 2B', 2D are started with the contour cutter blades of respective carriages B', D positioned the same distance inwardly of corresponding side edges of the web as the cutter head carriages D', B are positioned at the start at the lines of cut 2D', 2B'. In any event, regardless of the point at which a line of cut is to be started by each cutter head carriage, upon completion of each such line of cut, the corresponding carriage is moved outwardly to engage the corresponding switch 1094, as described with respect to the cutter head carriage D', and then moves inwardly until the corresponding abutment 1093 thereon engages the bell crank stop 1087.

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

We claim:

1. A method of cutting a web which comprises advancing the web in a substantially straight path in an intermittent step-by-step manner, moving a thin cutting blade having a substantially triangularly-shaped cutting edge into and out of the web in a reciprocating manner while the movement of the web is stopped between intermittent movements thereof and with the blade extending in substantially perpendicular relation to the web, turning the blade at various angles about a substantially perpendicular axis with respect to the path of travel of the web, and varying the depth of penetration of the blade into the web in substantially proportional relationship to said

various angles such that the lengths of all the cuts formed by the blade are substantially the same when measured in parallel relation to the path of travel of the web.

2. A method of cutting a web which comprises advancing the web in a substantially straight path in an intermittent step-by-step manner, moving the pointed end of a thin cutting blade having a substantially right-triangularly-shaped cutting edge and a perpendicular edge into and out of the web in a reciprocating manner while the web is stationary between intermittent movements thereof and with the blade extending in substantially perpendicular relation to the web, turning the blade at various angles about its perpendicular edge and about a substantially perpendicular axis with respect to the path of travel of the web, and varying the depth of penetration of the blade into the web in substantially proportional relationship to said various angles such that the length of all the cuts formed by the blade are substantially the same when measured in parallel relation to the path of travel of the web.

3. A method of cutting out articles from a web which comprises moving the web in a substantially straight path in an intermittent step-by-step manner, traversing a thin reciprocating cutting blade having a substantially right-triangularly-shaped cutting edge laterally of the web with the perpendicular edge of the blade extending in perpendicular relation to the web, moving the blade into and out of the web while the web is stationary between intermittent movements thereof, turning the blade about an axis substantially coincident with the perpendicular edge of the blade at various angles with respect to the path of travel of the web during the lateral traversing of the blade, and varying the depth of penetration of the blade into the web proportional to said various angles such that the lengths of all the cuts formed by the blade are substantially the same when measured in parallel relation to the path of travel of the web.

4. A method of cutting out articles from a web which comprises intermittently advancing the web in a substantially straight path, successively moving a thin reciprocating cutting blade having a triangularly-shaped cutting edge into and out of the web with the blade extending in substantially perpendicular relation to the web, indexing the blade laterally of the web, turning the blade at various angles with respect to the path of travel of the web and about a substantially perpendicular axis during the lateral traversing thereof relative to the web, and varying the depth of penetration of the blade into the web proportional to said various angles such that the length of each cut embraces a respective portion of the length of the web substantially equal to the distance the web moves between successive cuts.

5. A method of cutting out contoured articles from a web utilizing a right-triangularly-shaped blade having a hypotenuse cutting edge and a perpendicular edge which comprises intermittently advancing the web equidistantly in a substantially straight path, successively penetrating the web with the blade to various depths to form individual cuts of varying lengths, turning the blade at various angles about an axis substantially coincident with the perpendicular edge of the blade between certain successive cuts in which the depth of penetration of the web by the blade is so related to the angle of the blade with respect to the direction of travel of the web that each cut formed by the blade which is not at right angles to the path of travel of the web embraces a portion of the length of the web equal to the distance the web is advanced, and withdrawing the blade from the web following the formation of each cut thereby.

6. A method of cutting out contoured articles from a web utilizing a right-triangularly-shaped blade having a hypotenuse cutting edge and a perpendicular edge which comprises intermittently advancing the web equidistantly in a substantially straight path, successively penetrating the web with the blade to various depths to form individual cuts of varying length, turning the blade at various angles about an axis substantially coincident with the perpendicular edge of the blade between certain sucessive cuts in which the depth of penetration of the web by the blade is so related to the angle of the blade with respect to the direction of travel of the web that each cut formed by the blade which is not at right angles to the path of travel of the web embraces a portion of the length of the web equal to the distance the web is advanced, withdrawing the blade following the formation of each cut thereby, and intermittently shifting the blade transversely of the web in increments substantially equal to the transverse distance embraced by any immediately preceding cut so that each successive cut may be conjoint with the respective immediately preceding cut.

7. A method of cutting out variantly-shaped articles from a web, utilizing a substantially pointed, substantially triangularly-shaped blade having substantially flat opposed sides extending substantially perpendicular to the web, said method comprising advancing the web equidistantly in a step-by-step manner in a substantially straight path, inserting the pointed end of the blade in the web between certain successive advancements thereof with the flat sides of the blade extending at an angle to the path of the web of less than 90 degrees and while causing the blade to penetrate the web to a depth such that the length of the web embraced by the cut thus formed is substantially equal to the distance the web advances with each advancement thereof, withdrawing the blade from the web, shifting the blade transversely of the web a distance corresponding to that portion of the width of the web embraced by said cut while changing the angle of the sides of the blade relative to the path of travel of the web and relative to said first-named angle, and repeating the steps substantially as described.

8. A method of cutting out variantly-shaped articles from a web, utilizing a substantially pointed, substantially triangularly-shaped blade having substantially flat opposed sides extending substantially perpendicular to the web, said method comprising advancing the web equidistantly in a step-by-step manner in a substantially straight path, inserting the pointed end of the blade in the web between certain successive advancements thereof, withdrawing the blade from the web, then again inserting the blade in the web following another advancement of the web with the flat sides of the blade extending at an angle to the path of the web of less than 90 degrees in either direction and while causing the blade to penetrate the web to a depth such that the length of the web embraced by the cut thus formed is substantially equal to the distance the web advances with each advancement thereof, again withdrawing the blade from the web, shifting the blade transversely of the web a distance corresponding to that portion of the width of the web embraced by said cut, changing the angle of the sides of the blade relative to the path of travel of the web and relative to said first-named angle, and again inserting said blade in the web following still another advancement of the web.

9. A method of cutting out variantly-shaped articles from a relatively thin pliable web, utilizing a pointed, substantially triangularly-shaped, thin blade extending substantially perpendicular to the web, said method comprising advancing the web substantially equidistantly in each of a plurality of steps in a substantially straight horizontal path, inserting the pointed end of the blade downwardly through the web between certain successive advancements thereof with the blade extending at an acute angle to the path of the web, withdrawing the blade upwardly from the web to a predetermined height, shifting the blade transversely of the web a distance corresponding to that portion of the width of the web embraced by the cut last formed thereby while maintaining the blade at the predetermined height above the web and while changing the angle of the blade relative to said first-named angle but to an angle within less than 90

degrees relative to the path of travel of the web and while advancing the web another step in the plurality of steps of advancement, again inserting the blade downwardly through the web following another advancement of the web and causing the blade to penetrate the web to a depth such that the length of the web embraced by the cut thus formed is substantially equal to the distance the web will be advanced with the next advancement thereof to thereby form conjoint individual cuts, and repeating the steps substantially as described.

10. A method of cutting out contoured articles from a web utilizing a right-triangularly-shaped blade having a hypotenuse cutting edge and a perpendicular edge which comprises intermittently advancing the web in steps of substantially equal length in a substantially straight path, successively penetrating the web with the blade to various depths between successive pairs of a series of successive steps in the advancement of the web to form conjoint individual cuts of varying length therein, turning the blade at various angles about an axis substantially coincident with the perpendicular edge of the blade between certain successive cuts in which the extent of penetration of the web by the blade is so related to the angle of the blade with respect to the direction of travel of the web that each cut formed by the blade which is not at right angles to the path of travel of the web embraces a portion of the length of the web equal to the distance the web is advanced, and withdrawing the blade from the web following the formation of each cut thereby.

11. The method of claim 10, including stopping the formation of cuts by the blade during certain steps in advancement of the web.

12. Apparatus for cutting a web comprising a table adapted to support the web for longitudinal movement thereon, a cutter mounted for reciprocating motion along a line perpendicular to said table, means for reciprocating said cutter, said cutter having a free end movable into and out of the web with each reciprocation thereof, pattern controlled means rotating said cutter about a perpendicular axis and causing the cutter to occupy various angular positions with respect to the longitudinal axis of the table, pattern controlled means for shifting the cutter predetermined distances transversely of the table in either direction, said cutter being substantially triangularly shaped, and means to vary the depth of penetration of the cutter into the web during reciprocation of the cutter to thereby vary the length of the cuts formed in the web by the cutter.

13. Apparatus for cutting out contoured articles from a web intermittently moving in a substantially linear path comprising a substantially triangularly-shaped cutter blade, means for reciprocating said cutter blade along a line perpendicular to the plane of the web with the pointed end of the blade extending toward the web with respect to the reciprocating means and movable into and out of the web upon each reciprocation thereof, means for turning said blade about a perpendicular axis to various angles with respect to the path of travel of the web, and means for varying the effective length of the strokes of the blade proportional to the angularity of the blade to vary the depth of penetration of the blade into the web in proportional relationship to the various angles to which the blade is turned to thereby vary the lengths of the cuts formed in the web by the blade in accordance with the angles occupied by the blade with respect to the path of travel of the web.

14. Apparatus according to claim 13, including means for advancing the web in a step-by-step manner in which the advancing of the web occurs while the blade is withdrawn from the web and the web remains stationary while the blade is penetrating the web.

15. A structure according to claim 14, including pattern controlled means for shifting the blade inwardly and outwardly during that part of certain reciprocations of the blade in which the blade is withdrawn from the web, and said pattern controlled means including means for varying the extent of the transverse shifting of the blade in proportional relation to the angle occupied by the blade during any immediately preceding reciprocation thereof.

16. Apparatus for cutting contoured lines of cut in a web comprising means for advancing the web in a step-by-step manner in a substantially straight path and in steps of substantially equal length, a substantially pointed and substantially triangularly-shaped cutter blade, means for reciprocating said blade along a line substantially perpendicular to the plane of the web with the pointed end of said blade penetrating and withdrawing from the web with each reciprocation thereof and in timed relation to each of certain advancements of the web, pattern controlled means for turning said blade about a substantially perpendicular axis to various angles with respect to the path of travel of the web during intervals in which said blade is withdrawn, and means for varying the depth of penetration of said blade into the web in proportional relationship to the angles to which said blade is turned to thereby vary the lengths of the cuts formed in the web by said blade in accordance with the angles occupied by said blade with respect to the path of travel of the web.

17. Apparatus for cutting out variantly-shaped articles from a relatively thin pliable web comprising a pointed, substantially thin cutter blade, means for advancing the web in a substantially straight horizontal path in a step-by-step manner and in steps of substantially equal length, reciprocating means for moving the point of said cutter blade downwardly into and withdrawing said blade upwardly from the web to a predetermined height thereabove during certain intervals between successive steps in advancement of the web, means for turning said blade about an axis perpendicular to the plane of the web to various acute angles with respect to the path of travel of the web and during intervals in which said blade is withdrawn from the web and at said predetermined height thereabove, and means controlling the depth of penetration of the blade into the web and causing the blade to penetrate the web to such depth that the cut formed thereby is of a length substantially embracing the length of the web which is advanced with each of said steps.

18. Apparatus according to claim 17 including means for shifting said cutter blade transversely of the web following the formation of any cut in the web which extends at an acute angle to the path of travel of the web when said blade is withdrawn from the web and at said predetermined height thereabove, said last-named means being operable to shift the cutter blade a distance substantially equal to the portion of the web embraced by the cut last formed when measured transversely of the web.

19. Apparatus according to claim 17, including pattern controlled means for operating said reciprocating means at selected intervals.

20. Apparatus for forming contoured lines of cut in a web comprising a plurality of spaced substantially right-triangularly-shaped contour cutter blades, each blade having a hypotenuse edge and a perpendicular edge defining a pointed end, means for advancing the web in a substantially horizontal and straight path in a step-by-step manner and in steps of equal length, reciprocating means for moving the pointed ends of selected cutter blades into and out of and in perpendicular relation to the web during each of certain intervals between successive steps in advancement of the web whereby each selected cutter blade forms a series of cuts in the web, means for turning selected blades each about an axis substantially alined with the perpendicular edge of each selected blade and to various acute angles with respect to the path of travel of the web and during intervals in which said blade is withdrawn from the web, and means controlling the depth of penetration of each blade into the web and causing each blade to penetrate the web to

such depth that the cut formed thereby is of a length substantially equal to the length of the web which is advanced in each of said steps.

21. A structure according to claim 20, including a secondary cutter means normally spaced above the path of travel of the web, said secondary cutter means including means for forming at least one relatively short cut transversely of the web, and pattern controlled means for moving said last-named means downwardly through the web and then upwardly during a selected interval between successive steps in advancement of the web.

22. A structure according to claim 20, including a die cutter means comprising at least one endless die cutter blade normally spaced above the path of travel of the web, and pattern controlled means operable upon completion of a predetermined number of series of cuts by selected contour cutter blades for momentarily moving said die cutter blade through the web.

23. A structure according to claim 20, including a web severing means, and pattern controlled means for operating said severing means at selected intervals for severing said web into predetermined lengths.

24. Apparatus according to claim 20, including means for shifting selected cutter blades transversely of the web following the formation of any cuts in the web by the corresponding blades which extend at an acute angle to the path of travel of the web, said last-named means being operable to shift said corresponding blades each a distance equal to the portion of the web embraced by the cut last formed thereby when measured transversely of the web whereby the cuts in each series are conjoined.

25. A structure according to claim 24, including pattern controlled means for resetting each cutter blade to a predetermined starting position transversely of the web following the formation of a corresponding series of cuts and preparatory to the formation of a succeeding series of cuts thereby.

26. Apparatus for cutting contoured lines of cut in a web comprising a substantially pointed and substantially right-triangularly-shaped cutter blade, means for advancing the web past and beneath the point of said blade in a substantially straight substantially horizontal path in a step-by-step manner and in steps of substantially equal length, reciprocating means for moving the point of said blade downwardly from a position above the web into the web during certain intervals between successive steps in advancement of the web, pattern controlled means for turning said blade in either direction about a substantially vertical axis substantially corresponding to the perpendicular edge of said blade to various angles with respect to the path of travel of the web and during intervals in which said blade is withdrawn from the web, and cam means for varying the depth of penetration of the blade into the web in relation to the angle occupied by the blade relative to the path of travel of the web, said cam means serving to cause the blade to penetrate the web to such depth that the length of the cut formed thereby substantially embraces the length of the web which is advanced in each of said steps.

27. Apparatus according to claim 26 including pattern controlled means for shifting said cutter blade transversely of the web following the formation of any cut in the web which extends at an angle to the path of travel of the web, said last-named means being operable to shift the cutter blade a distance substantially equal to the portion of the web embraced by the cut last formed when measured transversely of the web.

28. Apparatus for cutting a web comprising means for advancing the web in a step-by-step manner in a substantially straight and substantially horizontal path and in steps of substantially equal length, a substantially pointed and substantially right-triangularly-shaped cutter blade, said blade having a hypotenuse cutting edge and a perpendicular edge, means for reciprocating said blade along a substantially vertical line perpendicular to the plane of the web with the point of said blade penetrating and withdrawing from the web with each reciprocation thereof and in timed relation to each advancement of the web, means for turning said blade about an axis substantially alined with said perpendicular edge to various angles with respect to the path of travel of the web during intervals in which said blade is withdrawn, and means for varying the depth of penetration of said blade into the web in proportional relation to the angle to which said blade is turned and to the angle of the hypotenuse cutting edge to thereby vary the lengths of the cuts formed in the web by said blade in accordance with the angles occupied by said blade with respect to the path of travel of the web.

29. Apparatus according to claim 28 including a slotted presser plate substantially alined with said cutter blade and adapted to have said web advanced thereover and in engagement therewith, said presser plate having a slot therein into which said blade moves when it penetrates said web, and means for turning said presser plate in unison with said blade and about an axis substantially alined with the perpendicular edge of said blade to assist in cutting the material.

30. Apparatus according to claim 28, including a pattern mechanism, a cycling means, means for driving said pattern mechanism and said cycling means in timed relationship to said reciprocating means and said advancing means, normally inoperative means under control of said cycling means for operating said blade turning means, and means under control of said pattern mechanism for rendering said cycling means operative at selected intervals.

31. Apparatus according to claim 28, including a pattern mechanism, means for driving said pattern mechanism in timed relation to said web advancing means, a normally disengaged single-revolution clutch interposed in said means for reciprocating said blade, and means under control of said pattern mechanism for effecting engagement of said clutch at selected intervals.

32. Apparatus according to claim 31, in which said means under control of said pattern mechanism includes a cycling device operatively connected to said clutch and driven in timed relation to said web advancing means, said means under control of said pattern mechanism also including means for rendering said cycling device operative at selected intervals, and means responsive to said cycling device being rendered operative for effecting engagement of said clutch in such timed relation to the advancement of the web that the blade penetrates and withdraws from the web during a selected interval between successive steps in the advancement of the web.

33. Apparatus according to claim 28, in which said means for advancing the web comprises a plurality of longitudinally spaced transverse rows of transversely spaced feed dogs, a fixed table upon which said web advances and having transverse rows of slots therein through which said feed dogs may pass, and means for rotating said feed dogs in substantially circular paths in which the feed dogs move upwardly and forwardly through said slots when said blade is withdrawn from the web and then recede into said slots in repetition whereby the web is advanced a step with each upward and forward movement of said feed dogs.

34. Apparatus according to claim 33, including yieldable web hold-down means positioned above said feed dogs for applying yieldable pressure to the web and against the feed dogs.

35. Apparatus according to claim 34, in which said yieldable hold-down means comprises transverse presser plates overlying at least some of the transverse rows of feed dogs, spring means applying yieldable downward pressure to said transverse presser plates, and manually operable means for raising said presser plates to a position spaced above the path of travel of the web.

36. Apparatus for cutting contoured lines of cut in a

web comprising means for advancing the web in a step-by-step manner in a substantially straight and substantially horizontal path and in steps of substantially equal length, a substantially right-triangularly-shaped cutter blade, said blade having a hypotenuse cutting edge and a perpendicular edge, a needle connected to and extending parallel to said perpendicular edge, said needle having a pointed end extending beyond the juncture of said hypotenuse cutting edge and said perpendicular edge, means for reciprocating said blade along a substantially vertical line perpendicular to the plane of the web with the pointed end of said needle and said blade penetrating and withdrawing from the web with each reciprocation thereof and in timed relation to each advancement of the web, means for turning said blade about an axis substantially alined with said needle to various angles with respect to the path of travel of the web during intervals in which said blade is withdrawn, and means for varying the depth of penetration of said blade into the web in proportional relationship to the angles to which said blade is turned and to the angle of the hypotenuse cutting edge to thereby vary the lengths of the cuts formed in the web by said blade in accordance with the angles occupied by said blade with respect to the path of travel of the web.

37. Apparatus for cutting contoured lines of cut in a web comprising a plurality of longitudinally spaced substantially right-triangularly-shaped contour cutter blades, each blade having a hypotenuse cutting edge and a perpendicular edge defining a substantially pointed end, an endless pattern mechanism, means for advancing the web in a substantially horizontal and straight path in a step-by-step manner and in steps of substantially equal length, means for imparting a step in movement to said pattern mechanism in timed relation to each step in advancement of the web, first means under control of said pattern mechanism for reciprocating the pointed ends of selected contour cutter blades into and out of and along a line perpendicular to the web during each of certain intervals between successive steps in advancement of the web whereby each selected cutter blade forms a series of cuts in the web, second means under control of said pattern mechanism for turning selected contour cutter blades each about an axis substantially alined with the perpendicular edge of each selected blade and to various angles with respect to the path of travel of the web and during intervals in which said blade is withdrawn, means for varying the extent of penetration of each selected cutter blade into the web in proportional relation to the angle of the hypotenuse thereof and the angles thereof with respect to the path of travel of the web, third means under control of said pattern mechanism for selectively shifting said blades transversely of said path of travel of said web for distances substantially equal to the width of respective portions of the web embraced by respective immediately preceding cuts formed by each respective contour cutter blade whereby the cuts in each series may be conjoined, a cycling device, means for driving said cycling device in timed relation to said web advancing means, and means interposed between each of said first, second and third means and under control of said pattern mechanism and said cycling device to effect predetermined sequential reciprocation, turning and shifting of each of said blades relative to said web advancing means.

38. Apparatus for cutting lines of cut in a web comprising means for advancing the web in a step-by-step manner in a substantially straight, substantially horizontal, path and in steps of substantially equal length, a substantially pointed and substantially right-triangularly-shaped cutter blade, said blade having a hypotenuse cutting edge and a perpendicular edge, said blade having its point projecting downwardly and normally spaced above the path of travel of the web, a carriage for said blade, a block guided for vertical movement in said carriage and above said blade, pattern controlled means for imparting a given range of downward and then upward movement to said block in the interim between certain successive steps in advancement of the web, a substantially upright shaft fixed to said blade and guided for vertical and rotary movement in said block, said shaft having a substantially vertical axis substantially alined with said perpendicular edge of said blade, pattern controlled means for turning said shaft about its substantially vertical axis to various angles relative to the path of travel of the web, and means for varying the position of said shaft along its substantially vertical axis relative to said block and in proportional relationship to the angle to which said blade is turned and to the angle of the hypotenuse cutting edge to thereby vary the lengths of the cuts formed in the web by said blade in accordance with the angles occupied by said blade with respect to the path of travel of the web.

39. Apparatus according to claim 38, in which said pattern controlled means for turning said shaft comprises a pinion carried by said carriage and in which said shaft is keyed for axial movement, a rack carried by said carriage and engaging said pinion, a pattern mechanism, means for driving said pattern mechanism in timed relation to said web advancing means, a cam reading means, means under control of said pattern mechanism for shifting said reading means from a cam engaging position to a neutral position, a series of increment cams positioned adjacent said cam reading means and movable in a fixed path adjacent the cam reading means while the latter is in neutral position, said increment cams having cam surfaces thereon normally spaced various distances from the cam reading means, means under control of said pattern mechanism for selectively shifting the increment cams in said series, one at a time, into alinement with said cam reading means, means operatively connecting said reading means to said rack, means under control of said pattern mechanism for shifting said rack in either direction and shifting said reading means therewith whereby said reading means moves into engagement with the cam surface of the corresponding increment cam and accordingly limits the movement of the rack in the corresponding direction to thereby cause the cutter blade to occupy a predetermined angular position with respect to the path of travel of the web.

40. Apparatus according to claim 39, in which said means for shifting said reading means to a neutral position causes the blade to extend parallel to the path of travel of the web, at a predetermined interval following each instance in which said blade is moved to an angular position with respect to the path of travel of the web.

41. Apparatus for cutting contoured lines of cut in a web comprising means for advancing the web in a step-by-step manner in a substantially straight, substantially horizontal, path and in steps of substantially equal length, a substantially pointed and substantially right-triangularly-shaped cutter blade, said blade having a hypotenuse cutting edge and a perpendicular edge, said blade having its point projecting downwardly and normally spaced above the path of travel of the web, a carriage for said blade, a cam block guided for vertical movement in said carriage and above said blade, pattern controlled means for imparting downward and then upward movement to said block during certain selected intervals between successive steps in advancement of the web, a substantially upright shaft fixed to said blade and guided for vertical and rotary movement in said block, said block having a cam surface thereon, a cam follower on said shaft engaging said cam surface, pattern controlled means for turning said shaft about its substantially vertical axis to various angles relative to the path of travel of the web, and said cam surface being so formed as to cause the point of said blade to penetrate said web a given distance when the blade is alined with the path of travel of the web and to progressively increase the depth of the blade through the web with corresponding increases in the angularity of the blade

effected by said last-mentioned pattern controlled means.

42. Apparatus for cutting lines in the form of a series of conjoined cuts in a web comprising a table, means for advancing the web along said table in a step-by-step manner in a substantially straight path and in steps of substantially equal length, a substantially pointed and substantially right-triangularly-shaped cutter blade, said blade having a hypotenuse cutting edge and a perpendicular edge, said blade having its point projecting downwardly and normally spaced above the path of travel of the web, a carriage for said blade, a block guided for vertical movement in said carriage and above said blade, pattern controlled means for imparting a fixed range of downward and then upward movement to said block in the interim between certain successive steps in advancement of the web, a substantially upright shaft fixed to said blade and guided for vertical and rotary movement in said block, said shaft having a substantially vertical axis substantially alined with said perpendicular edge of said blade, pattern controlled means for turning said shaft about its substantially vertical axis to various angles relative to the path of travel of the web, means for varying the position of said shaft along its substantially vertical axis relative to said block and in proportional relationship to the angle to which said blade is turned and to the angle of the hypotenuse cutting edge to thereby vary the lengths of the cuts formed in the web by said blade in accordance with the angles occupied by said blade with respect to the path of travel of the web, and means for shifting said carriage in either direction transversely of the web following the formation of any cut in the web by said blade which extends at an angle of less than ninety degrees and more than zero degrees relative to the path of travel of the web, said last-named means being operable to shift the cutter blade a distance substantially equal to the portion of the web embraced by the cut last formed when measured transversely of the web.

43. Apparatus according to claim 42, including a stripper plate carried by said carriage, said stripper plate being disposed above the path of travel of the web and having a slot therein through which said blade passes during the downward and upward movement of said block, and means for turning said stripper plate in synchronism with said blade and on an axis substantially alined with the vertical axis of said shaft.

44. Apparatus according to claim 42, in which said carriage is guided for lateral movement relative to said web advancing means, said carriage shifting means comprising a series of increment cams movable in a fixed path parallel to said series, follower means positioned adjacent and to one side of the fixed path of said increment cams, yielding means urging said follower means toward said increment cams to said last-named position, said increment cams having respective cam surfaces projecting varying distances therefrom toward the plane of said follower means, pattern controlled means for selectively switching said cams in said series, one at a time, into alinement with said follower means, means for reciprocating said series of increment cams laterally of said fixed path whereby any increment cam alined with said follower means engages and imparts predetermined movement to said follower means, and means operatively connecting said follower means to said carriage for imparting lateral movement to said carriage in either direction in accordance with the extent of movement imparted to the follower means by the corresponding increment cam.

45. Apparatus according to claim 44, in which said means operatively connecting said follower means to said carriage comprises an overriding clutch, a connection between said follower means and said clutch whereby said clutch is moved in opposite directions in response to movement of said follower means in opposite directions, pattern controlled means for establishing a first fixed connection between said clutch and the carriage for transmitting lateral movement to the carriage in one direction but not in the other direction, and pattern controlled means for establishing a second fixed connection between said clutch and said carriage for transmitting movement from said clutch to said carriage in said other direction but not in said one direction.

46. Apparatus according to claim 45, including pattern controlled means for breaking the first and second connections between said clutch and said carriage whereby relative movement may occur between said clutch and said carriage.

47. Apparatus according to claim 45, including pattern controlled means for breaking the first and second connections between said clutch and said carriage, and means for then moving said carriage laterally outwardly relative to said web advancing means to a predetermined position at which the blade is to start the formation of a succeeding series of cuts in the web.

48. Apparatus for cutting a web comprising a substantially horizontal table, means for advancing the web along said table in a step-by-step manner in a substantially straight path and in steps of substantially equal length, a substantially pointed and substantially right-triangularly-shaped cutter blade, said blade having a hypotenuse edge and a perpendicular edge, means for reciprocating said blade along a substantially vertical line with the point of said blade penetrating and withdrawing from the web with each reciprocation thereof and in timed relation to each advancement of the web, a carriage having a portion overlying said table, said reciprocating means including a substantially vertical shaft guided for vertical and rotary movement in said portion of said carriage and to the lower end of which said blade is secured, a stripper plate carried by said carriage and having a slot therein through which said blade reciprocates, means for turning said shaft, said blade and said stripper plate about an axis substantially alined with said perpendicular edge to various angles with respect to the path of travel of the web during intervals in which said blade is withdrawn, and means for varying the depth of penetration of said blade into the web and relative to said stripper plate in proportional relationship to the angles to which said blade is turned and to the angle of the hypotenuse edge to thereby vary the lengths of the cuts formed in the web by said blade in accordance with the angles occupied by said blade with respect to the path of travel of the web.

49. Apparatus according to claim 48, including a presser plate positioned beneath said stripper plate and having a slot therein through which said blade reciprocates as it is penetraitng and withdrawing from the web and over which said web is advanced.

50. Apparatus according to claim 49, in which said stripper plate is spaced above the path of travel of the web, means for raising said presser plate to press the web against the lower surface of said stripper plate during each reciprocation of said blade, and means operatively connected to said means for turning said blade for turning said presser plate in synchronism with the turning of said blade.

51. Apparatus according to claim 48, including a presser plate normally disposed in substantially flush relationship to said table and being spaced beneath said stripper plate, said presser plate having a slot therein coinciding with the slot in said stripper plate, means for turning said presser plate in synchronism with the turning of said shaft and on an axis substantially alined with said vertical axis, and means for raising said presser plate to press the web against the lower surface of the stripper plate and returning said presser plate to flush relationship with said table in timed relation to each downward and upward movement of said block.

52. Apparatus according to claim 51, in which said means for turning said presser plate includes a second shaft connected to and depending from said presser plate, a second block surrounding at least the upper por-

tion of said second shaft, said table having a transverse gap therein within which said second block is positioned, means operatively connecting said second block to said carriage and causing said second block to move along said gap in either direction transversely of the table in synchronism with said carriage and said blade, the upper surface of said second block being substantially flush with the upper surface of said table, a plurality of closely transversely spaced gates bridging said gap and having their upper surfaces substantially flush with the upper surface of said table, and means on said second block engageable with said gates for moving said gates out of its path during the transverse shifting of said second clock and for returning any gates to closed position as said second block moves out of engagement with said gates.

53. Apparatus according to claim 52, in which said means on said second block for moving said gates out of the path of said second block comprises a cam surface on said second block, and means on each of said gates engageable by said cam surface, said cam surface being so formed as to open any gates alined longitudinally of the table with said second block and to close said gates as said second block moves out of longitudinal alinement therewith.

54. Apparatus for cutting contoured lines of cut in a web comprising a plurality of longitudinally spaced substantially right-triangularly-shaped contour cutter blades, each blade having a hypotenuse cutting edge and a perpendicular edge defining a pointed end, a pattern mechanism, means for advancing the web in a substantially horizontal and straight path in a step-by-step manner and in steps of substantially equal length, means for imparting a step in movement to said pattern mechanism in timed relation to each step in advancement of the web, means under control of said pattern mechanism for reciprocating the pointed ends of selected contour cutter blades into and out of and in perpendicular relation to the web during each of certain intervals between successive steps in advancement of the web whereby each selected cutter blade forms a series of cuts in the web, means under control of said pattern mechanism for turning selected contour cutter blades each about an axis substantially alined with the perpendicular edge of each selected blade and to various angles with respect to the path of travel of the web and during intervals in which said blade is withdrawn, means for varying the extent of penetration of each selected cutter blade into the web in proportional relation to the angle of the hypotenuse thereof and the angles thereof with respect to the path of travel of the web, and means under control of said pattern mechanism for selectively shifting said blades transversely of said path of travel of said web for distances substantially equal to the width of respective portions of the web embraced by respective immediately preceding cuts formed by each respective contour cutter blade whereby the cuts in each series may be conjoined.

55. Apparatus according to claim 54, including at least one die cutter blade normally spaced from and in perpendicular relation to the path of travel of the web, means for counting the steps in advancement of the web, and means responsive to said counting means for momentarily moving said die cutter blade through the web upon completion of a predetermined number of steps in advancement of the web following a previous movement of the die cutter blade through the web.

56. Apparatus for cutting contoured lines of cut in in a web comprising a plurality of longitudinally spaced substantially right-triangularly-shaped contour cutter blades, each blade having a hypotenuse cutting edge and a perpendicular edge defining a pointed end, an endless pattern mechanism, means for advancing the web in a substantially horizontal and straight path in a step-by-step manner and in steps of substantially equal length, means for imparting a step in movement to said pattern mechanism in timed relation to each step in advancement of the web whereby a predetermined length of the web is advanced with each complete cycle of said pattern mechanism, means under control of said pattern mechanism for reciprocating the pointed ends of selected contour cutter blades into and out of and in perpendicular relation to the web during each of certain intervals between successive steps in advancement of the web whereby each selected cutter blade forms a series of cuts in the web, means under control of said pattern mechanism for turning selected contour cutter blades each about an axis substantially alined with the perpendicular edge of each selected blade and to various angles with respect to the path of travel of the web and during intervals in which said blade is withdrawn, means for varying the extent of penetration of each selected cutter blade into the web in proportional relation to the angle of the hypotenuse thereof and the angles thereof with respect to the path of travel of the web, means under control of said pattern mechanism for selectively shifting said blades transversely of said path of travel of said web for distances substantially equal to the width of respective portions of the web embraced by respective immediately preceding cuts formed by each respective contour cutter blade whereby the cuts in each series may be conjoined, a normally inactive web severing device spaced forwardly from said contour cutter blades, and means under control of said pattern mechanism for actuating said severing device once during each cycle of said mechanism whereby the web may be severed into substantially uniform lengths.

57. Apparatus according to claim 56, including at least one die cutter blade normally spaced above the path of travel of the web and spaced generally longitudinally from said contour cutter blades, a normally inactive counting device, means under control of said pattern mechanism for actuating said counting device at least once during each cycle of said mechanism, means responsive to a predetermined number of actuations of said counting device for rendering inoperative said means for imparting movement to said pattern mechanism whereby the latter is stopped while said web continues to advance, means responsive to a predetermined number of advancements of the web, following the stopping of said pattern mechanism, for rendering operative said means for imparting movement to said pattern mechanism, and means automatically operable following the rendering operative of said means for imparting movement to said pattern mechanism in the manner last set forth for momentarily moving said die cutter blade downwardly through the web.

58. Apparatus according to claim 57, including additional normally inactive means under control of said pattern mechanism for actuating said severing device, and said counting device including means for rendering active said additional means in timed relation to said means for rendering inoperative the means for imparting movement to said pattern mechanism.

59. Apparatus for cutting lines of cut in a web comprising a table, means for advancing the web in a step-by-step manner in a substantially straight path upon said table and in steps of substantially equal length, a plurality of spaced carriages overlying said table, a block guided for vertical movement in each of said carriages and above said table, pattern controlled means for selectively imparting downward and then upward movement to each of said blocks during certain selected intervals between successive steps in advancement of the web, a substantially upright shaft guided for vertical and rotary movement in each of said blocks, a substantially pointed and substantially right-triangularly-shaped cutter blade fixed to and depending from each of said shafts, a hypotenuse cutting edge and a perpendicular edge on each blade, each blade having its point projecting downwardly and normally spaced above the path of travel of the web, the perpendicular edge of each blade being substantially

alined with the vertical axis of each respective shaft, pattern controlled means for turning each of said shafts about its substantially vertical axis to various angles relative to the path of travel of the web, and means for varying the position of each shaft along its substantially vertical axis relative to the corresponding block and in proportional relationship to the angle to which each blade is turned and to the angle of the hypotenuse cutting edge thereof to thereby vary the lengths of the cuts formed in the web by each blade in accordance with the angles occupied thereby with respect to the path of travel of the web.

60. Apparatus for cutting lines of cut in a web comprising a table, means for advancing the web in a step-by-step manner along said table in a substantially straight path and in steps of substantially equal length, a plurality of spaced carriages each having an arm overlying said table, a substantially pointed and substantially right-triangularly-shaped cutter blade carried by each arm, a hypotenuse cutting edge and a perpendicular edge on each blade defining a point projecting downwardly and normally spaced above the path of travel of the web, pattern controlled means for selectively imparting downward and then upward movement to each blade during certain selected intervals between successive steps in advancement of the web, pattern controlled means for turning each blade about a substantially vertical axis substantially alined with its perpendicular edge and to various angles relative to the path of travel of the web, means to cause the point of each blade to penetrate said web a given distance when the blade is alined with the path of travel of the web and to progressively increase the depth of each blade through the web with corresponding increases in the angularity of the blade effected by said last-mentioned pattern controlled means, means for shifting each carriage in either direction transversely of the web following the formation of any cut in the web by the corresponding blade which extends at an angle of from 5 degrees to 90 degrees relative to the path of travel of the web, and said last-named means being operable to shift each such cutter blade a distance substantially equal to the portion of the web embraced by the cut last formed thereby when measured transversely of the web.

61. Apparatus according to claim 60, in which said shifting means for each carriage comprising a series of increment cams movable in a fixed path parallel to said series, follower means yieldably biased to a position adjacent to one side of the fixed path of each series of increment cams, the increment cams of each series having respective cam surfaces projecting varying distances therefrom toward the plane of said follower means, pattern controlled means for selectively switching said cams in each series into alinement with the corresponding follower means, means for reciprocating each series of increment cams laterally of said fixed path whereby any increment cam alined with a follower means engages and imparts predetermined reciprocatory movement thereto, and means operatively connecting each follower means to the respective carriage for imparting lateral movement to the respective carriage in either direction in accordance with the extent of movement imparted to the follower means by the corresponding increment cam.

62. Apparatus according to claim 61 in which said means operatively connecting each follower means to the respective carriage comprises a bar carried by each carriage and extending transversely relative to said table, and overriding clutch mounted on each bar, a connection between each follower means and the respective clutch whereby each clutch is reciprocated in response to reciprocatory movement of its follower means, pattern controlled means for establishing a first fixed connection between each clutch and the respective bar for transmitting lateral movement to the respective carriage in one direction but not in the other direction, and pattern controlled means for establishing a second connection between each clutch and its bar for transmitting movement from the respective clutch to its carriage in said other direction but not in said one direction.

63. Apparatus according to claim 61, in which said means operatively connecting each follower means to said carriage comprises a bar carried by each carriage and extending transversely relative to said table, an overriding clutch mounted on each bar, a connection between each follower means and the respective clutch whereby each clutch is reciprocated in response to reciprocatory movement of its follower means, electrically operable means for establishing a first fixed connection between each clutch and the respective bar for transmitting lateral movement to the respective carriage in one direction but not in the other direction, electrically operable means for establishing a second connection between each clutch and its bar for transmitting movement from the respective clutch to its carriage in said other direction but not in said one direction, a driven pattern mechanism switch means interposed in an electrical circuit to each of said electrically operable means, and means under control of said pattern mechanism for operating said switch means.

64. A method of forming contoured lines of cut in a web utilizing a plurality of substantially right-triangularly-shaped contour cutter blades having a hypotenuse edge and a perpendicular edge defining a pointed end, said method comprising the steps of advancing the web in a substantially horizontal and straight path in a step-by-step manner with the steps being of equal length, inserting the pointed ends of selected cutter blades downwardly through the web between certain successive steps in advancement of the web to form a cut in the web with each cutter blade, withdrawing the selected cutter blades upwardly out of the web, then shifting selected cutter blades transversely of the web following the formation of any cuts in the web by the blades which extend at an acute angle to the path of travel of the web a distance equal to the portion of the web embraced by the cut last formed thereby when measured transversely of the web while turning selected blades each about an axis substantially alined with the perpendicular edge of each selected blade to various acute angles with respect to the path of travel of the web and while advancing the web another step in its advancement, varying the depth of penetration of each blade into the web such that the length of the cut formed thereby when measured parallel to the path of travel of the web embraces a portion of the web equal to the distance the web is advanced in each step of advancement, and repeating the steps substantially as described to form a series of conjoined cuts in the web with each cutter blade.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,184,158 May 18, 1965

Franciscus H. J. Beeren et al.

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 10, line 67, strike out "each", second occurrence; column 14, line 67, for "aaginst" read -- against --; column 17, line 51, for "contuor" read -- contour --; column 27, line 70, for "wtih" read -- with --; column 39, line 40, for "heretoforce" read -- heretofore --; column 47, line 47, for "a", first occurrence, read -- at --; column 49, line 50, for "ofter" read -- after --; column 50, line 52, for "wheeel" read -- wheel --; column 60, line 28, after "substantially" insert -- triangularly-shaped, --; column 65, line 52, for "yielding" read -- yieldable --; column 66, line 50, for "penetraitng" read -- penetrating --; column 67, line 14, for "clock" read - block --; line 67, strike out "in", first occurrence.

Signed and sealed this 16th day of November 1965.

SEAL)
ttest:

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