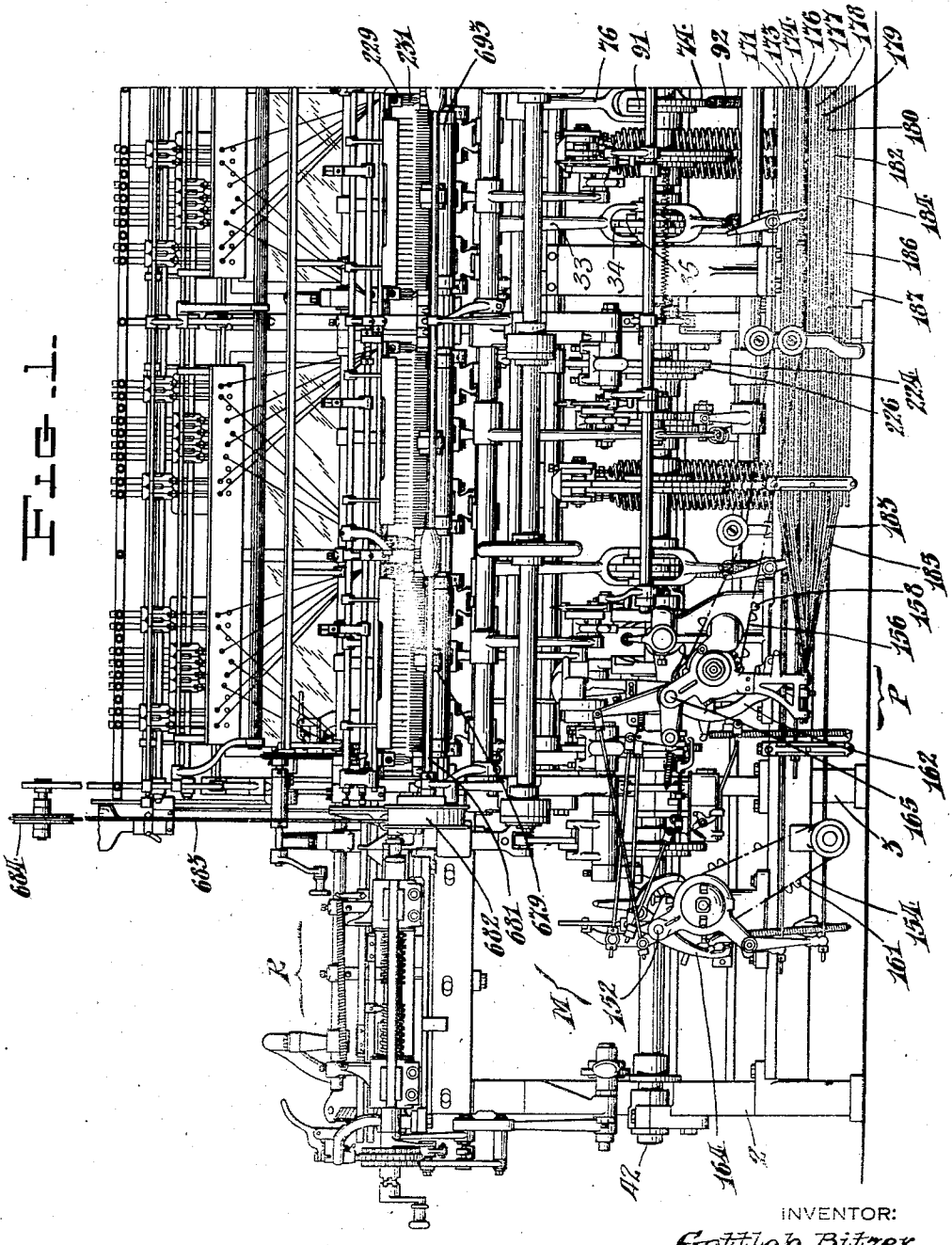
Dec. 31, 1946. G. BITZER 2,413,601

AUTOMATICALLY PERFORMING WELTING OPERATIONS

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Fig. 1.



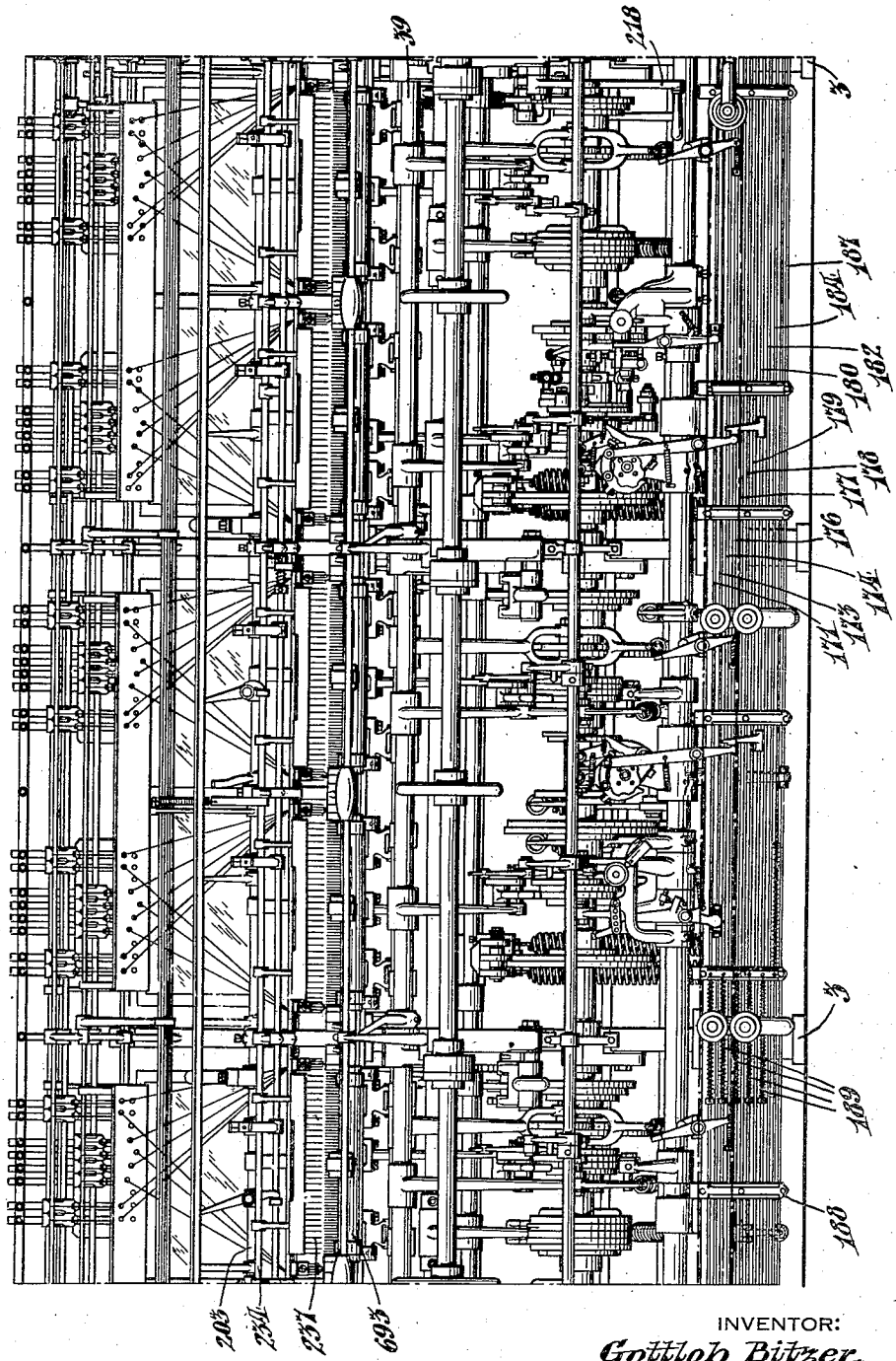
INVENTOR:
Gottlob Bitzer,
BY Fred E. Ackingers
ATTORNEY.

Dec. 31, 1946. G. BITZER 2,413,601

AUTOMATICALLY PERFORMING WELTING OPERATIONS

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Fig. 2.



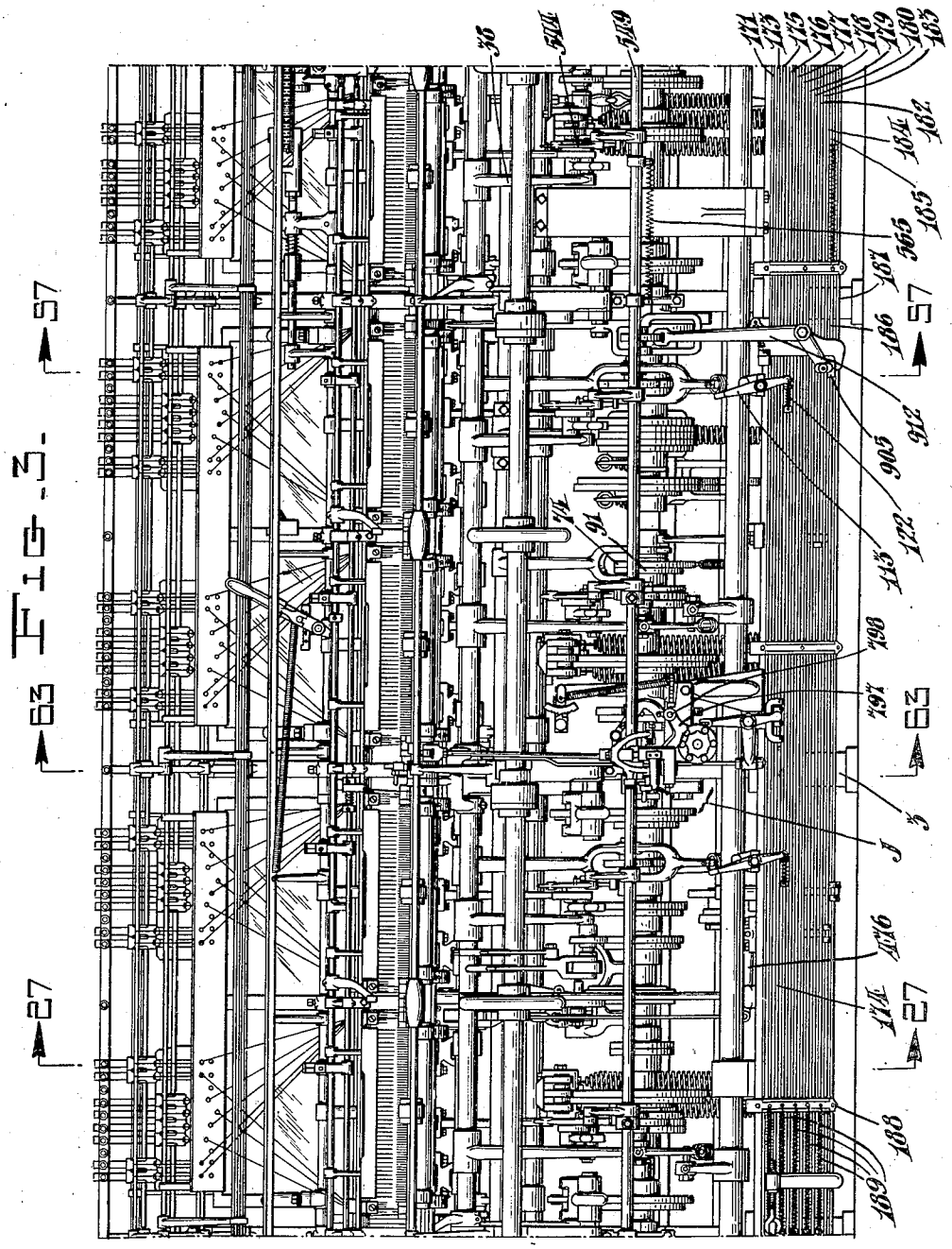
INVENTOR:
Gottlob Bitzer,
BY Alfred E. Ischinger
ATTORNEY.

Dec. 31, 1946. G. BITZER 2,413,601

AUTOMATICALLY PERFORMING WELTING OPERATIONS

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FIG. 3.

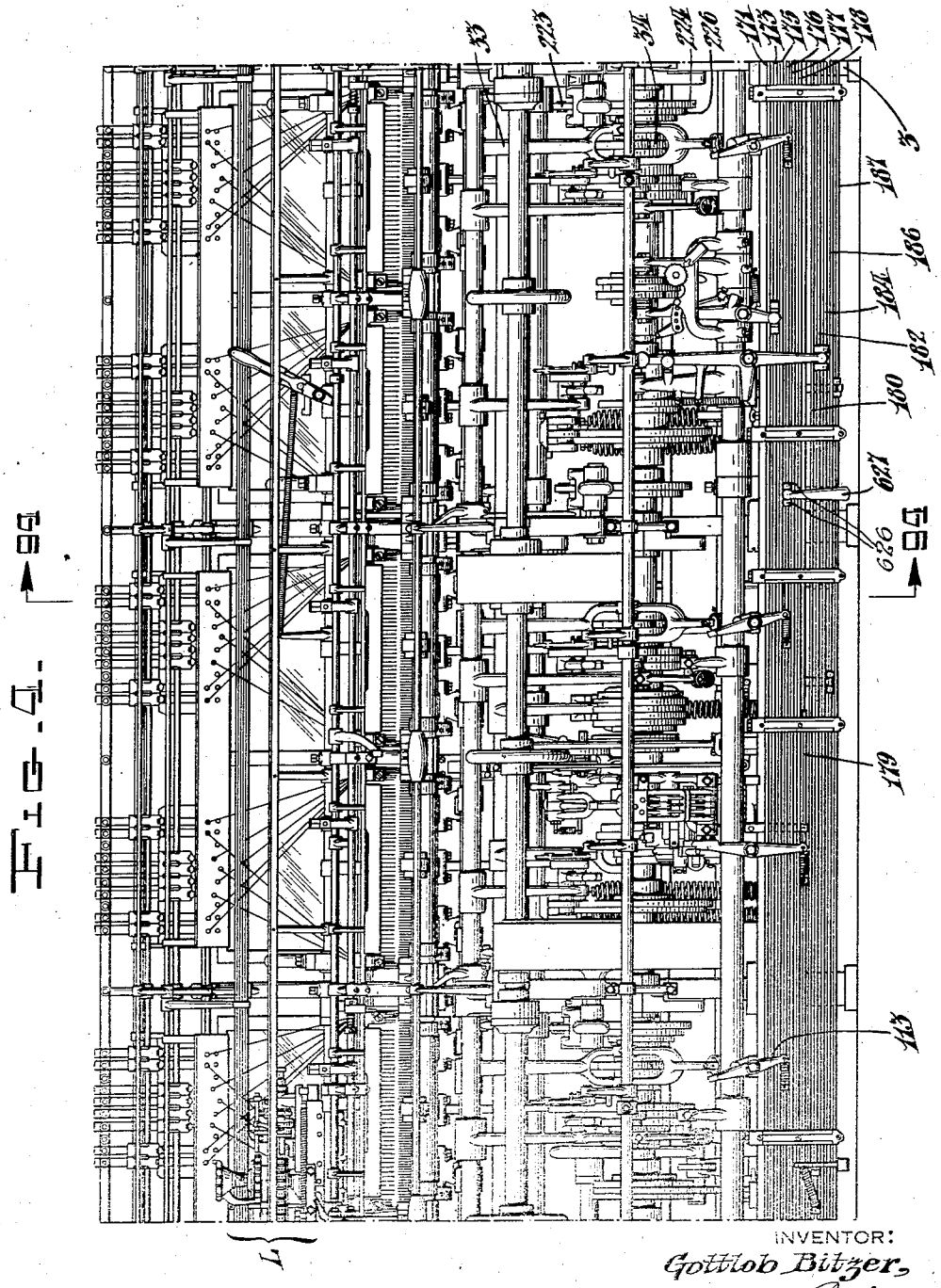


INVENTOR:
Gottlob Bitzer,
BY Fred E. Eschinger
ATTORNEY.

Dec. 31, 1946. G. BITZER 2,413,601

AUTOMATICALLY PERFORMING WELTING OPERATIONS

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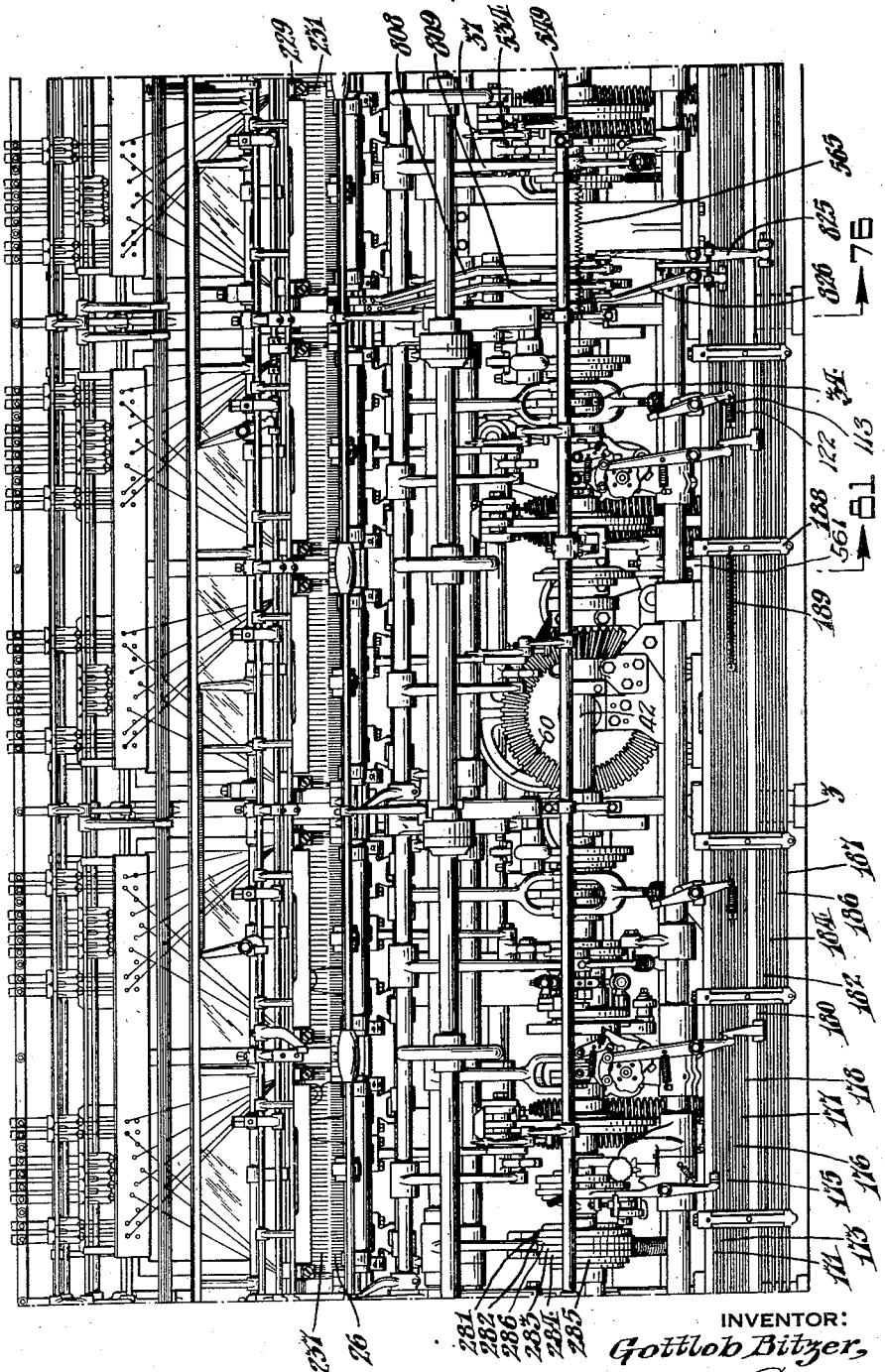
INVENTOR:
Gottlob Bitzer,
BY Fred E. Dechinger.
ATTORNEY.

Dec. 31, 1946. G. BITZER 2,413,601

AUTOMATICALLY PERFORMING WELTING OPERATIONS

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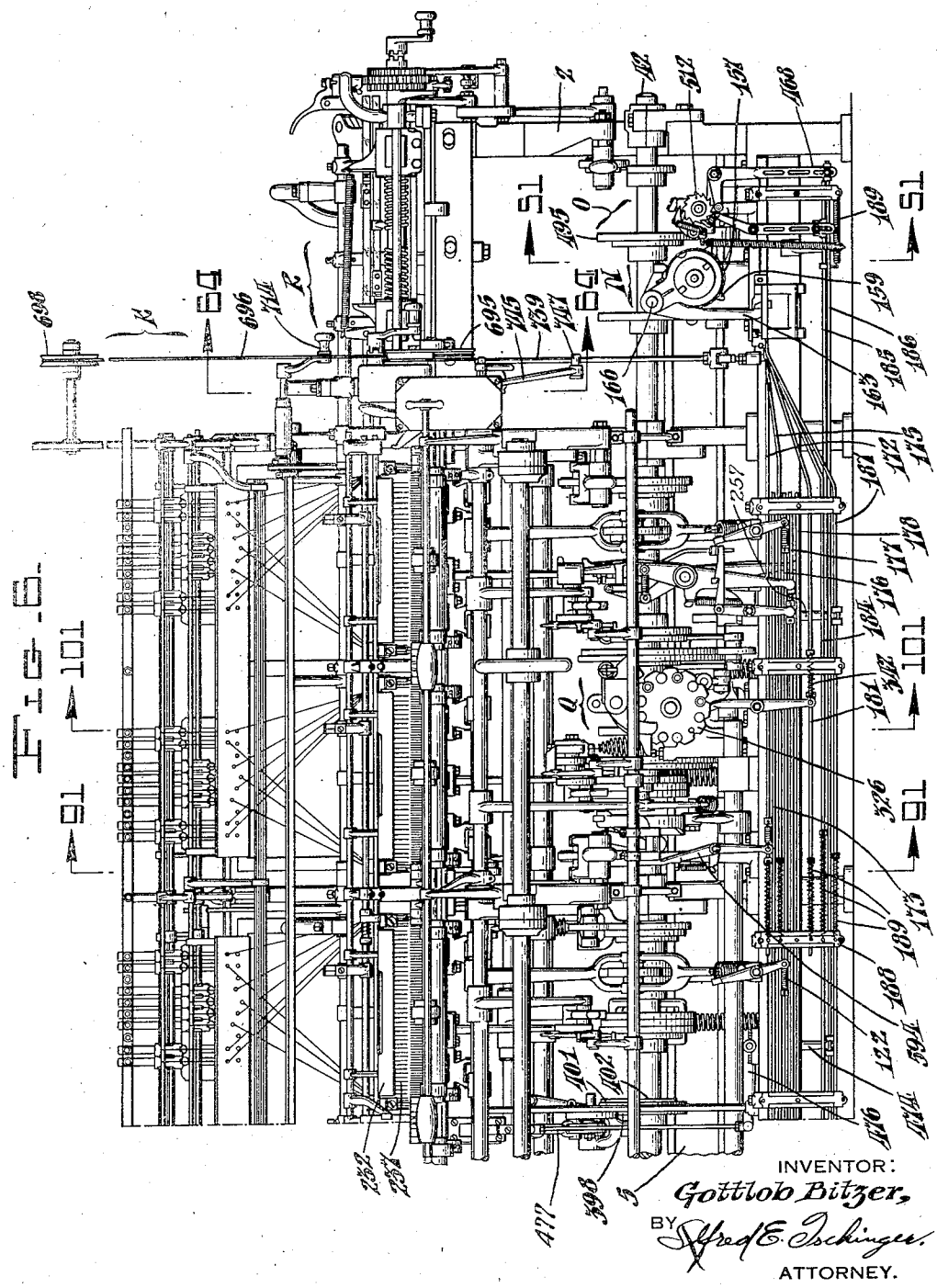
Fig. 5.



Dec. 31, 1946. G. BITZER 2,413,601

AUTOMATICALLY PERFORMING WELTING OPERATIONS

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Dec. 31, 1946. G. BITZER 2,413,601

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FIG. 7.

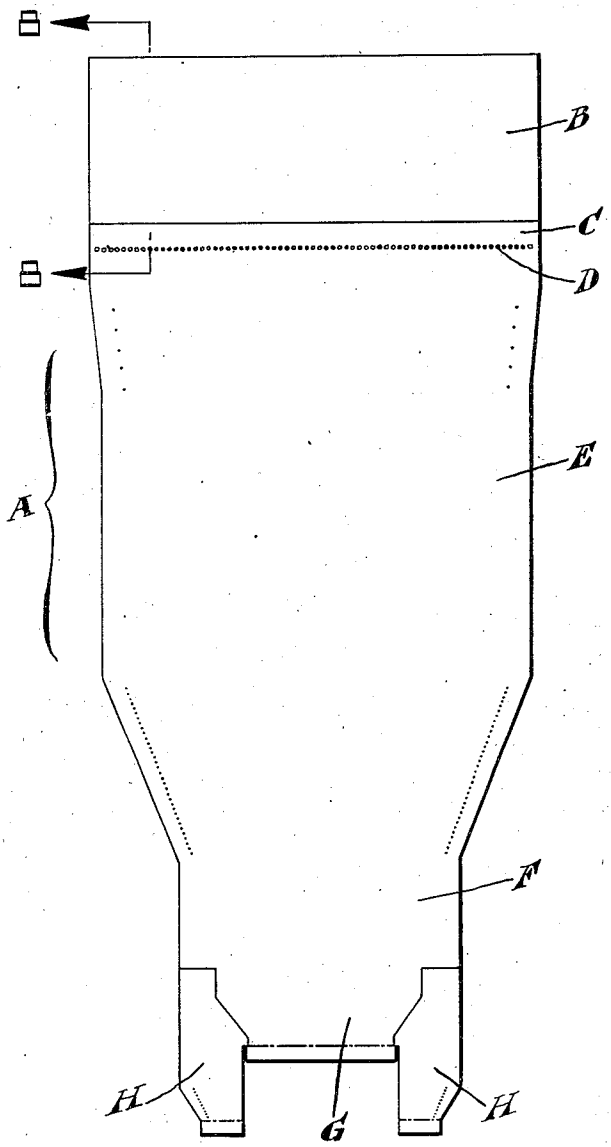
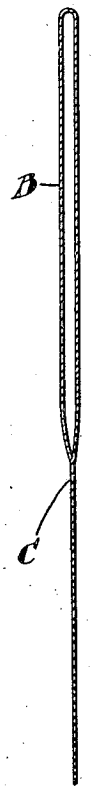


FIG. 8.



INVENTOR:
Gottlob Bitzer,
BY Fred E. Jackinger
ATTORNEY.

Dec. 31, 1946. G. BITZER 2,413,601

AUTOMATICALLY PERFORMING WELTING OPERATIONS

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FIG. 9.

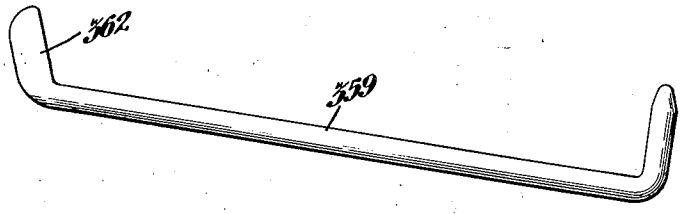


FIG. 10.

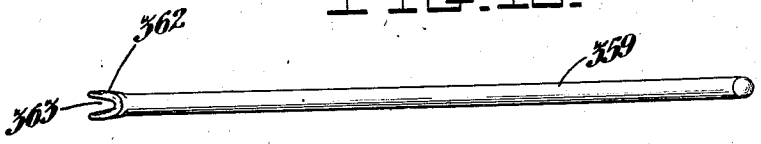


FIG. 11.



FIG. 12.



INVENTOR:
Gottlob Bitzer,
BY Alfred E. Bachinger
ATTORNEY.

Dec. 31, 1946. G. BITZER 2,413,601

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Fig. 13.

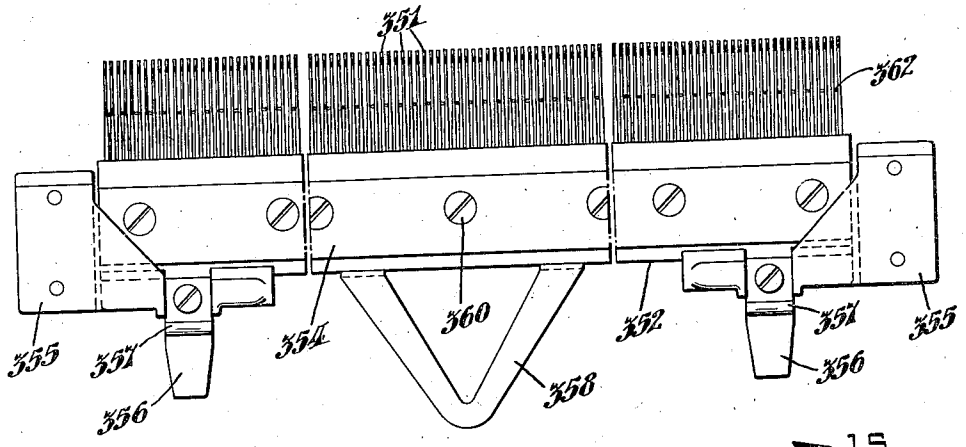


Fig. 14.

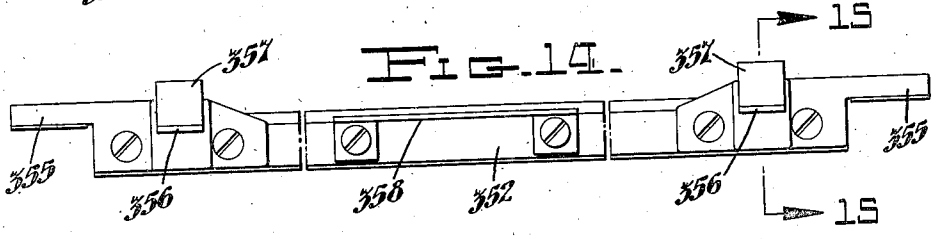


Fig. 15.

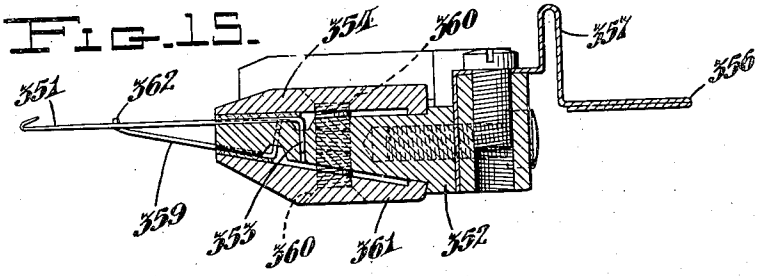
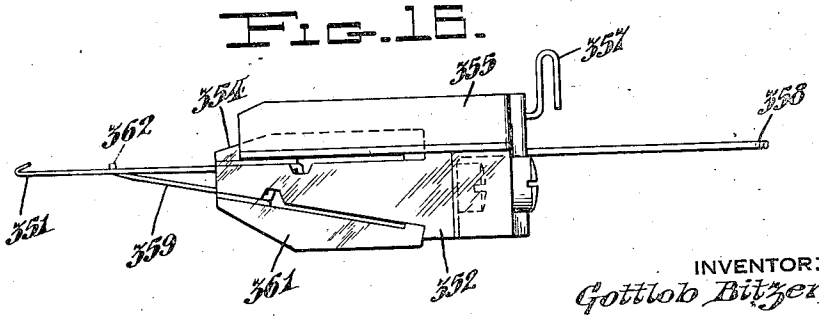


Fig. 16.



INVENTOR:
Gottlob Bitzer,
BY Jacob E. Ishinger
ATTORNEY.

Dec. 31, 1946. G. BITZER 2,413,601

AUTOMATICALLY PERFORMING WELTING OPERATIONS

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FIG. 17.

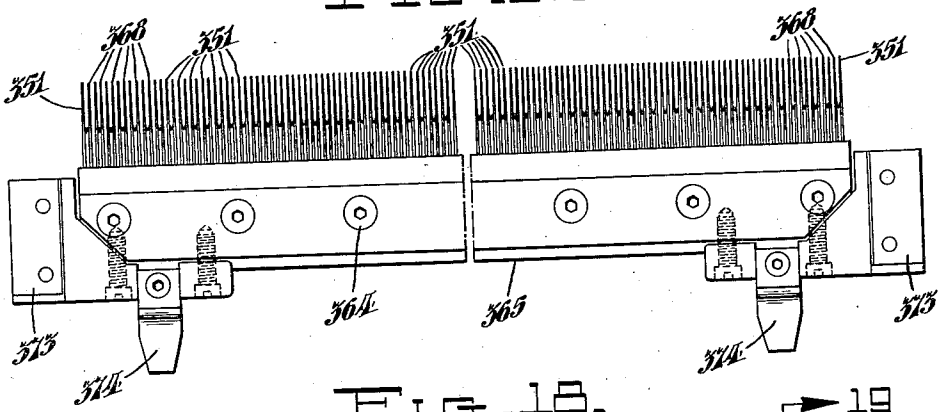


FIG. 18.

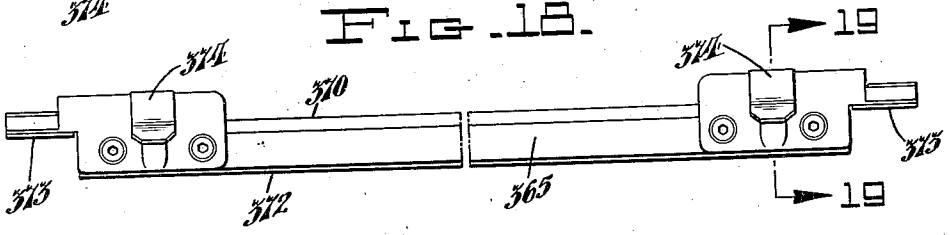


FIG. 19.

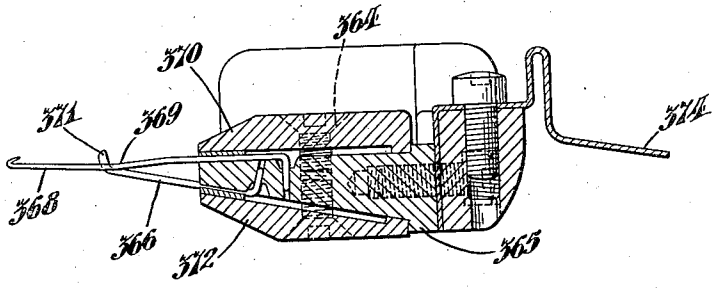
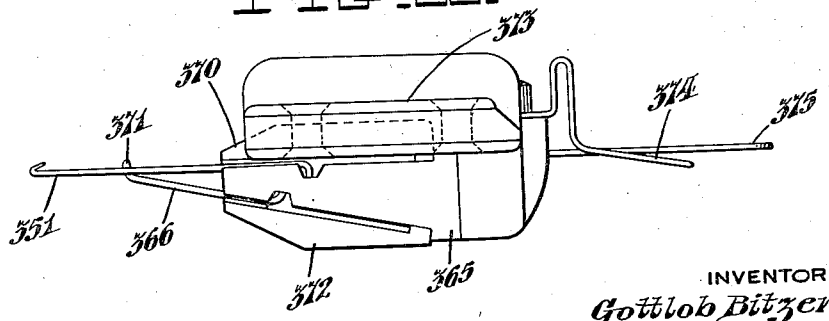


FIG. 20.



INVENTOR:
Gottlob Bitzer,
BY Fred E. Eschinger,
ATTORNEY.

Dec. 31, 1946. G. BITZER 2,413,601

AUTOMATICALLY PERFORMING WELTING OPERATIONS

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FIG. 21.

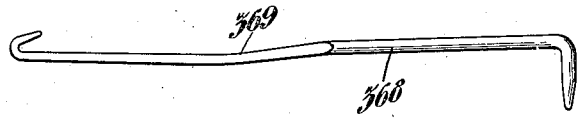


FIG. 22.

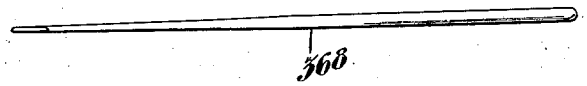


FIG. 24.

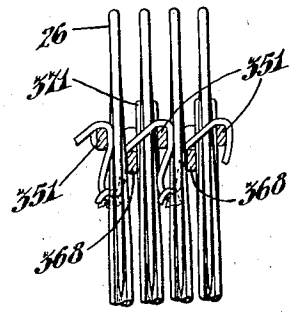


FIG. 23.

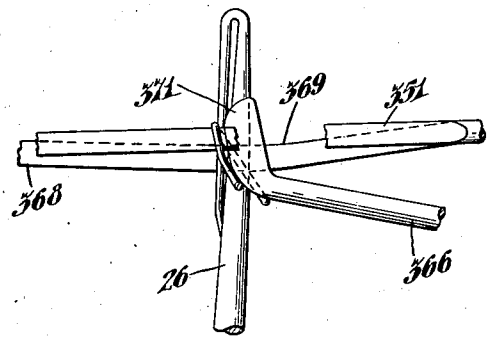


FIG. 25.

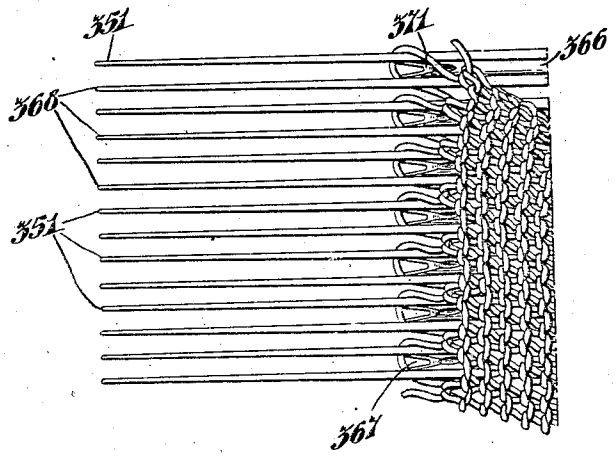
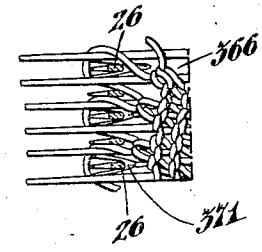


FIG. 26.



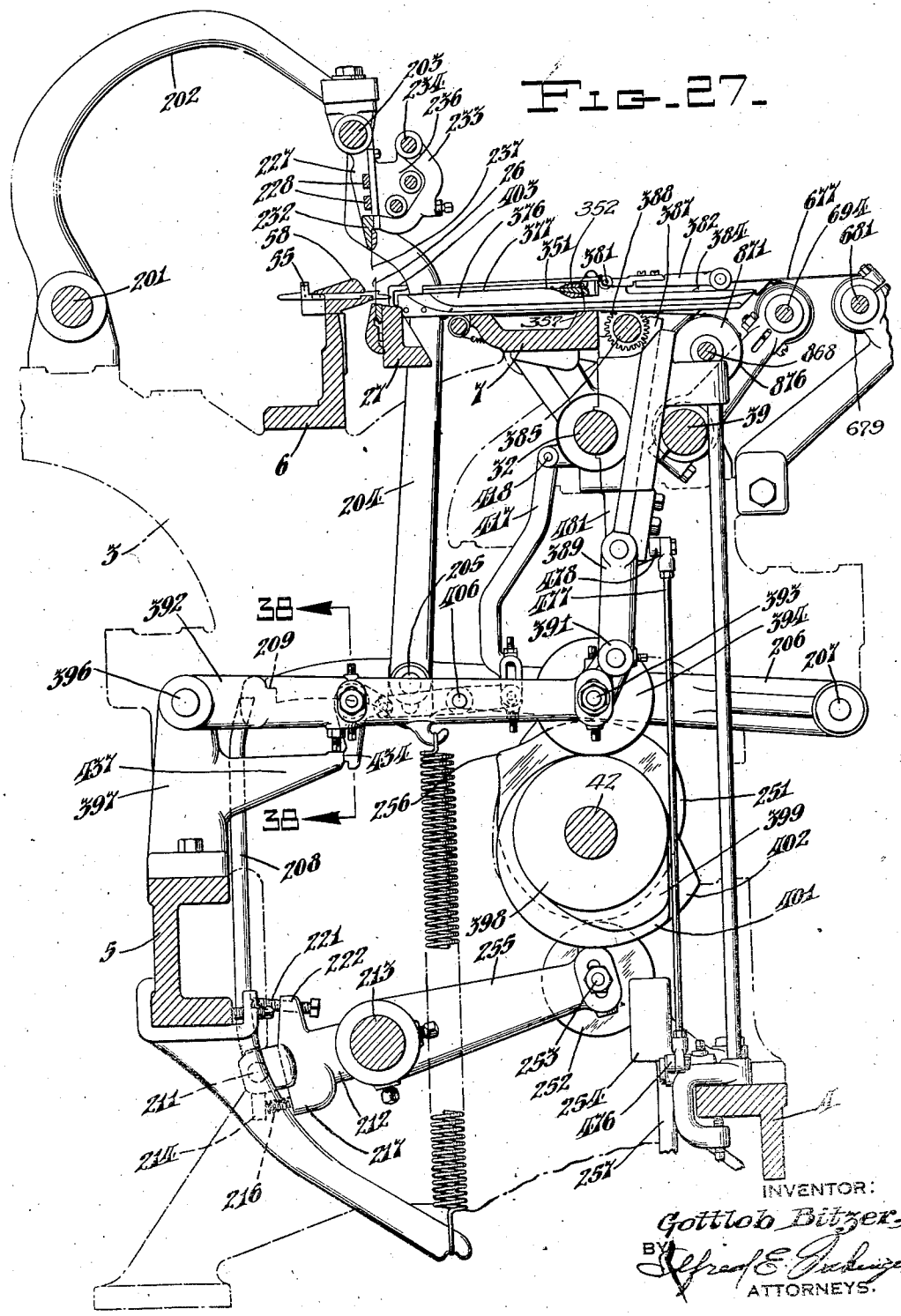
INVENTOR:
Gottlob Bitzer,
BY Alfred E. Jockinger
ATTORNEY.

Dec. 31, 1946. G. BITZER 2,413,601

AUTOMATICALLY PERFORMING WELTING OPERATIONS

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Fig. 27.



INVENTOR:
Gottlob Bitzer
BY Alfred E. Jackson
ATTORNEYS.

Dec. 31, 1946. G. BITZER 2,413,601

AUTOMATICALLY PERFORMING WELTING OPERATIONS

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FIG-28-

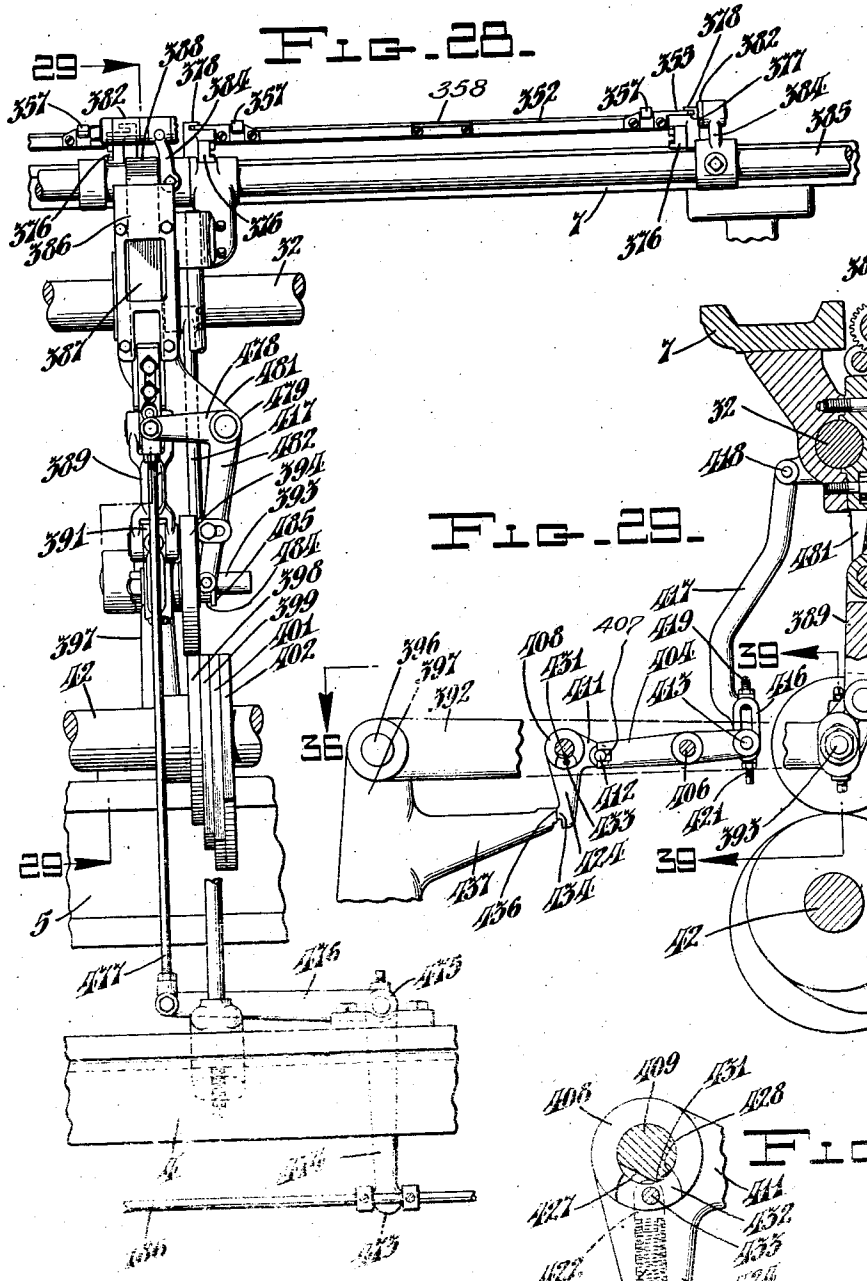
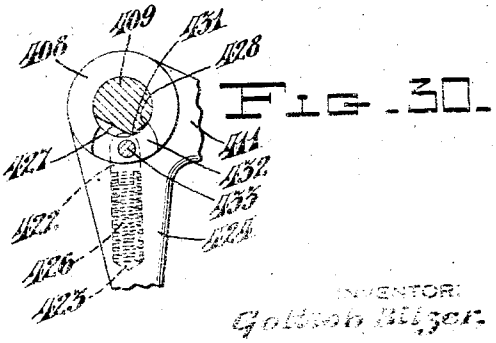


FIG-29-

FIG-30-



INVENTOR:
Gottlob Bitzer.
BY
ATTORNEY.

Dec. 31, 1946. G. BITZER 2,413,601

AUTOMATICALLY PERFORMING WELTING OPERATIONS

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FIG. 31.

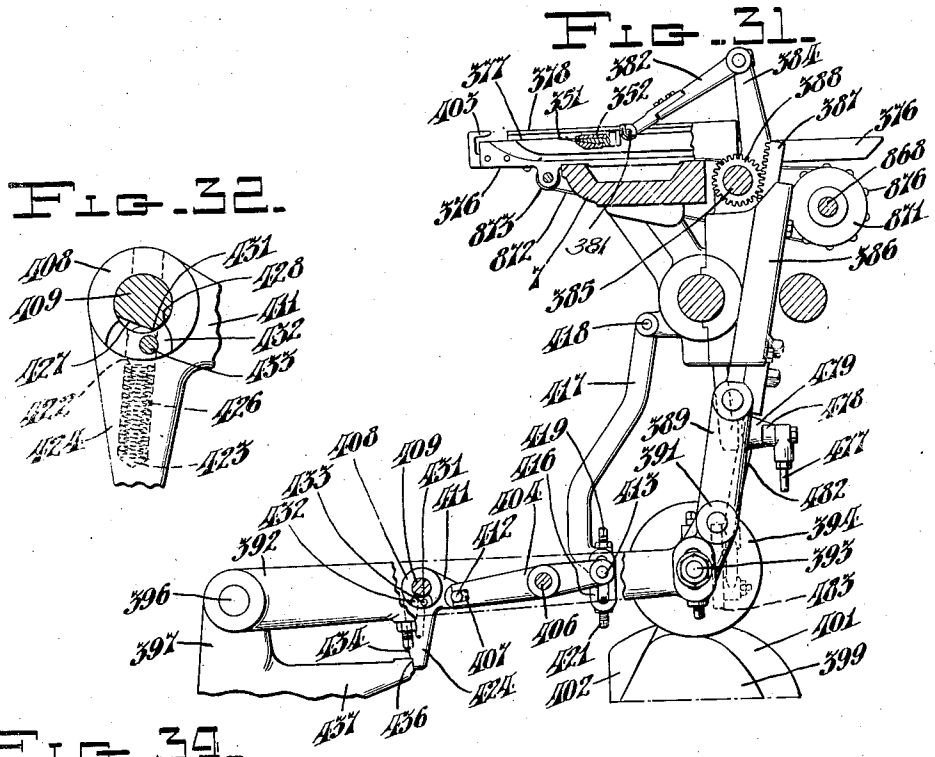


FIG. 32.

FIG. 33.

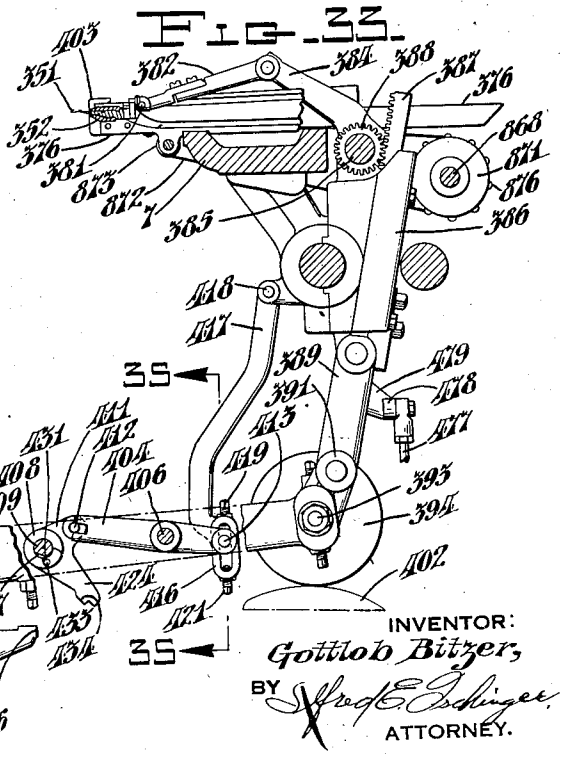


FIG. 34.

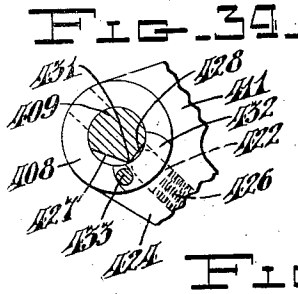
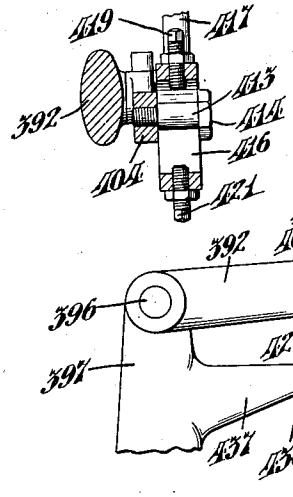


FIG. 35.



INVENTOR:
Gottlob Bitzer,
BY Fred E. Schlinger
ATTORNEY.

Dec. 31, 1946. G. BITZER 2,413,601

AUTOMATICALLY PERFORMING WELTING OPERATIONS

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FIG-36-

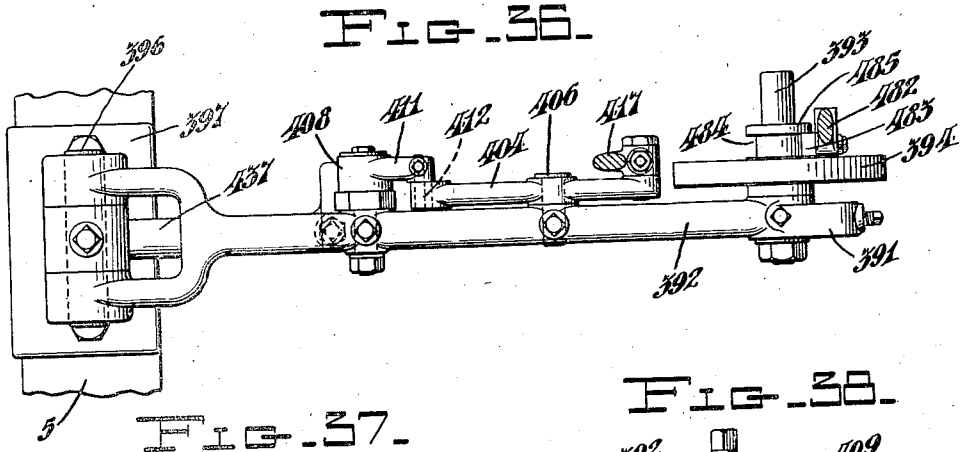


FIG-37-

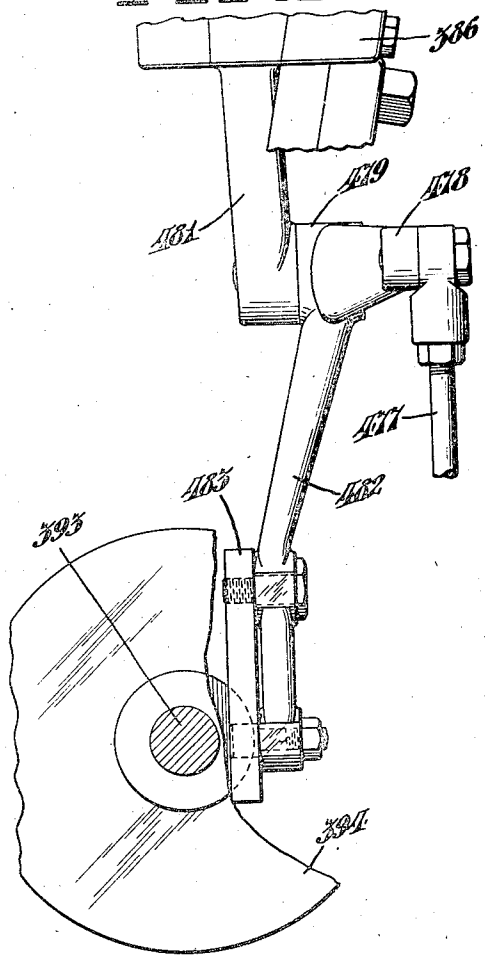


FIG-38-

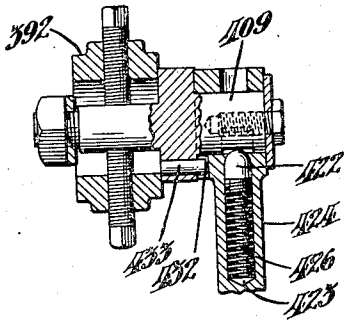
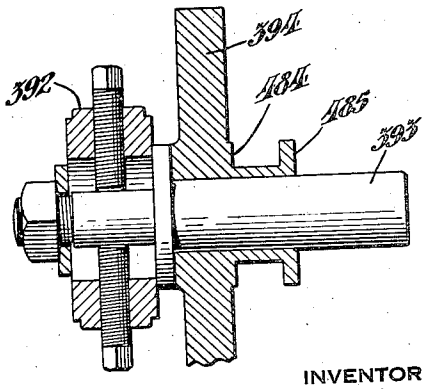


FIG-39-



INVENTOR:
Gottlob Bitzer,
BY Alfred E. Tschinger,
ATTORNEY.

Dec. 31, 1946. G. BITZER 2,413,601

AUTOMATICALLY PERFORMING WELTING OPERATIONS

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Fig. 90.

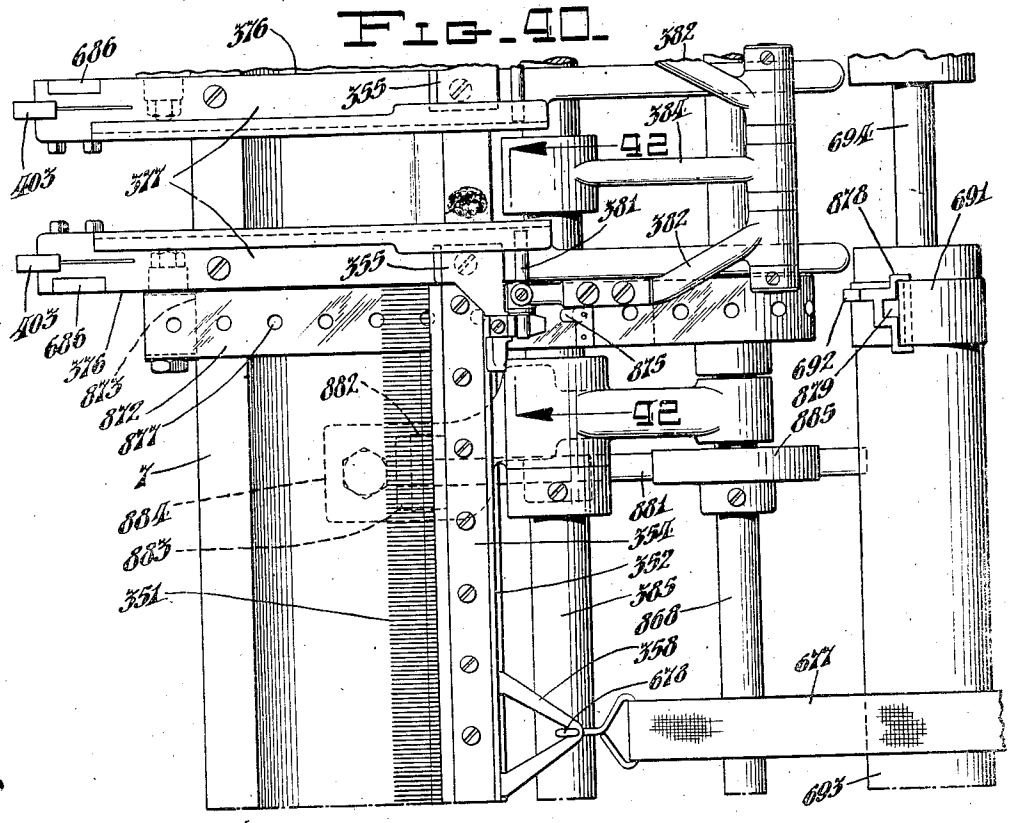


Fig. 91.

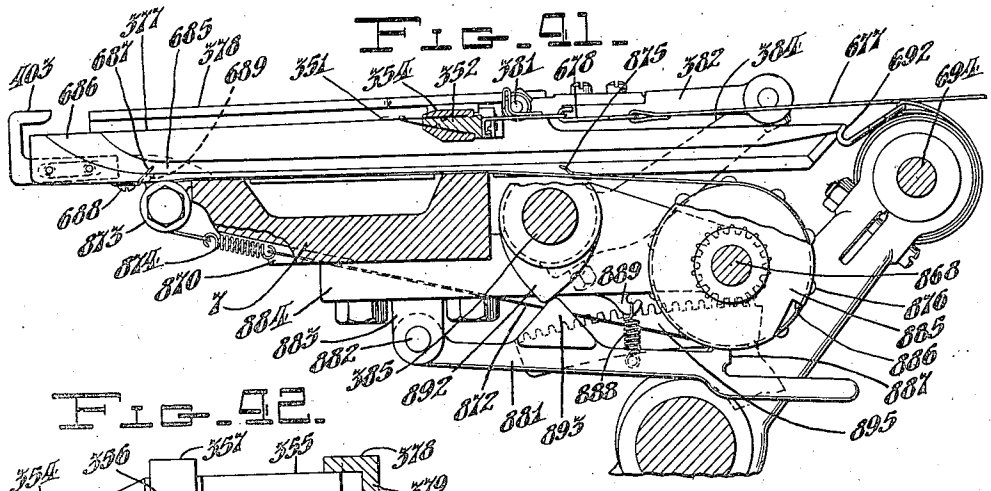
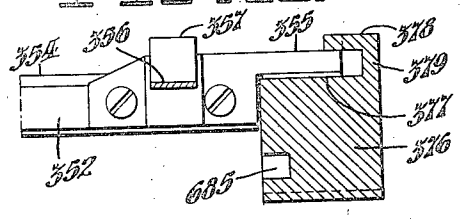


Fig. 92.



INVENTOR:
Gottlob Bitzer,
BY Alfred E. Jenkins
ATTORNEY.

Dec. 31, 1946. G. BITZER 2,413,601

AUTOMATICALLY PERFORMING WELTING OPERATIONS

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Fig. 93.

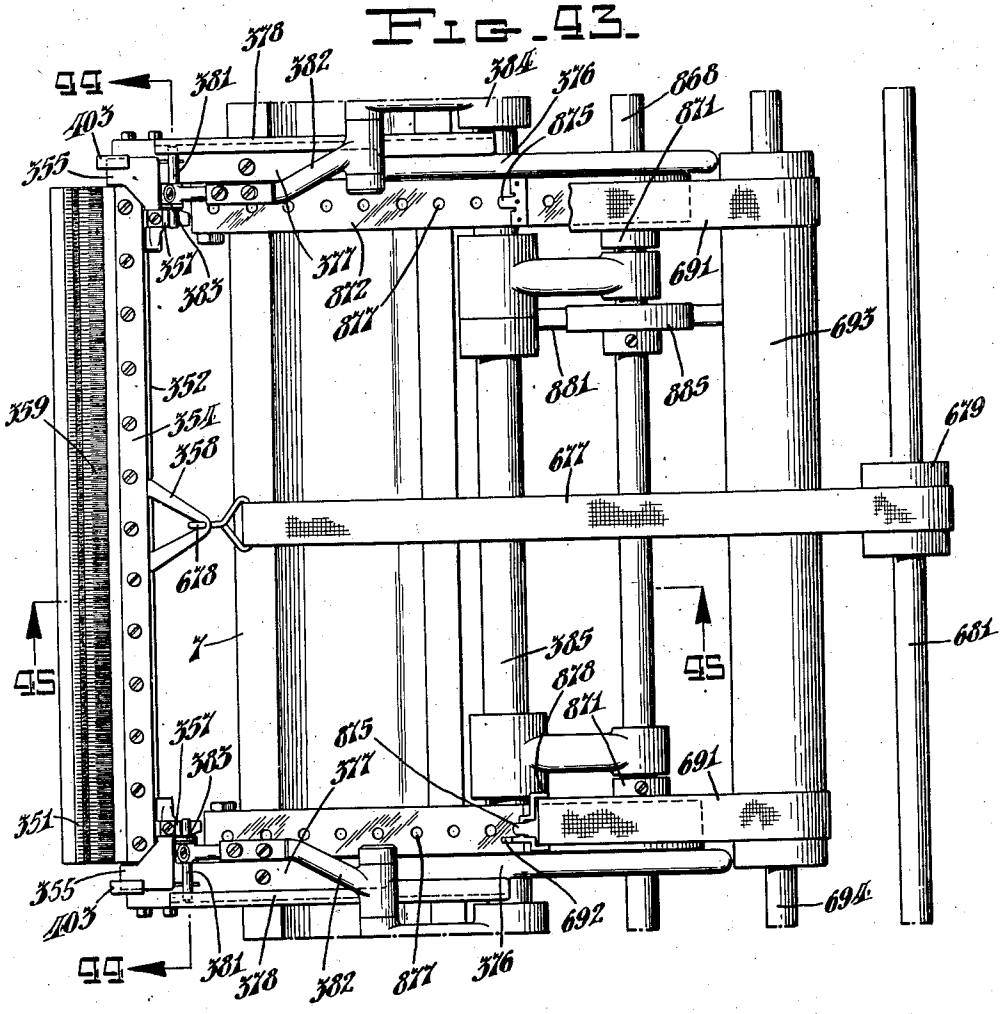
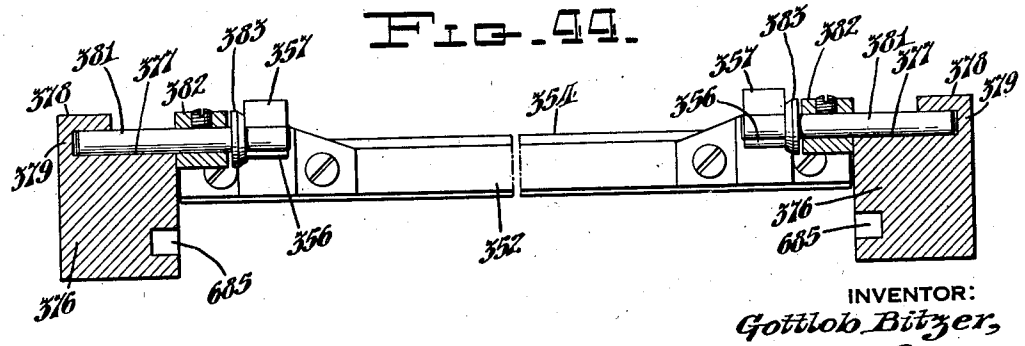


Fig. 94.



INVENTOR:
Gottlob Bitzer,
BY Alfred E. Jackinger,
ATTORNEY.

Dec. 31, 1946. G. BITZER 2,413,601

AUTOMATICALLY PERFORMING WELTING OPERATIONS

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Fig. 95.

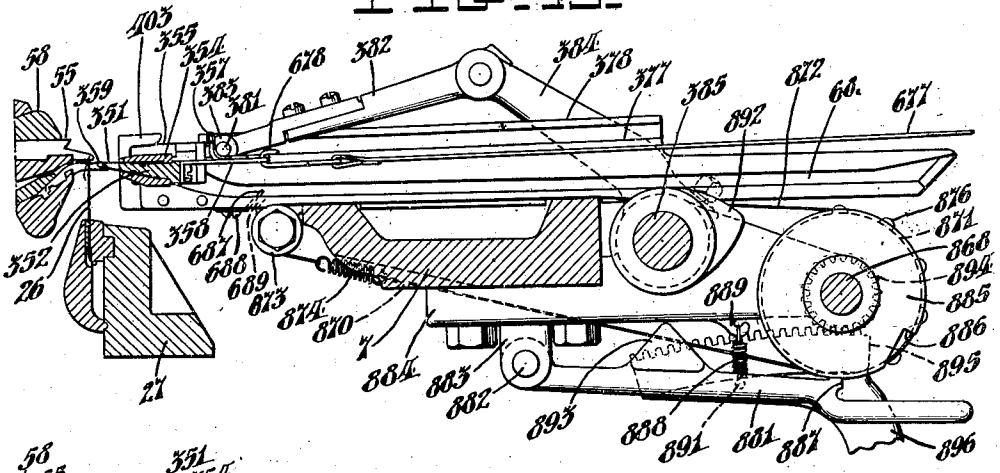


Fig. 96.

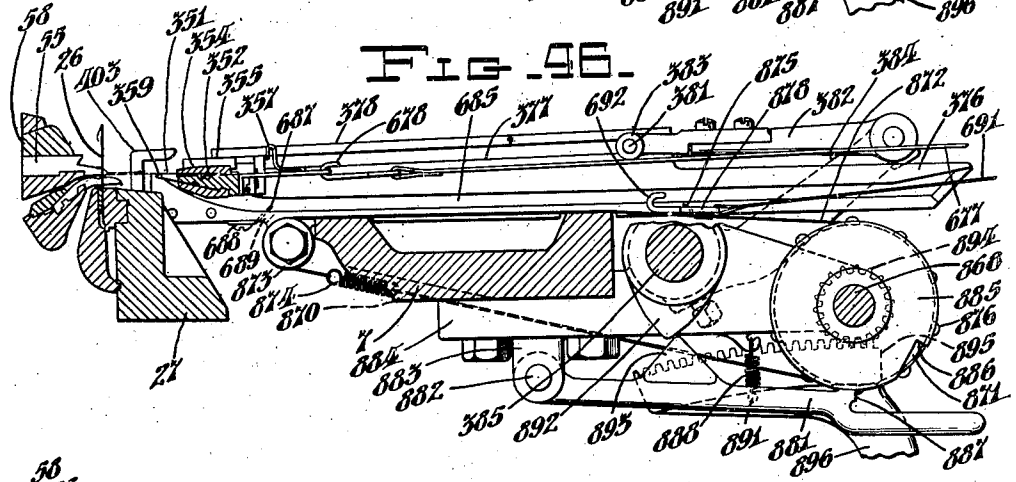
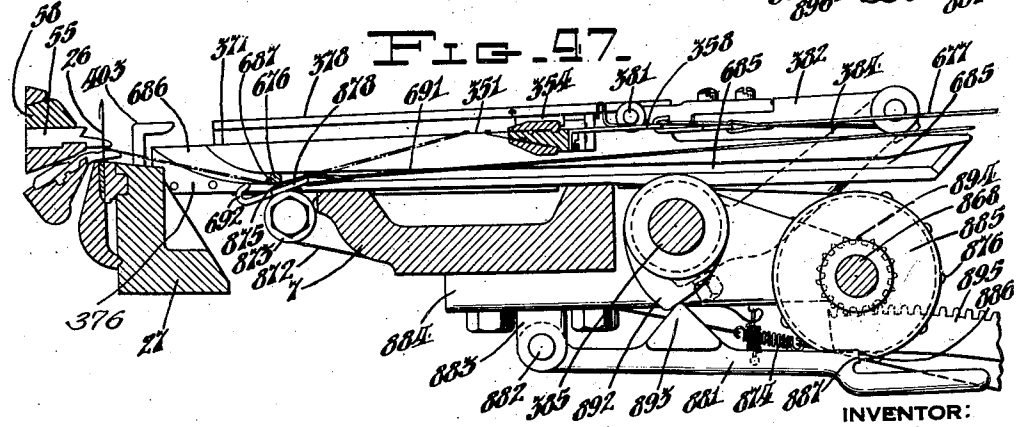


Fig. 97.



INVENTOR:
Gottlob Bitzer,
BY Fred E. Ischinger.
ATTORNEY.

Dec. 31, 1946. G. BITZER 2,413,601

AUTOMATICALLY PERFORMING WELTING OPERATIONS

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FIG-48-

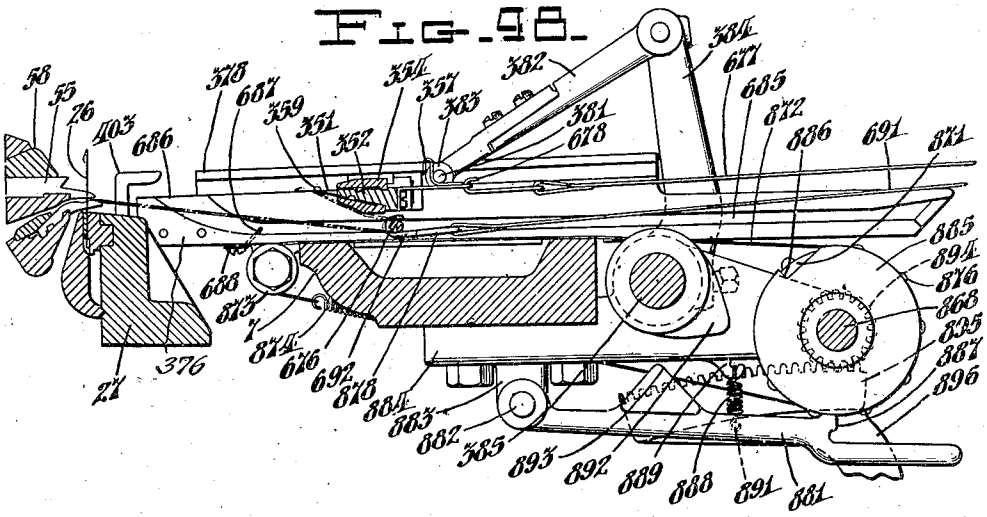


FIG-49-

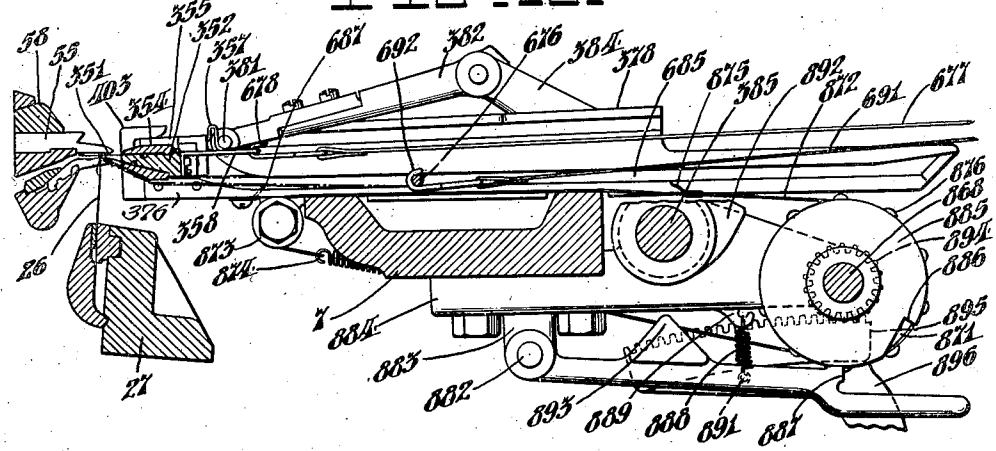
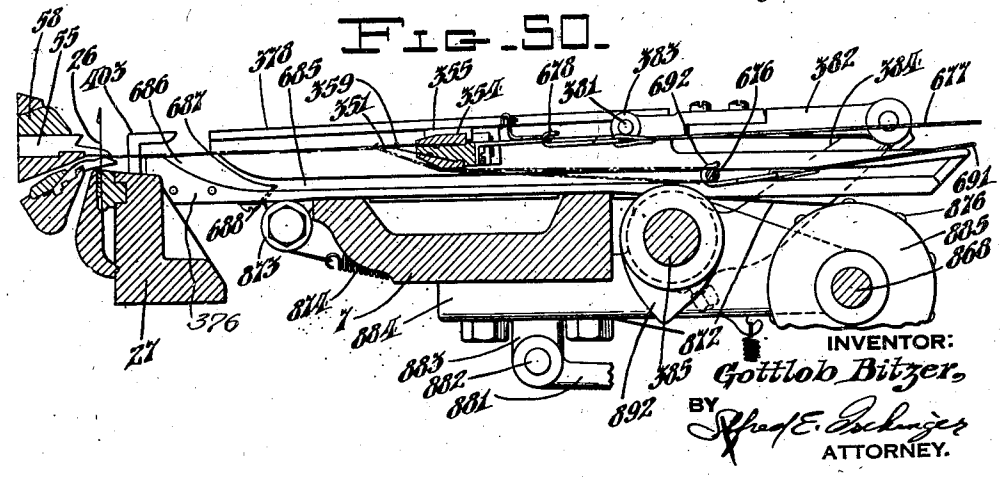


FIG-50-



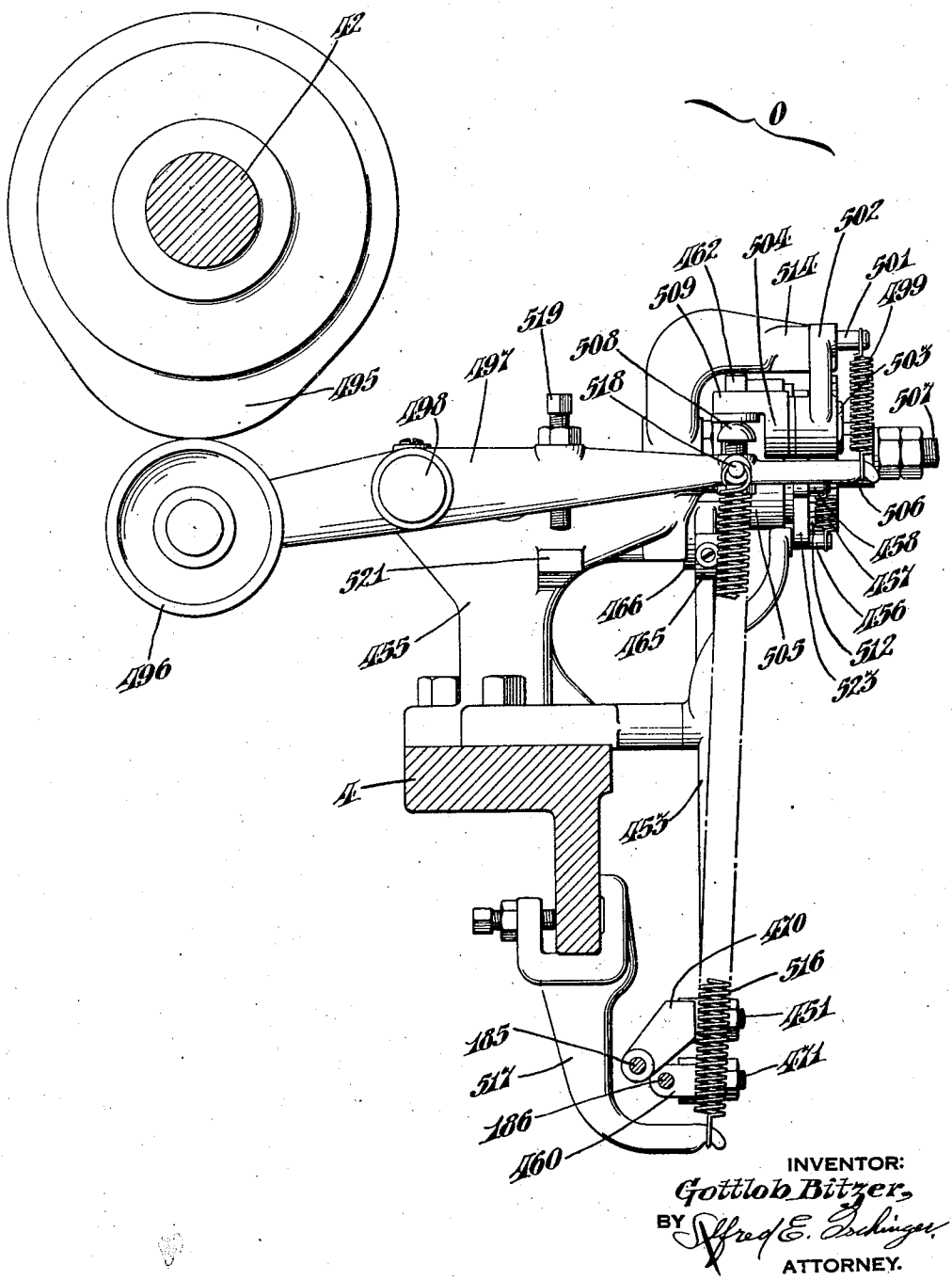
INVENTOR:
Gottlob Bitzer,
BY Chas. E. Buchanan
ATTORNEY.

Dec. 31, 1946. G. BITZER 2,413,601

AUTOMATICALLY PERFORMING WELTING OPERATIONS

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Fig. 81.



INVENTOR:
Gottlob Bitzer,
BY Alfred E. Zschinger,
ATTORNEY.

Dec. 31, 1946. G. BITZER 2,413,601

AUTOMATICALLY PERFORMING WELTING OPERATIONS

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FIG-52-

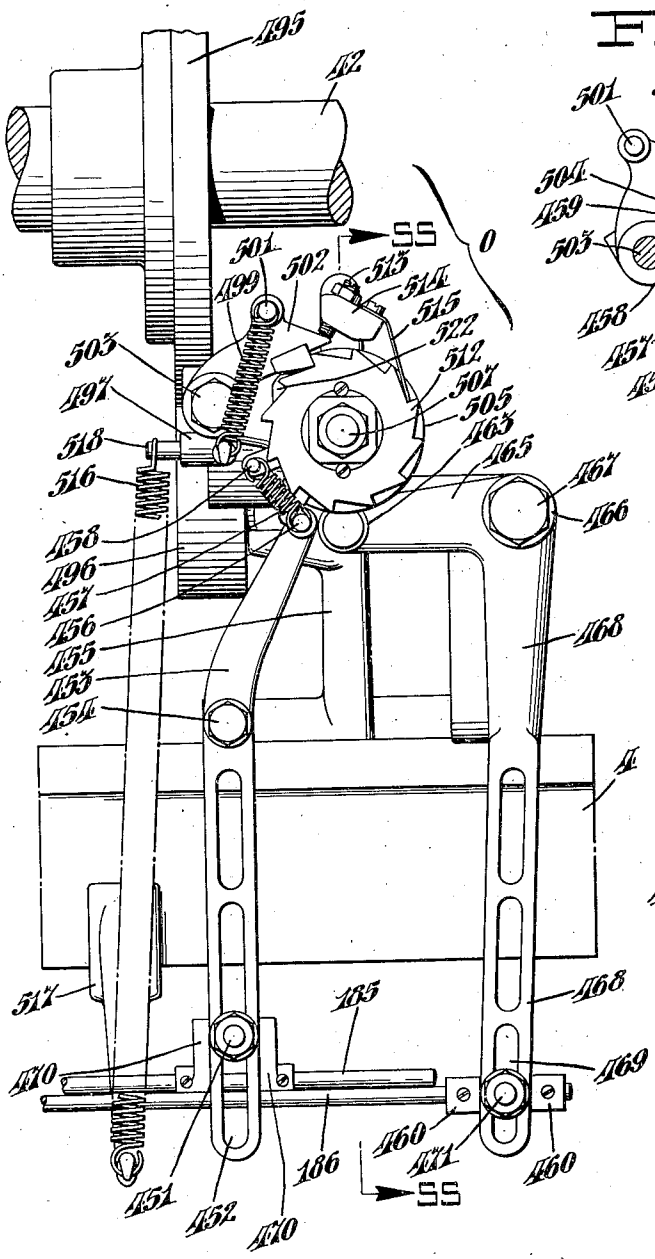


FIG-53-

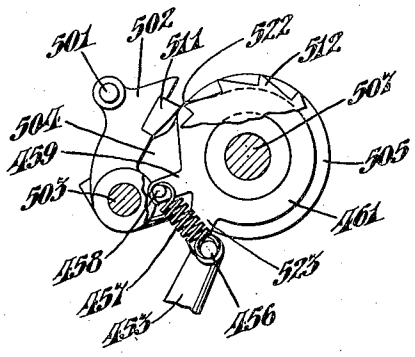
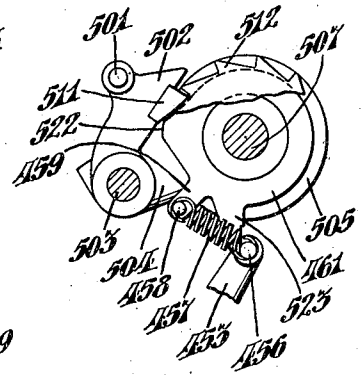


FIG-54-



INVENTOR:
Gottlob Bitzer,
BY Alfred E. Tschinger.
ATTORNEY.

Dec. 31, 1946. G. BITZER 2,413,601

AUTOMATICALLY PERFORMING WELTING OPERATIONS

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Fig. 55.

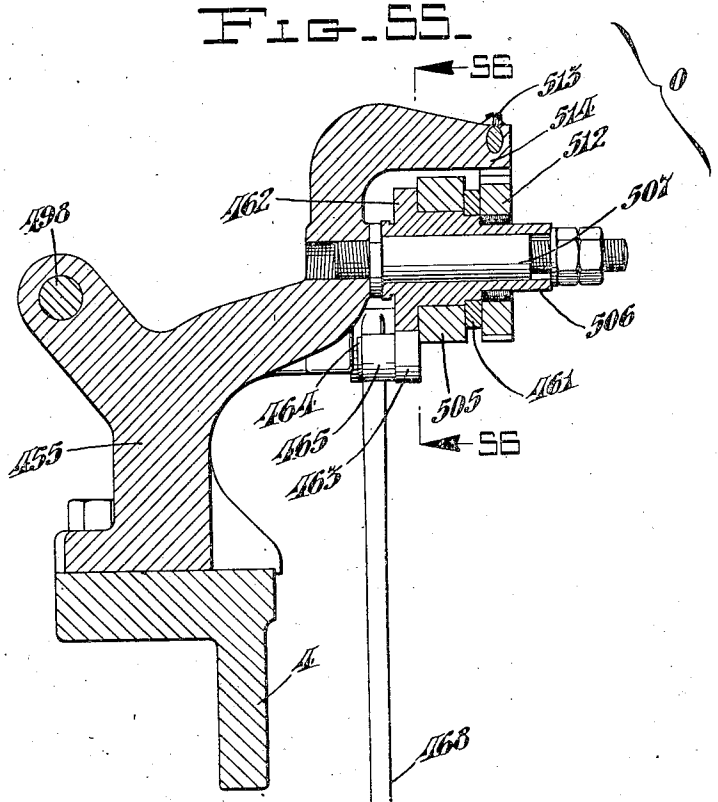
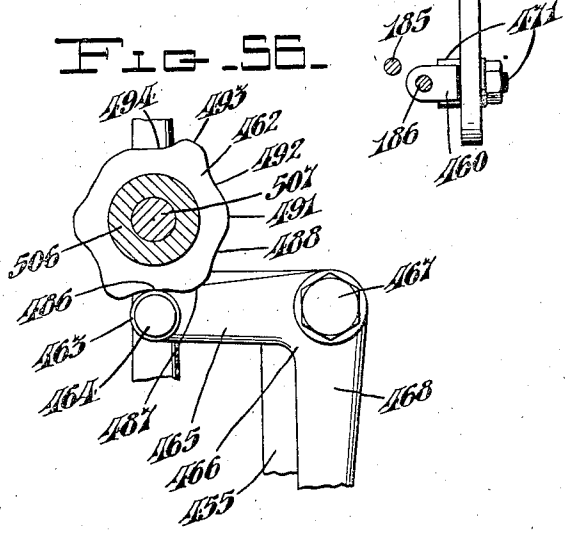


Fig. 56.



INVENTOR:
Gottlob Bitzer,
BY Alfred E. Eschinger,
ATTORNEY.

Dec. 31, 1946. G. BITZER 2,413,601

AUTOMATICALLY PERFORMING WELTING OPERATIONS

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FIG. 57.

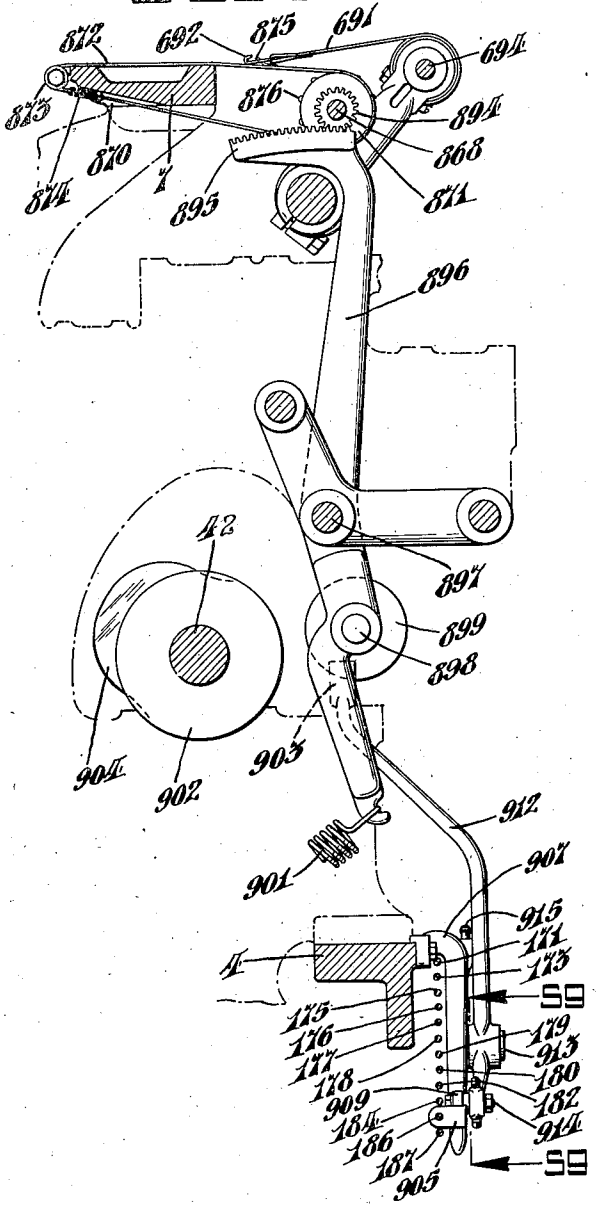


FIG. 58.

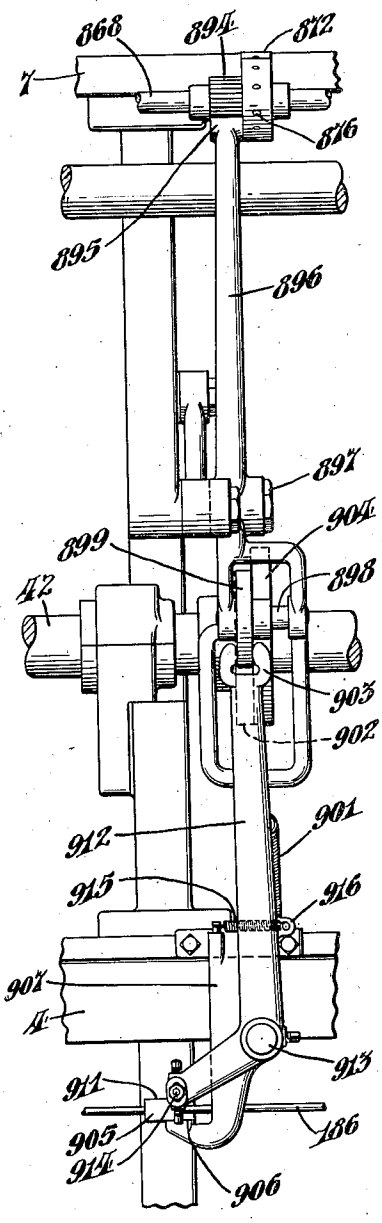
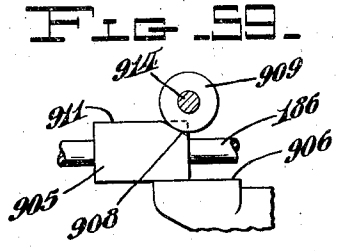


FIG. 59.



INVENTOR:
Gottlob Bitzer,
BY Fred E. Jackinger
ATTORNEY.

Dec. 31, 1946. G. BITZER 2,413,601

AUTOMATICALLY PERFORMING WELTING OPERATIONS

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Fig. 60.

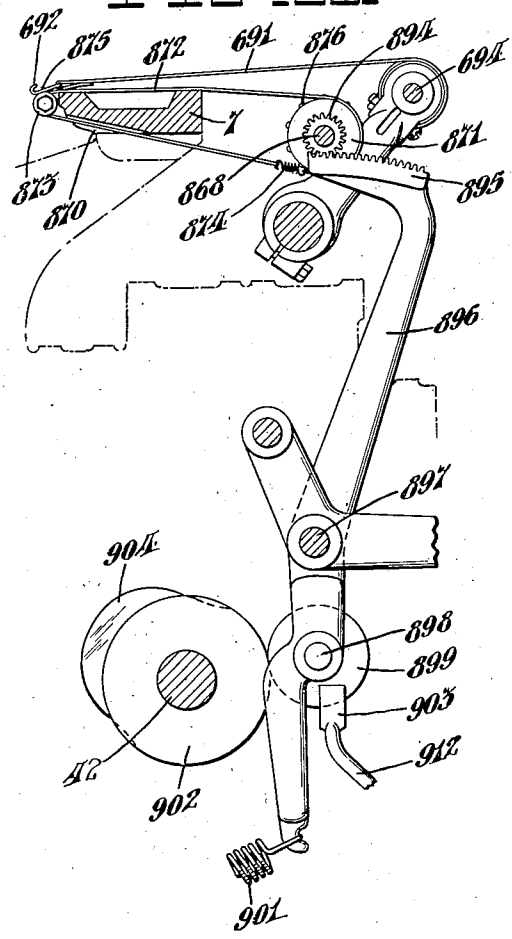


Fig. 61.

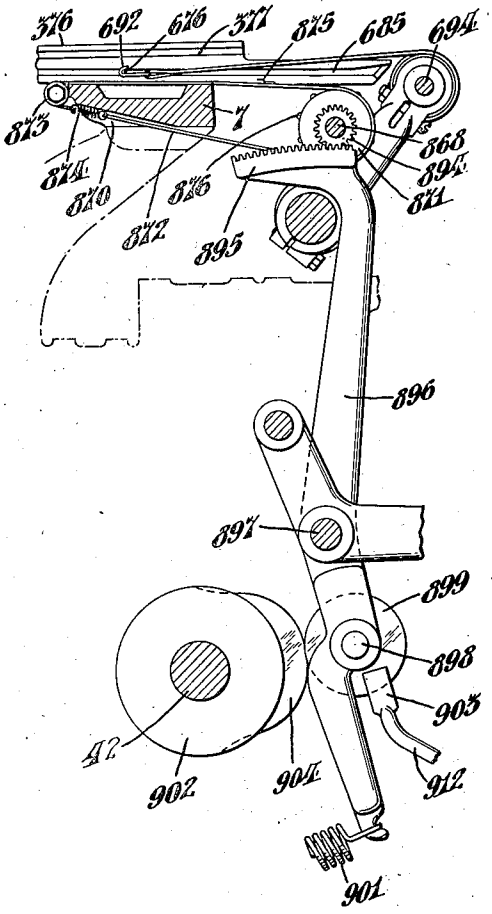
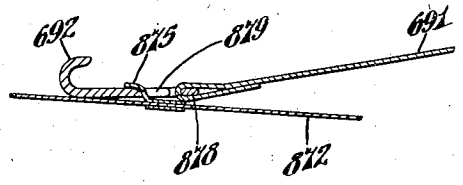


Fig. 62.



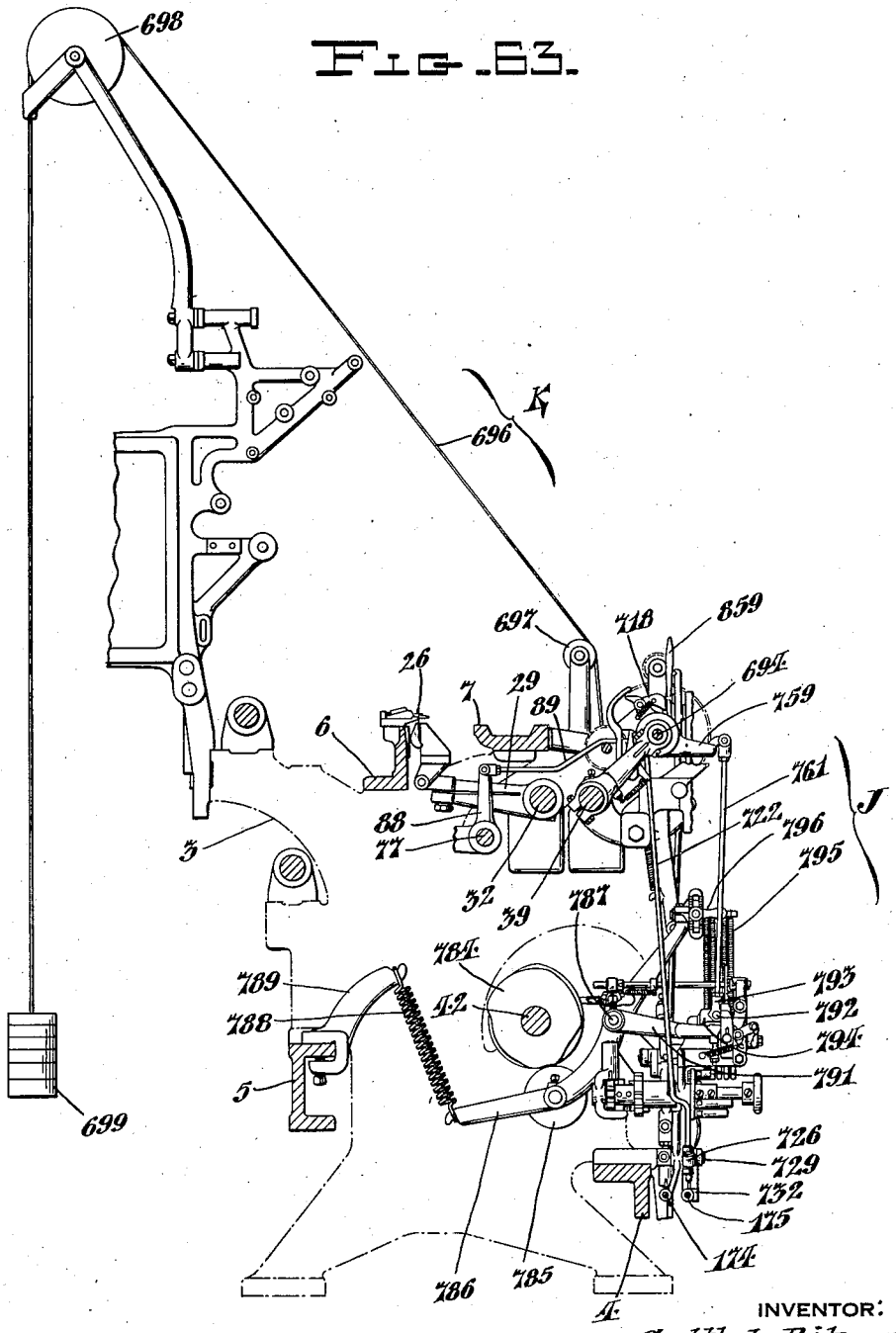
INVENTOR:
Gottlob Bitzer,
BY Alfred E. Jenkins,
ATTORNEY.

Dec. 31, 1946. G. BITZER 2,413,601

AUTOMATICALLY PERFORMING WELTING OPERATIONS

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FIG. 63.



INVENTOR:
Gottlob Bitzer,
BY Alfred E. Dubinger.
ATTORNEY.

Dec. 31, 1946. G. BITZER 2,413,601

AUTOMATICALLY PERFORMING WELTING OPERATIONS

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FIG. 64.

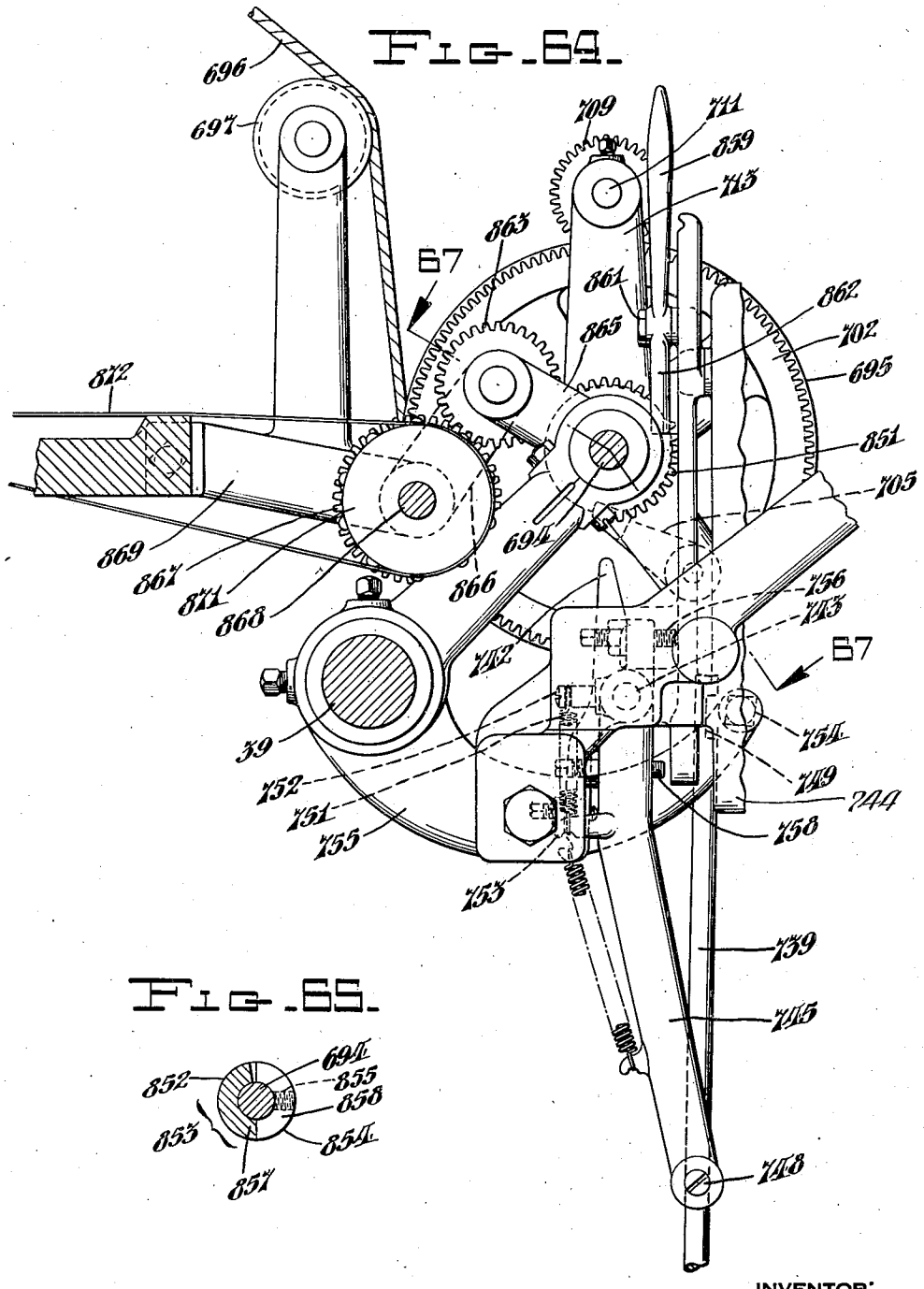


FIG. 65.

INVENTOR:
Gottlob Bitzer,
BY Alfred E. Ischinger
ATTORNEY.

Dec. 31, 1946. G. BITZER 2,413,601

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FIG-66-

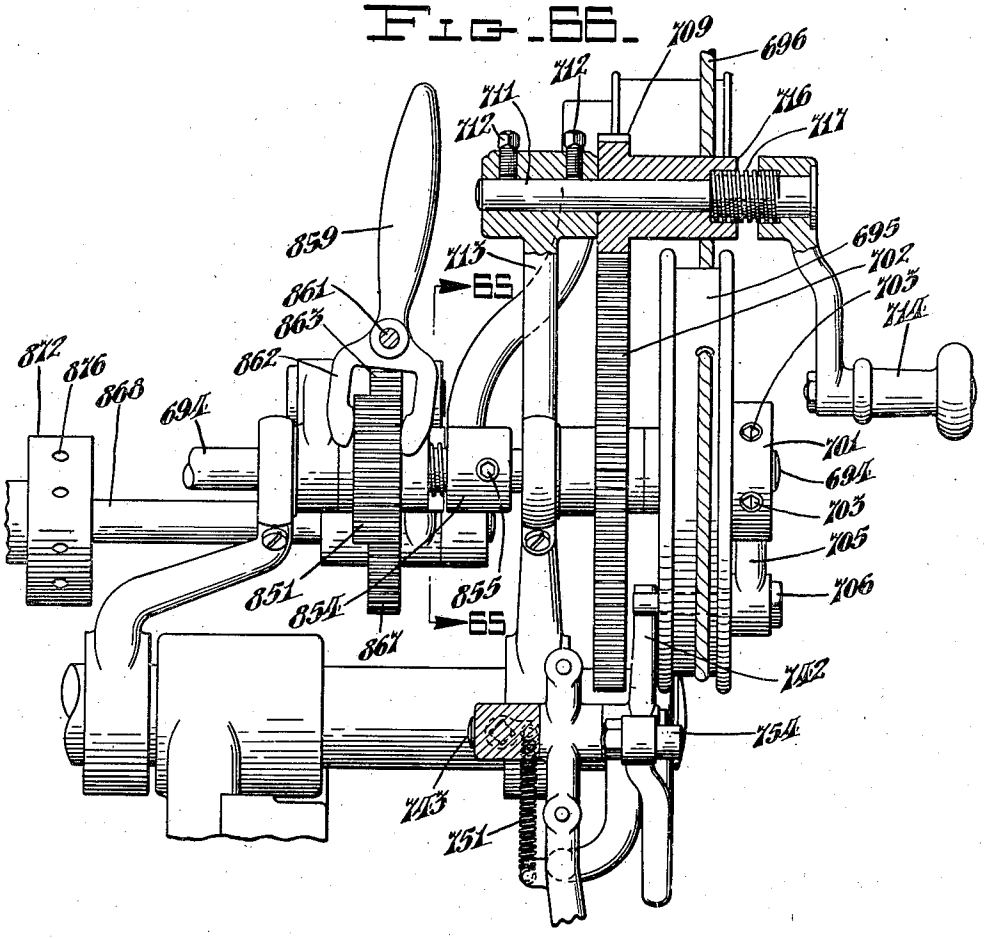
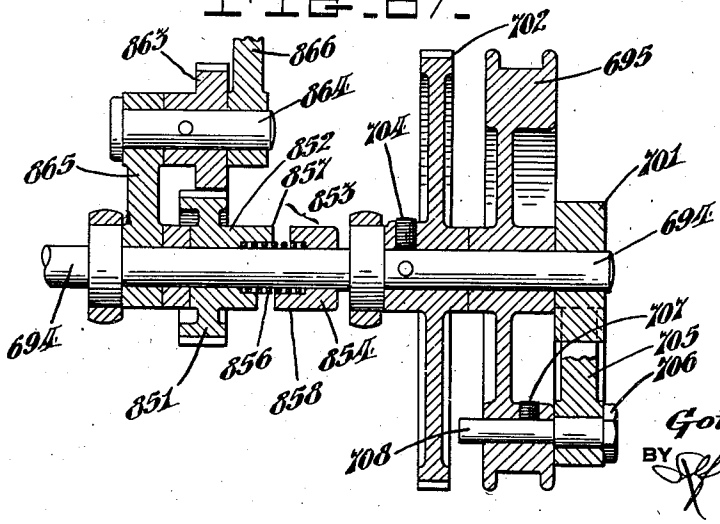


FIG-67-



INVENTOR:
Gottlob Bitzer,
BY Alfred E. Lockinger
ATTORNEY.

Dec. 31, 1946. G. BITZER 2,413,601

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FIG-68

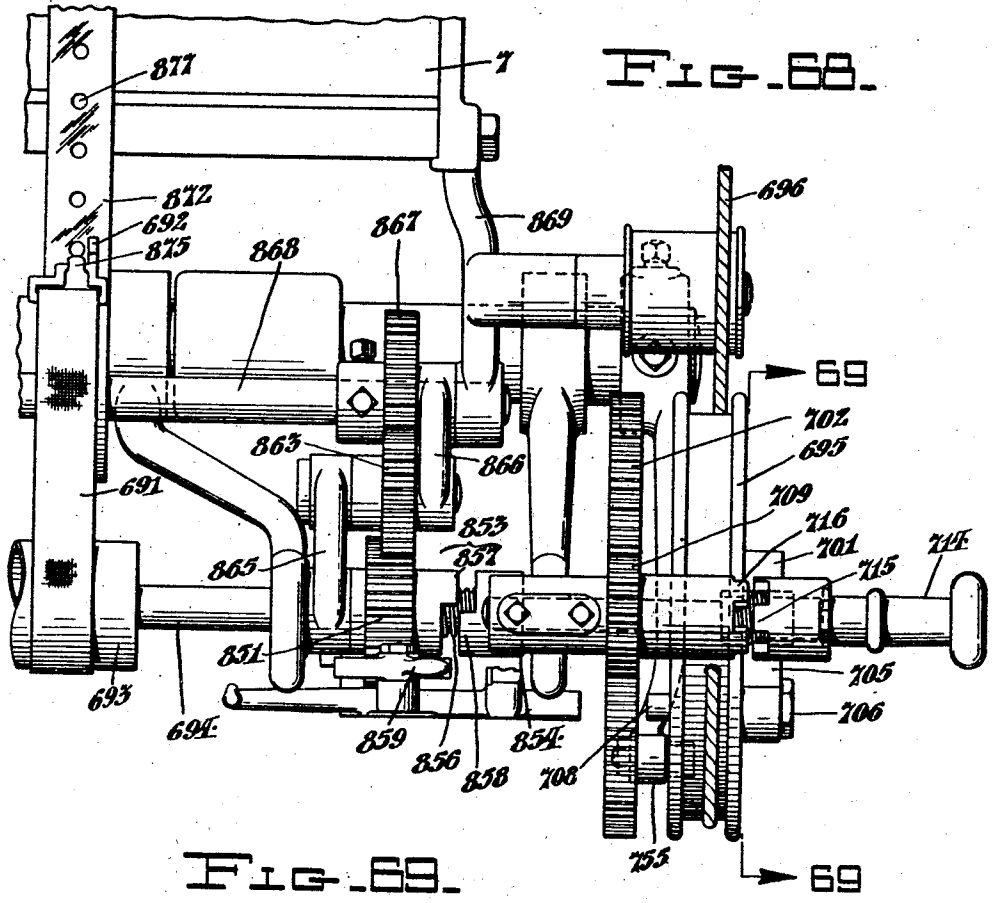
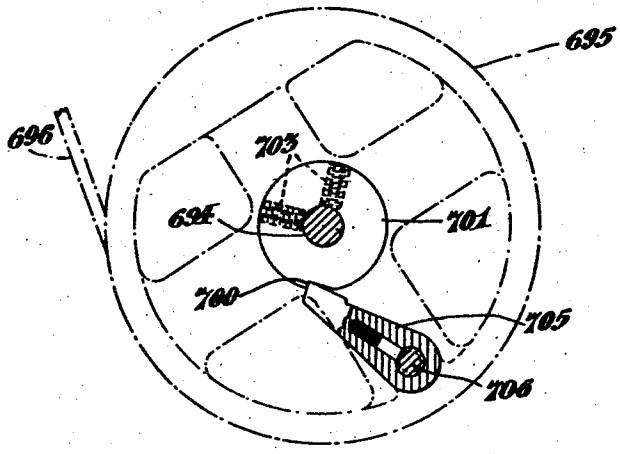


FIG-69



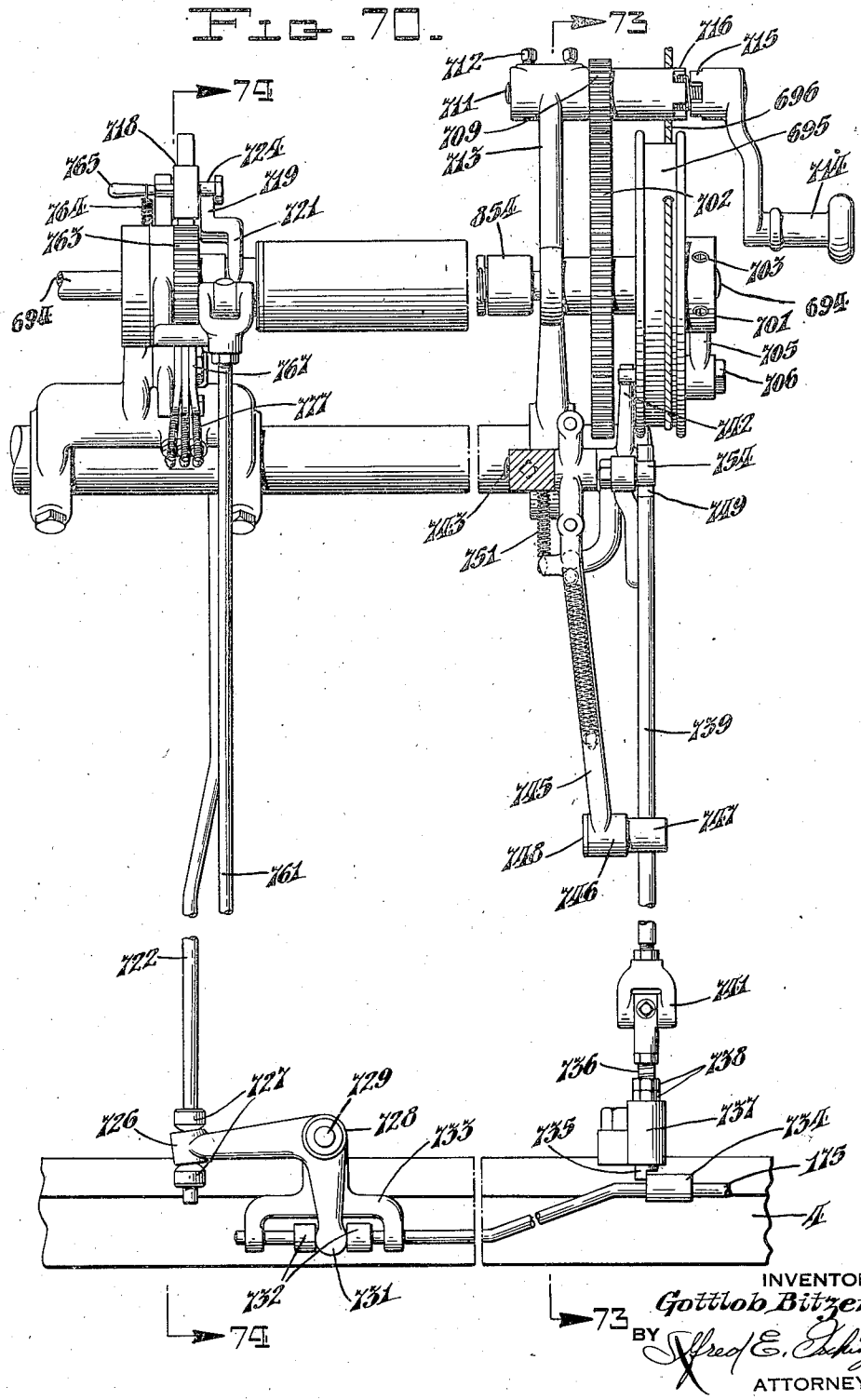
INVENTOR:
Gottlob Bitzer,
BY Alfred E. Imhinger
ATTORNEY.

Dec. 31, 1946. G. BITZER 2,413,601

AUTOMATICALLY PERFORMING WELTING OPERATIONS

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Fig. 70.



INVENTOR:
Gottlob Bitzer,
BY Alfred E. Eskingers,
ATTORNEY.

Dec. 31, 1946. G. BITZER 2,413,601

AUTOMATICALLY PERFORMING WELTING OPERATIONS

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Fig. 71.

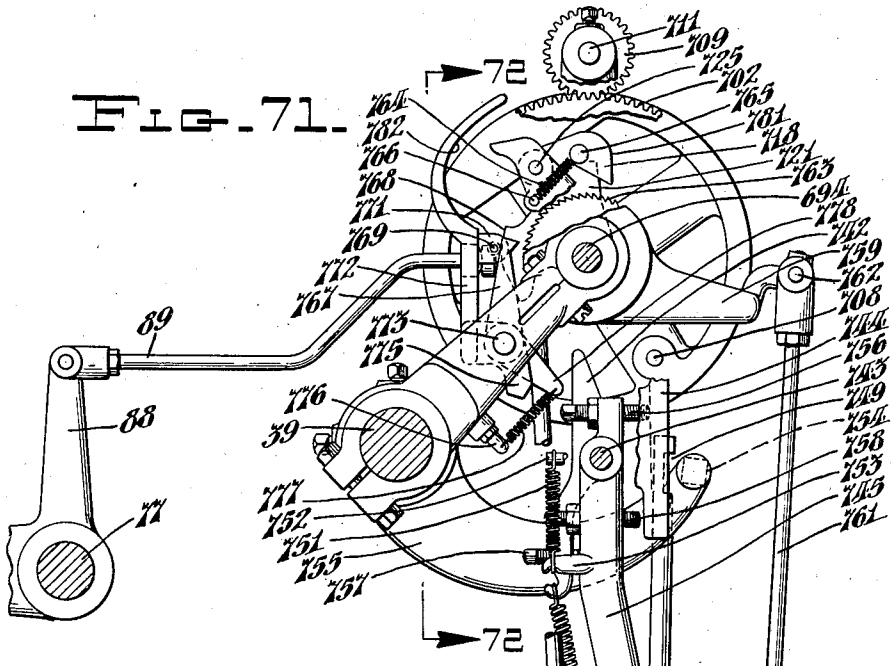
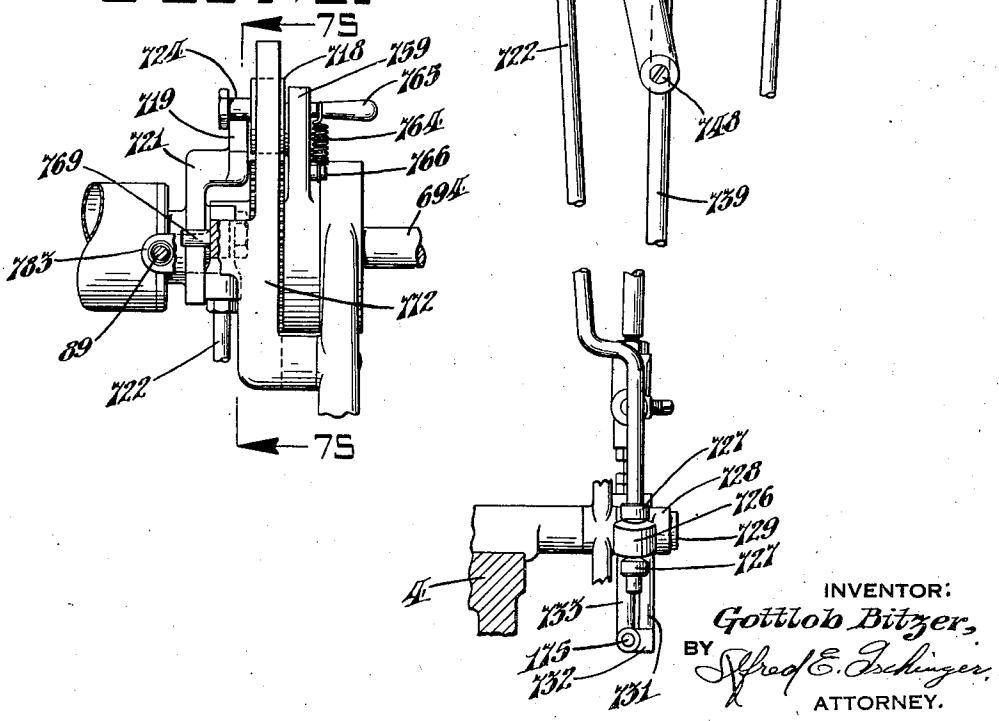


Fig. 72.



INVENTOR:
Gottlob Bitzer,
BY Alfred E. Ischinger,
ATTORNEY.

Dec. 31, 1946. G. BITZER 2,413,601

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FIG. 73.

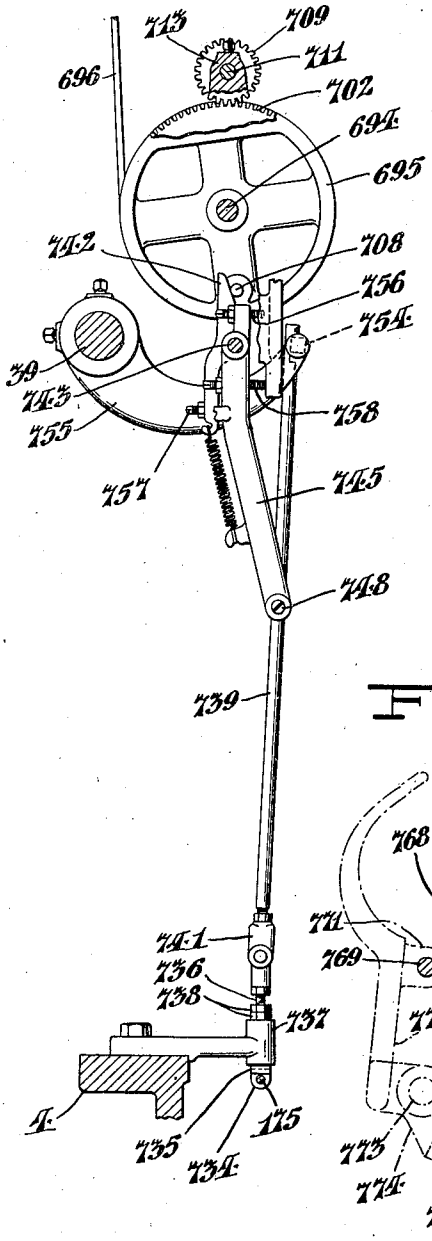


FIG. 74.

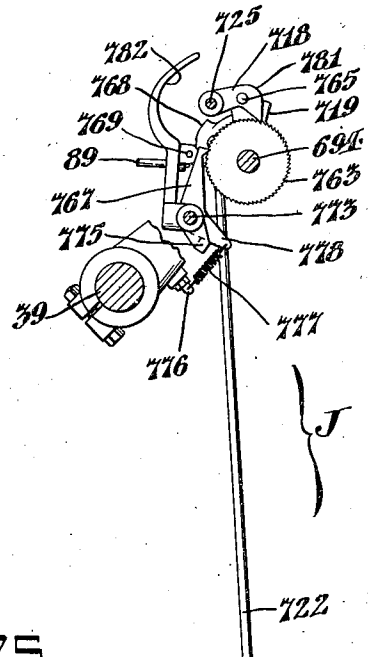
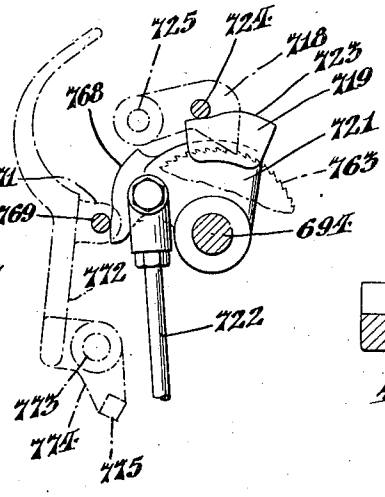
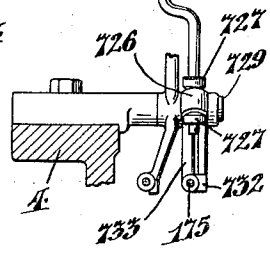


FIG. 75.





INVENTOR:
Gottlob Bitzer,
BY Alfred E. Jenkins,
ATTORNEY.

Dec. 31, 1946. G. BITZER 2,413,601

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FIG. 76.

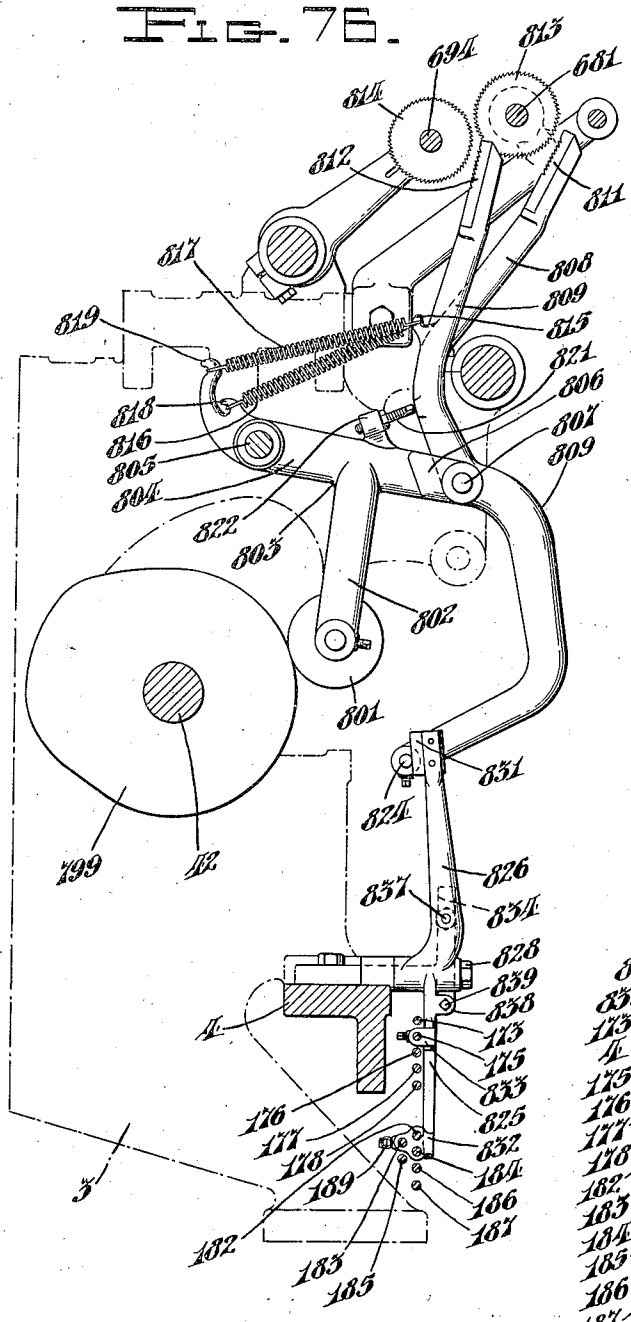
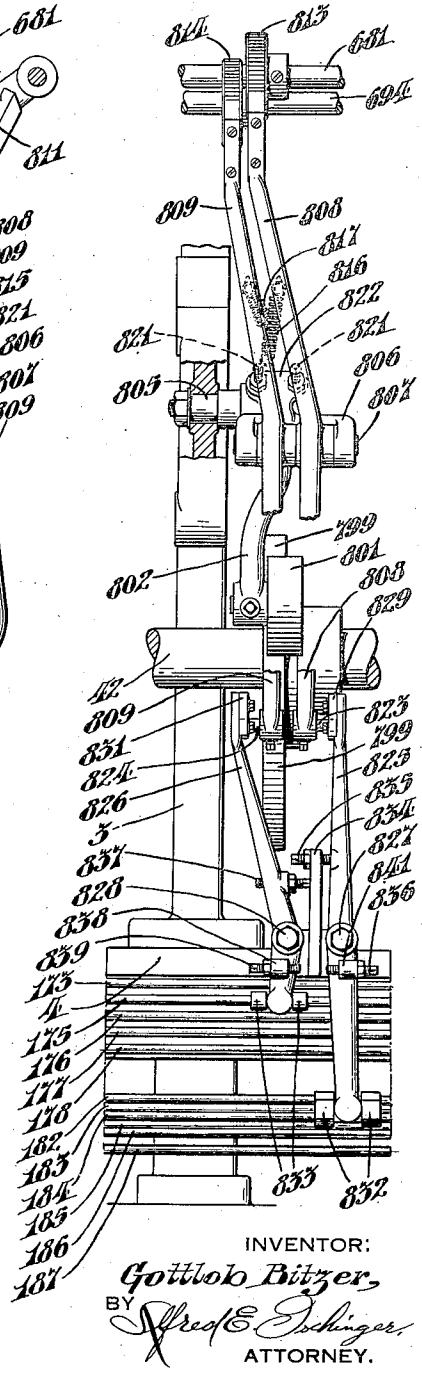


FIG. 77.



INVENTOR:
Gottlob Bitzer,
BY
Alfred E. Tschinger
ATTORNEY.

Dec. 31, 1946. G. BITZER 2,413,601

AUTOMATICALLY PERFORMING WELTING OPERATIONS

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Fig. 78.

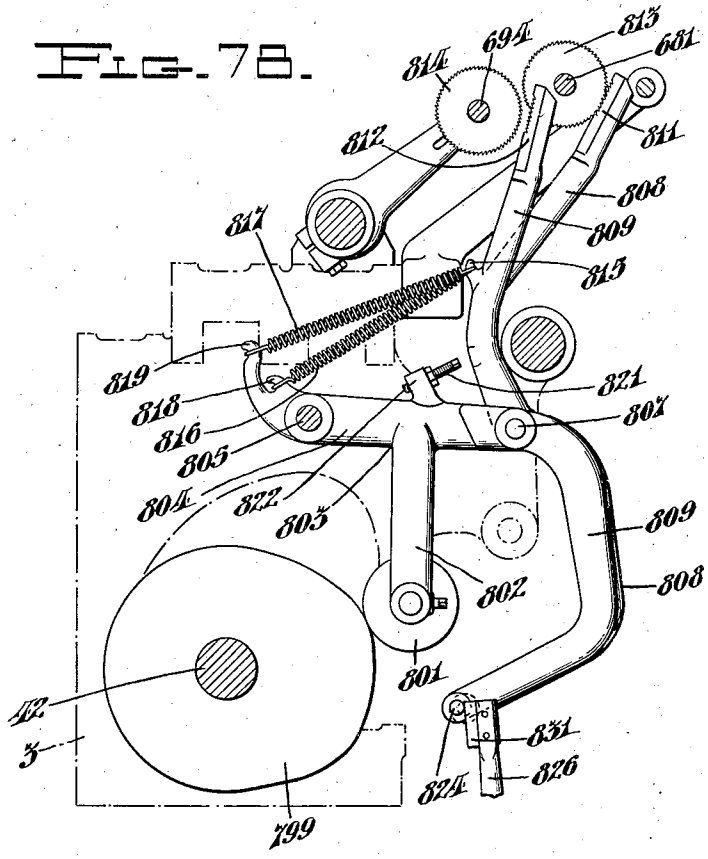


Fig. 79.

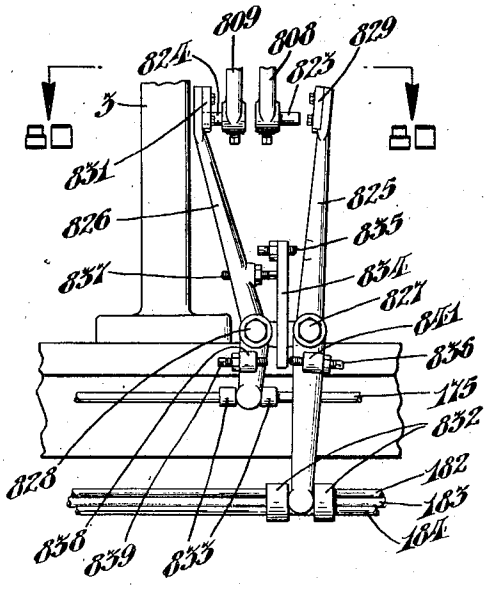
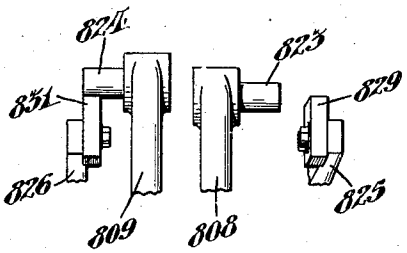


Fig. 80.



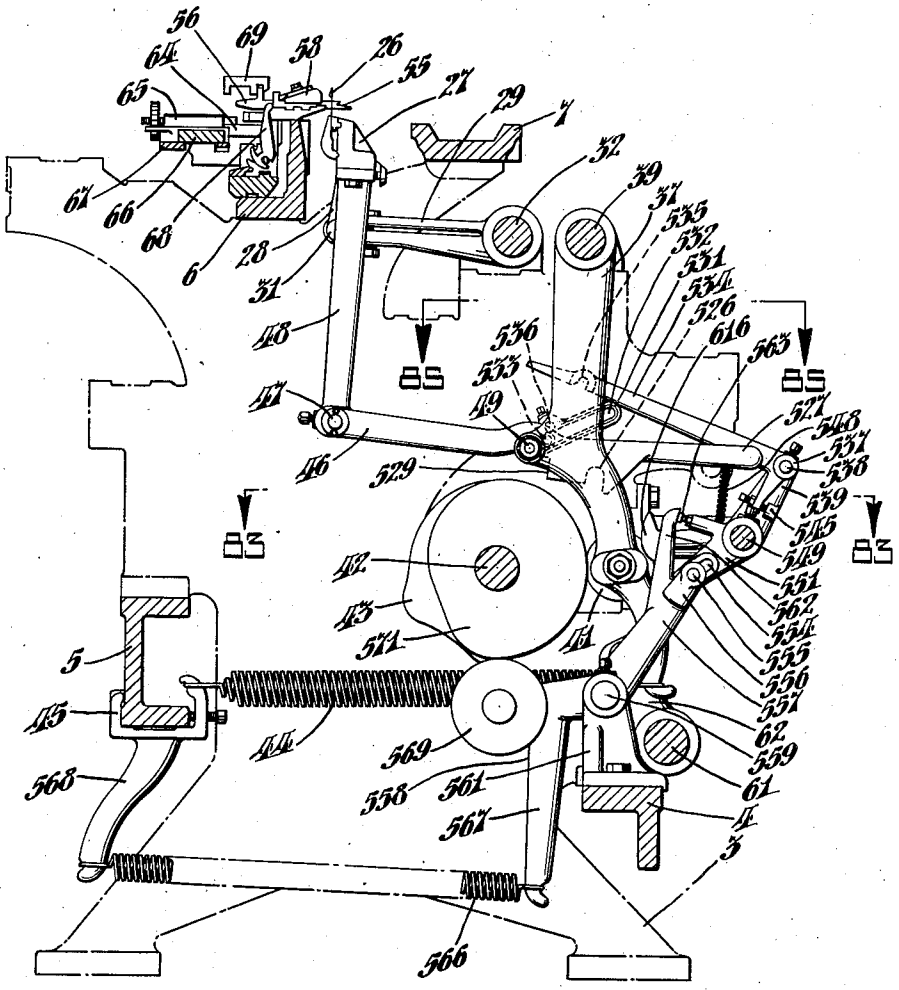
INVENTOR:
Gottlob Bitzer,
BY Hoyt E. Ashinger,
ATTORNEY.

Dec. 31, 1946. G. BITZER 2,413,601

AUTOMATICALLY PERFORMING WELTING OPERATIONS

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FIG. 81.



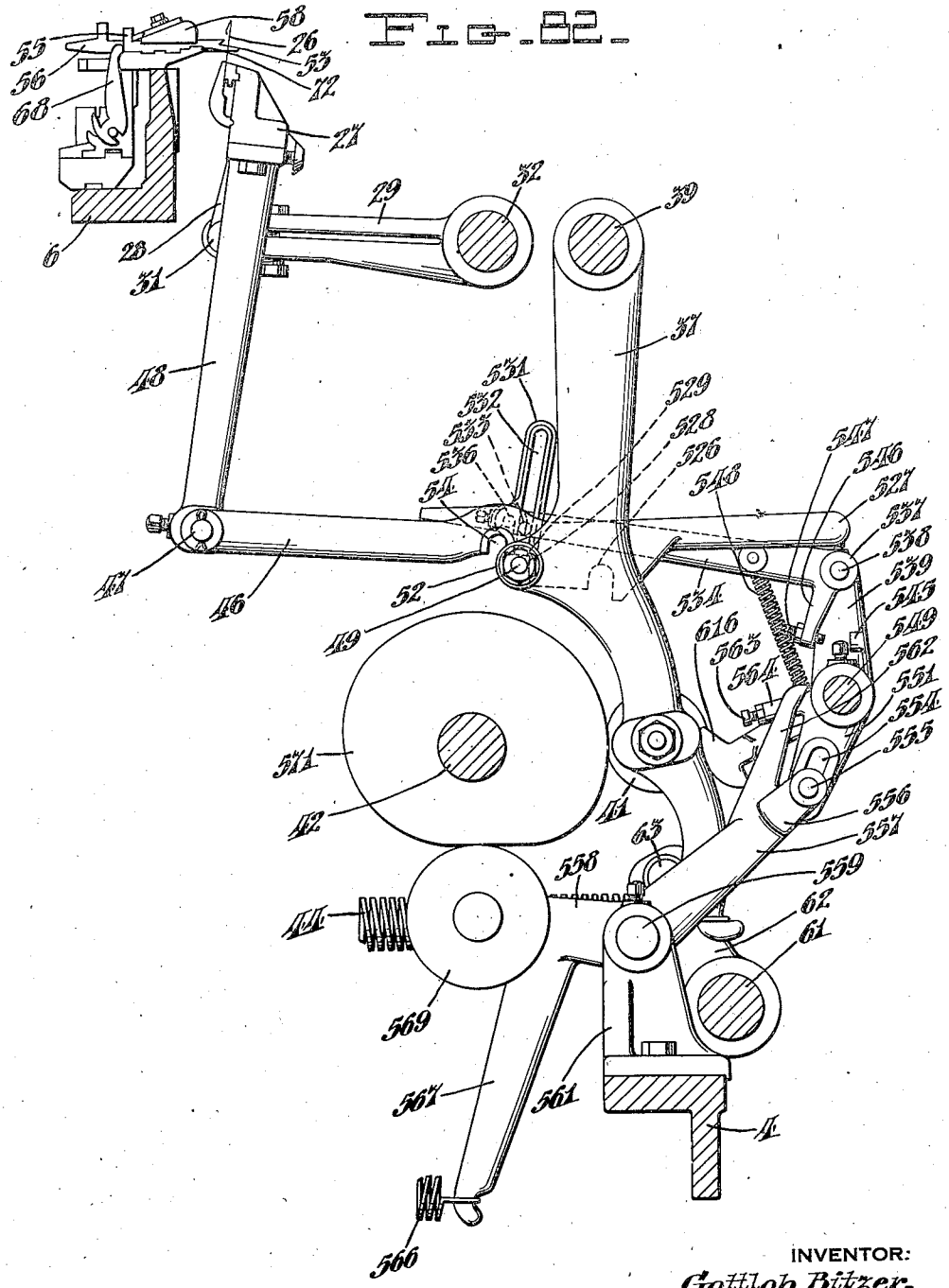
INVENTOR:
Gottlob Bitzer,
BY Alfred E. Schinger,
ATTORNEY.

Dec. 31, 1946. G. BITZER 2,413,601

AUTOMATICALLY PERFORMING WELTING OPERATIONS

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Fig. 82.



INVENTOR:
Gottlob Bitzer,
BY Alfred E. Ockinger.
ATTORNEYS.

Dec. 31, 1946. G. BITZER 2,413,601

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FIG-83-

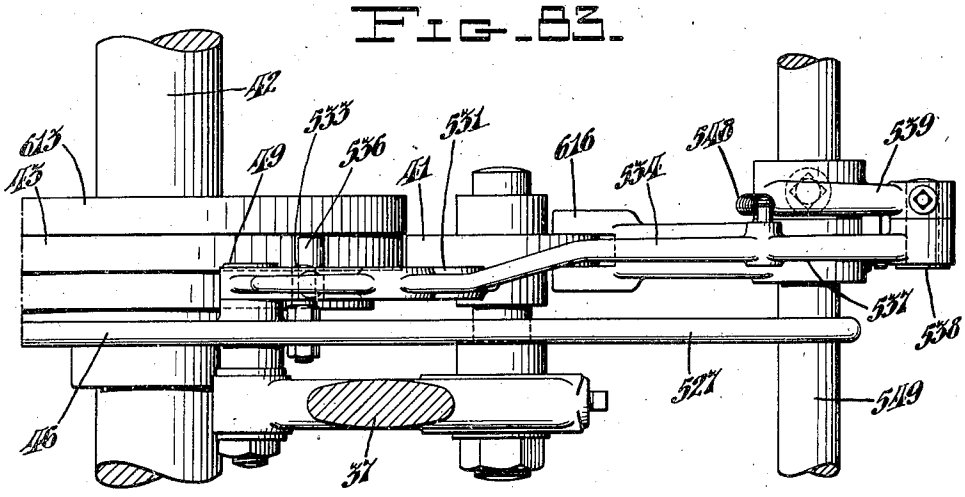


FIG-84-

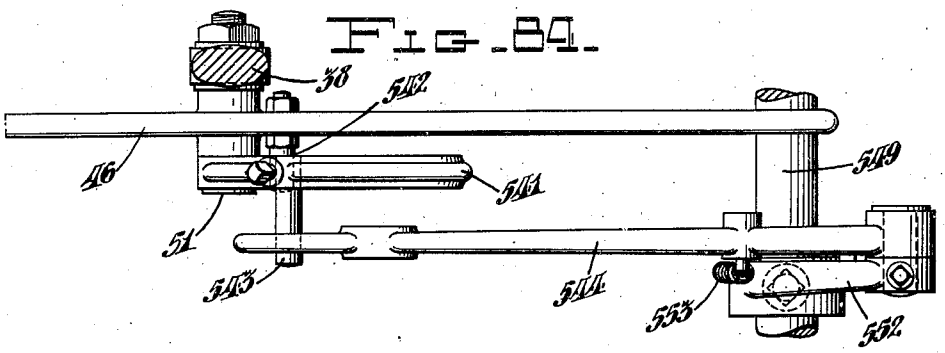
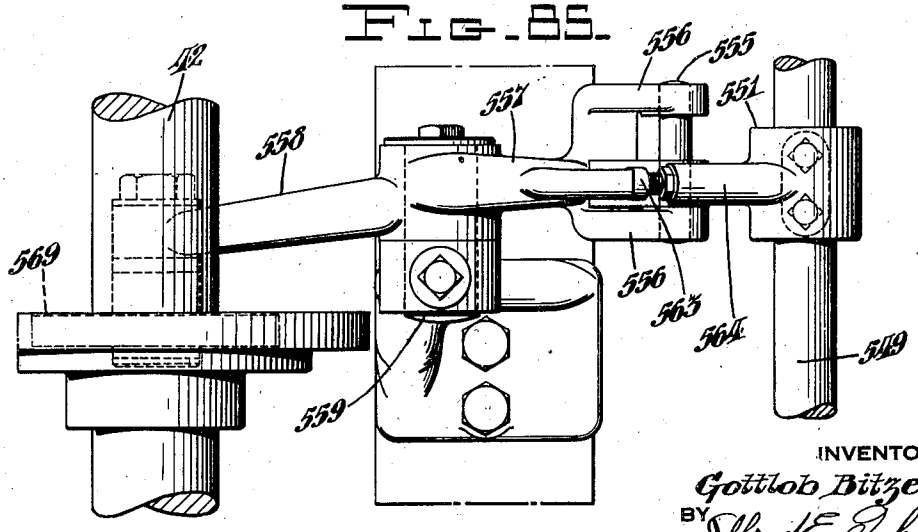


FIG-85-



INVENTOR:
Gottlob Bitzer,
BY Alfred E. Eschinger.
ATTORNEY.

Dec. 31, 1946. G. BITZER 2,413,601

AUTOMATICALLY PERFORMING WELTING OPERATIONS

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FIG-86-

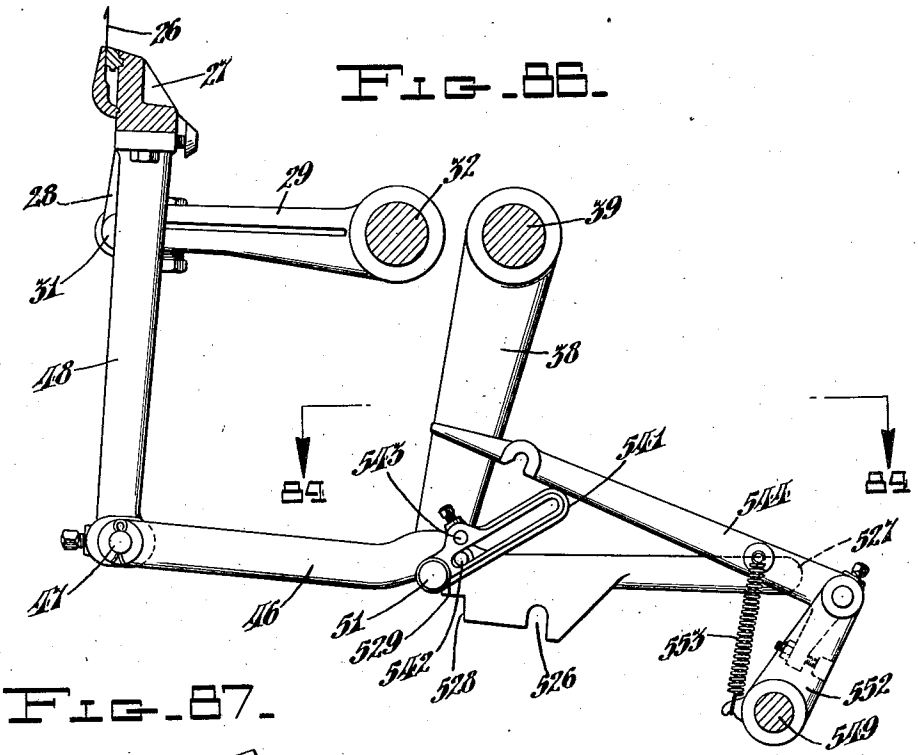


FIG-87-

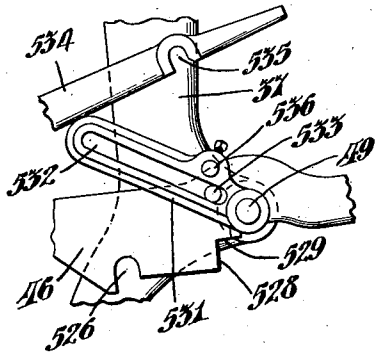


FIG-88-

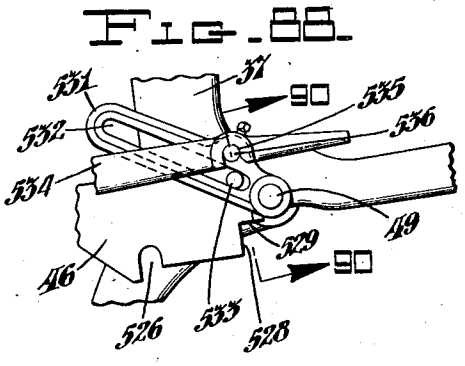


FIG-89-

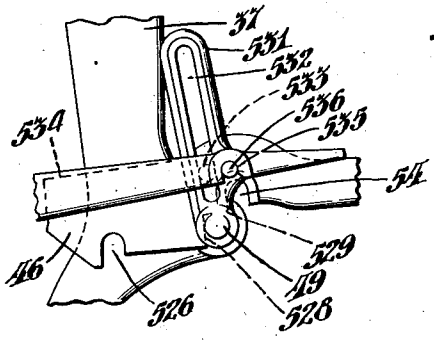
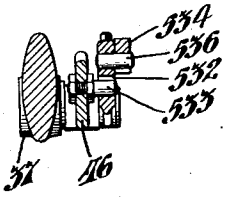


FIG-90-



INVENTOR:
Gottlob Bitzer,
BY Alfred E. Jackinger
ATTORNEY.

Dec. 31, 1946. G. BITZER 2,413,601

AUTOMATICALLY PERFORMING WELTING OPERATIONS

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Fig. 91.

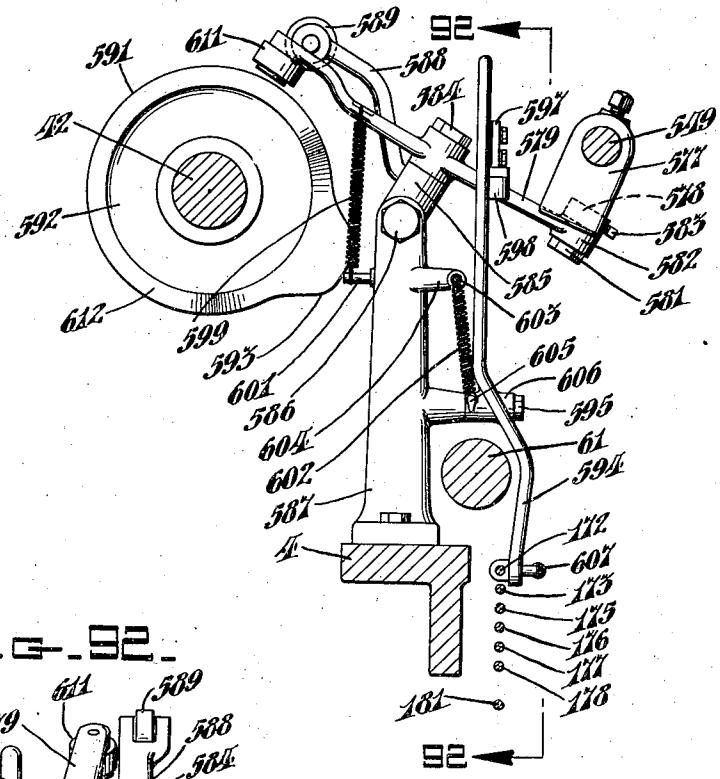


Fig. 92.

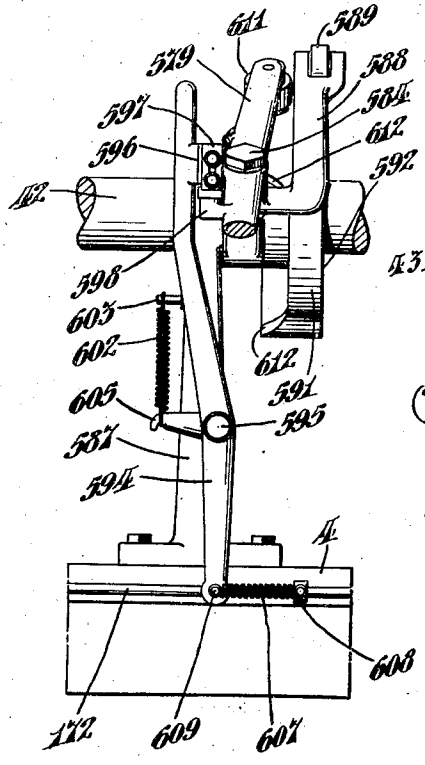
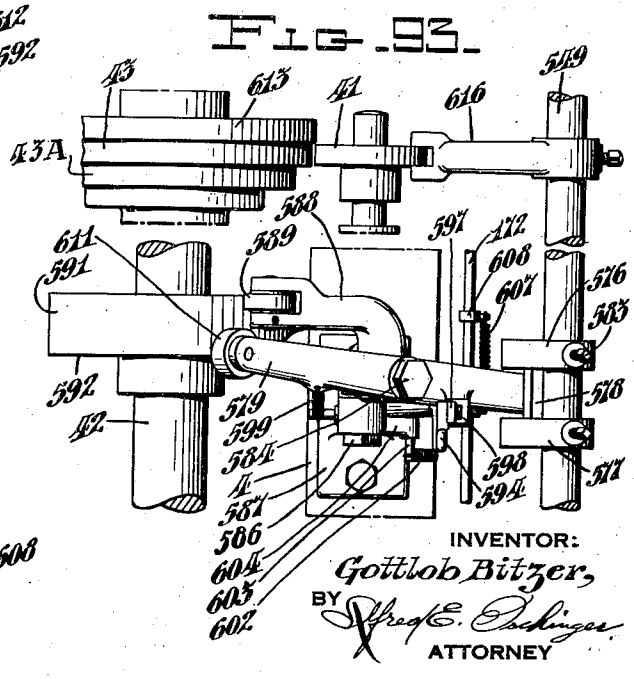


Fig. 93.



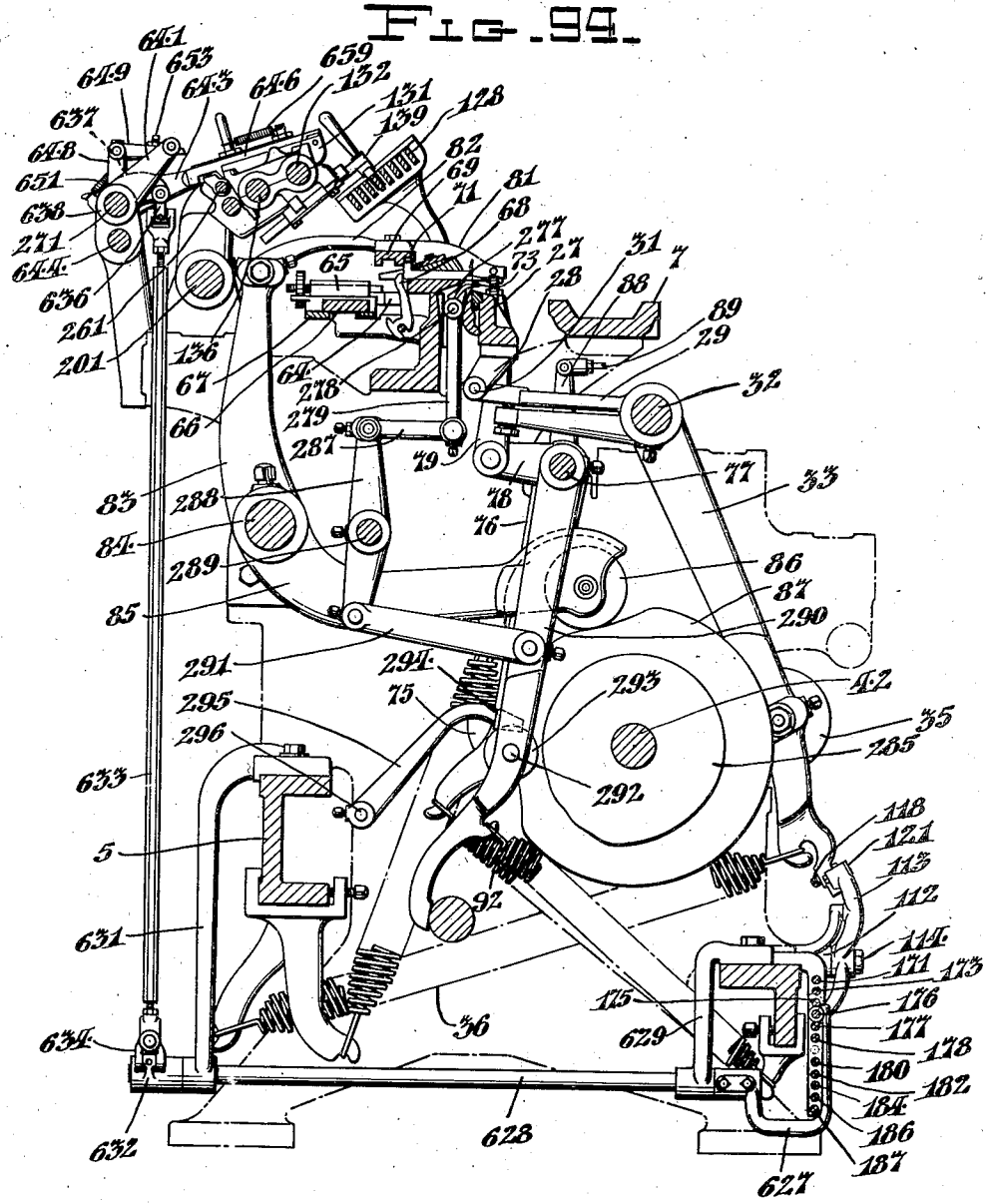
INVENTOR:
Gottlob Bitzer,
BY Fred E. Darlinger
ATTORNEY

Dec. 31, 1946. G. BITZER 2,413,601

AUTOMATICALLY PERFORMING WELTING OPERATIONS

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Fig. 99.



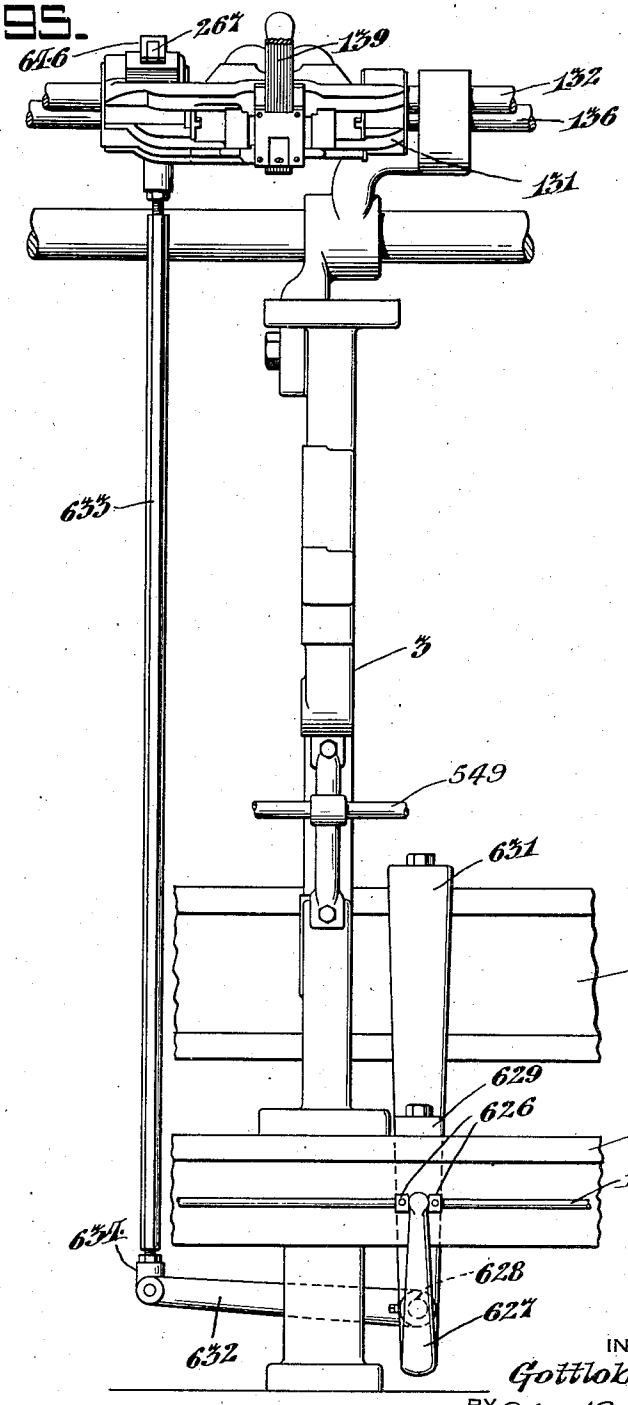
INVENTOR:
Gottlob Bitzer,
BY Alfred E. Bachinger,
ATTORNEY.

Dec. 31, 1946. G. BITZER 2,413,601

AUTOMATICALLY PERFORMING WELTING OPERATIONS

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Fig. 95.



INVENTOR:
Gottlob Bitzer,
BY Alfred E. Eschinger,
ATTORNEY.

Dec. 31, 1946. G. BITZER 2,413,601

AUTOMATICALLY PERFORMING WELTING OPERATIONS

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Fig. 96.

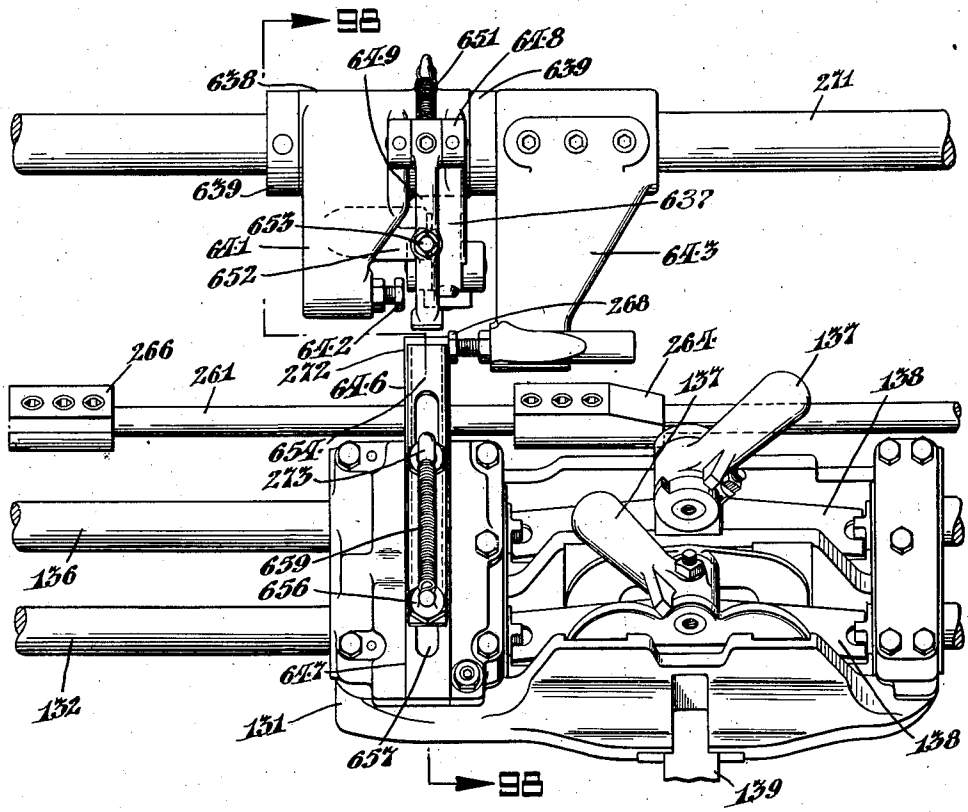
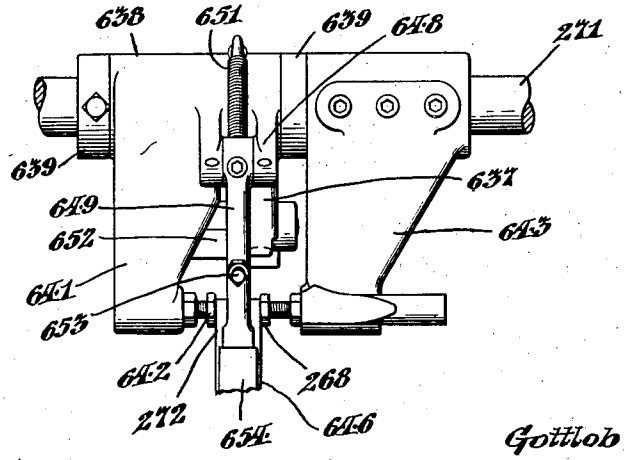


Fig. 97.



INVENTOR:
Gottlob Bitzer,
BY Alfred E. Dickinson
ATTORNEY.

Dec. 31, 1946. G. BITZER 2,413,601

AUTOMATICALLY PERFORMING WELTING OPERATIONS

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Fig. 98.

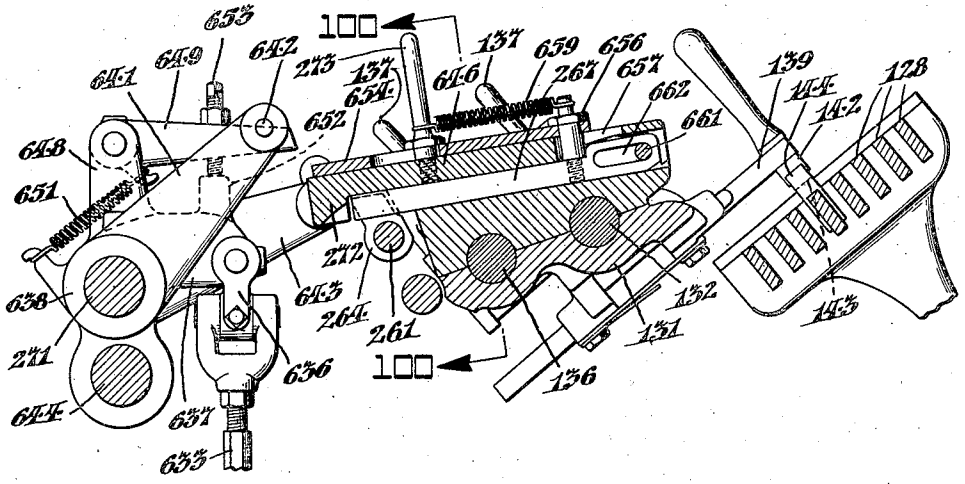


Fig. 99.

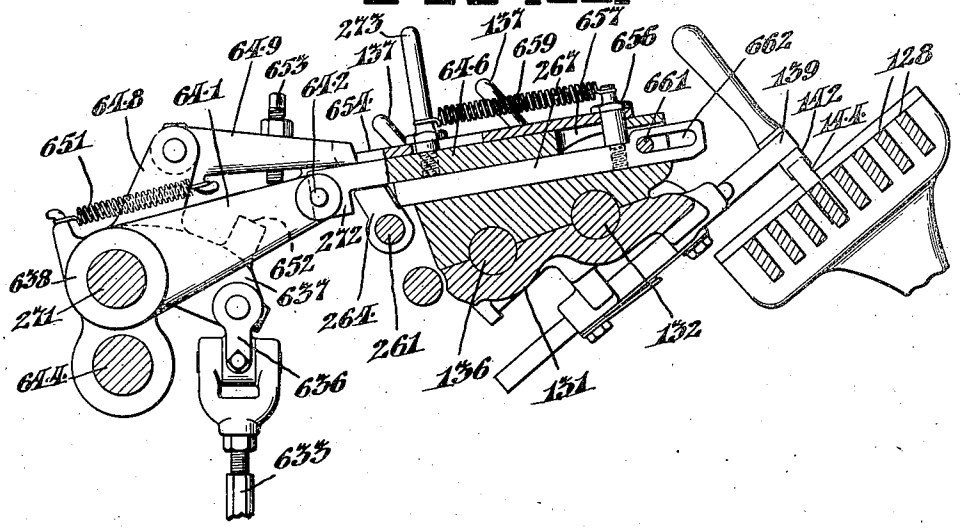
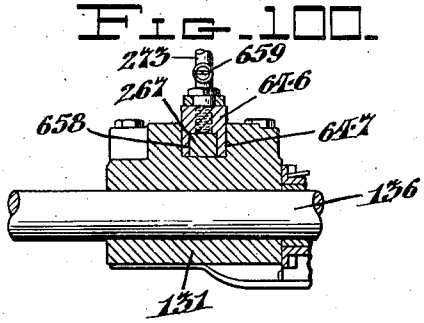


Fig. 100.



INVENTOR:
Gottlob Bitzer,
BY Fred E. Aschinger,
ATTORNEY.

Dec. 31, 1946. G. BITZER 2,413,601

AUTOMATICALLY PERFORMING WELTING OPERATIONS

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Fig. 101.

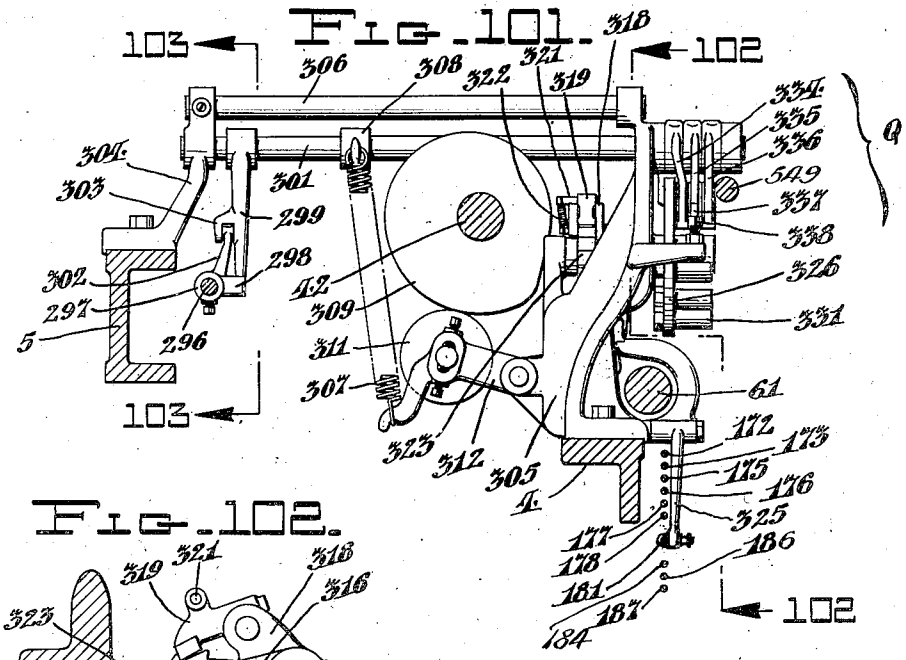


Fig. 102.

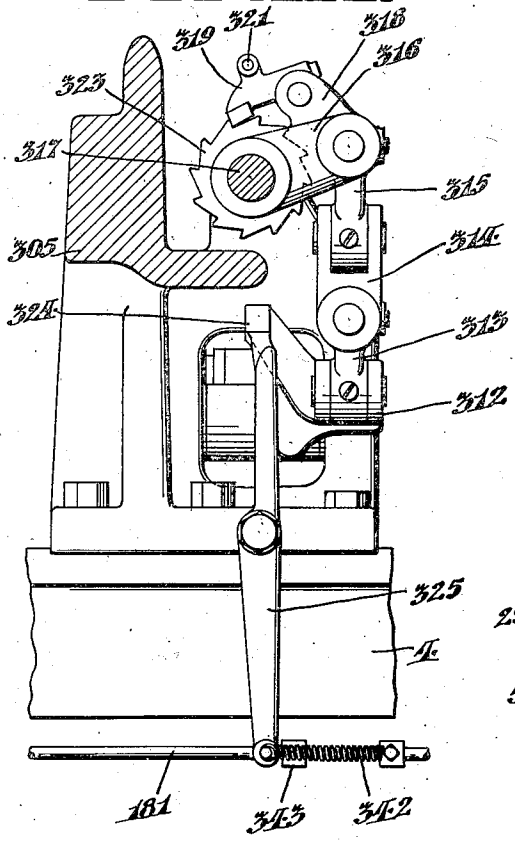
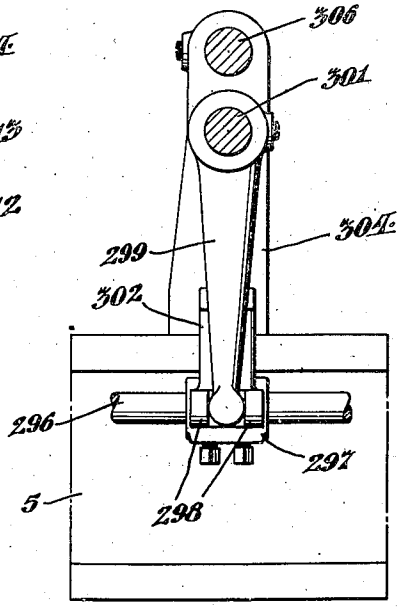


Fig. 103.



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AUTOMATICALLY PERFORMING WELTING OPERATIONS

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Fig. 104.

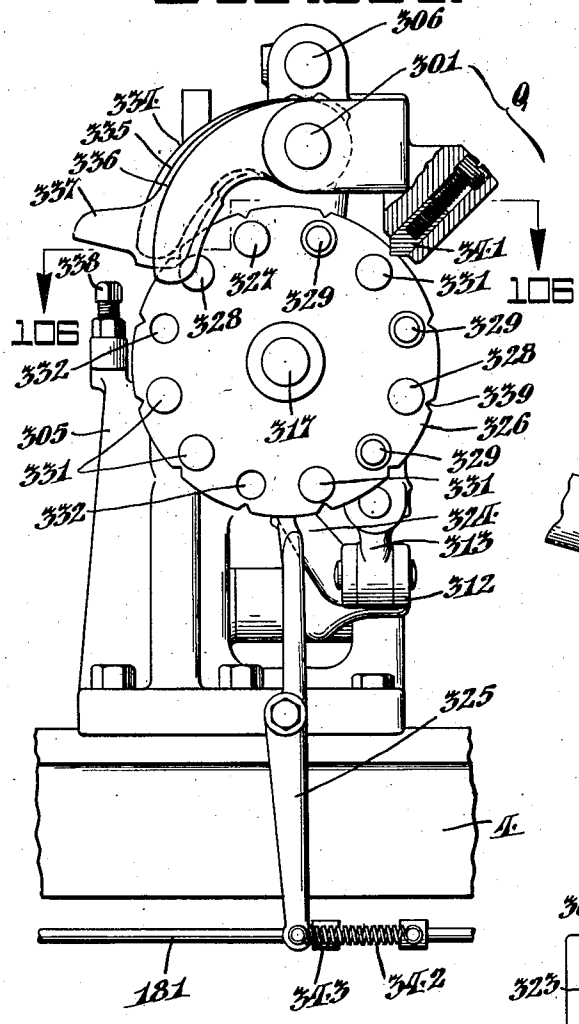


Fig. 105.

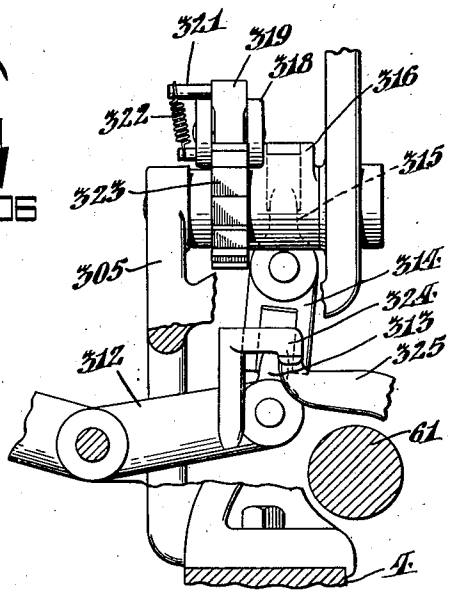
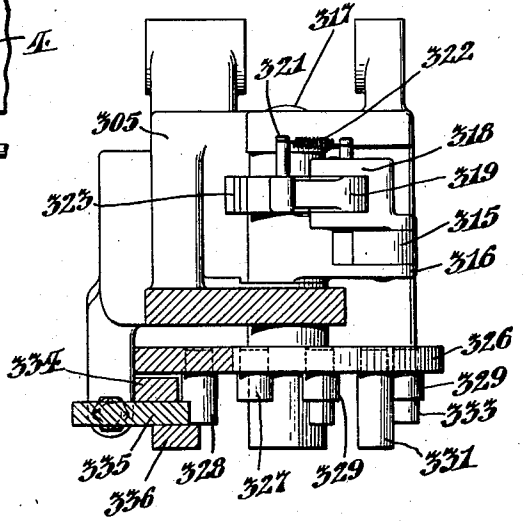


Fig. 106



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FIG-107.

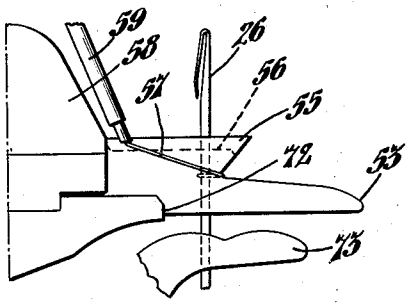


FIG-108.

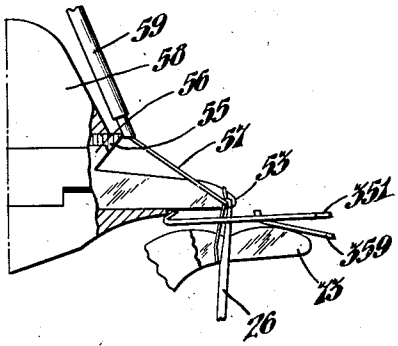


FIG-109.

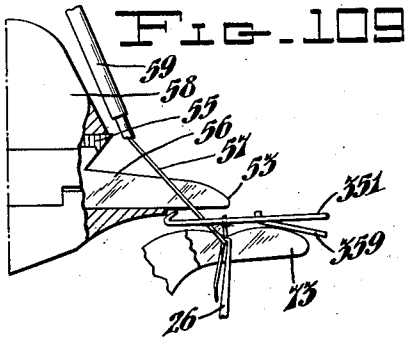


FIG-110.

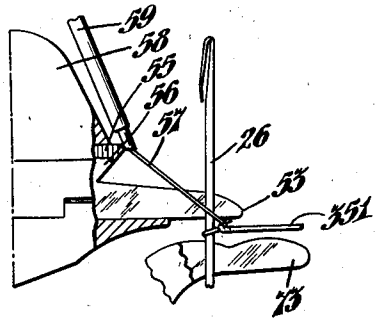


FIG-111.

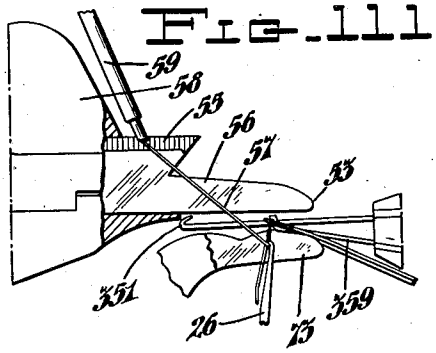


FIG-112.

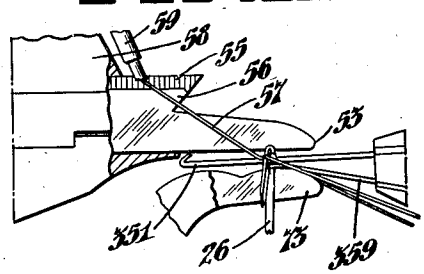


FIG-113.

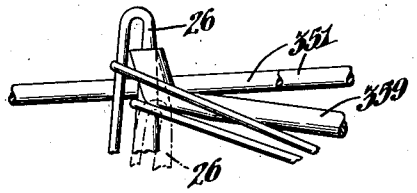
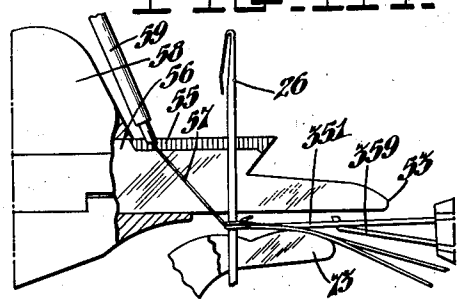


FIG-114.



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AUTOMATICALLY PERFORMING WELTING OPERATIONS

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FIG. 118.

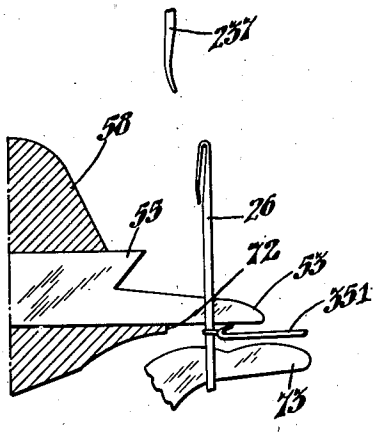


FIG. 115.

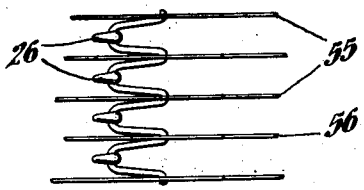


FIG. 116.

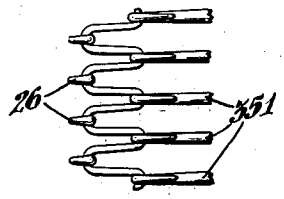


FIG. 119.

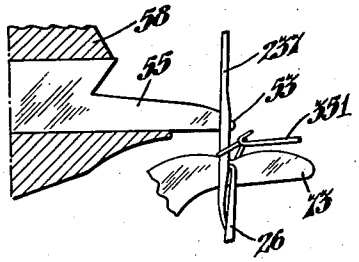


FIG. 120.

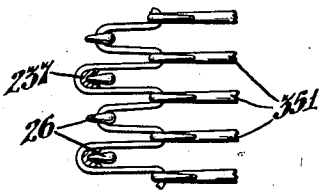


FIG. 121.

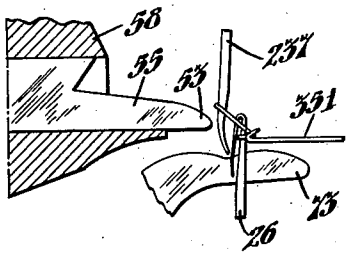


FIG. 123.

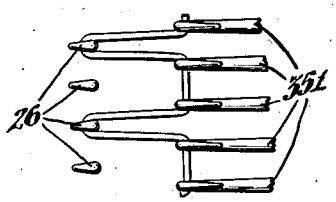


FIG. 122.

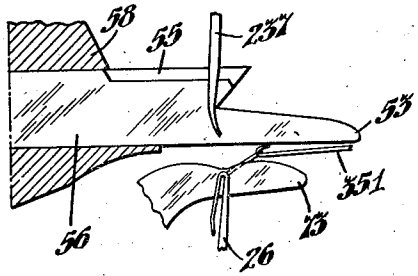
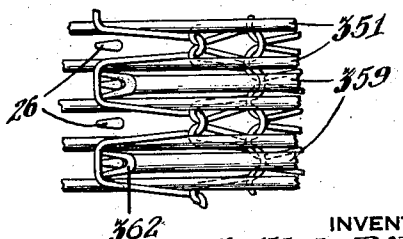


FIG. 117.



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AUTOMATICALLY PERFORMING WELTING OPERATIONS

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Fig. 124.

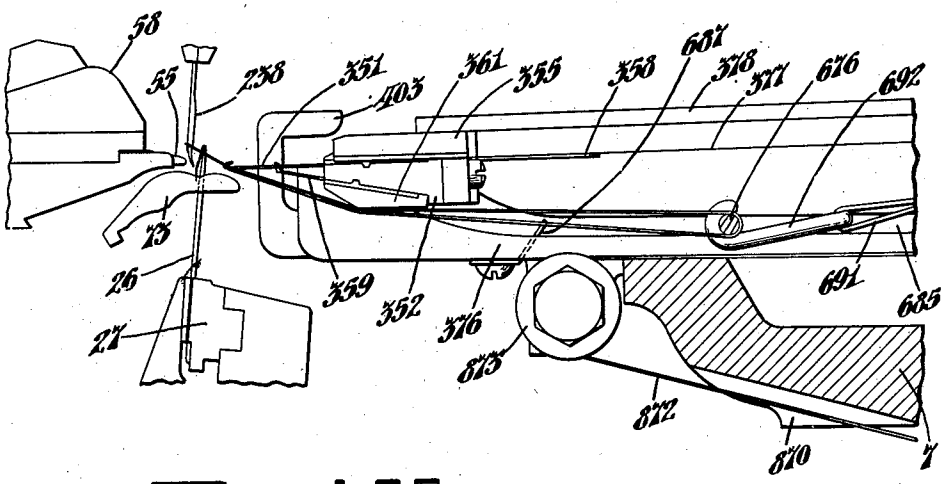


Fig. 125.

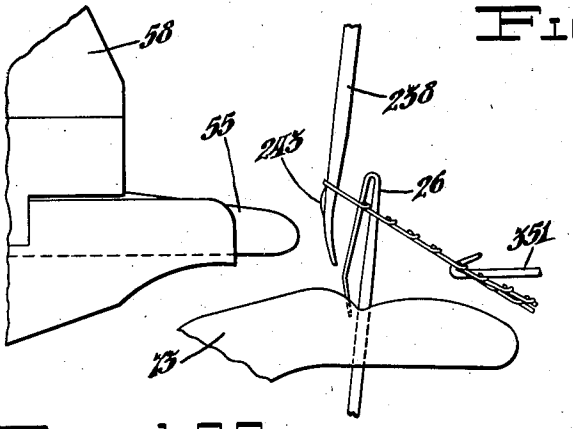


Fig. 127.

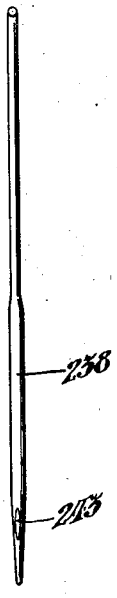


Fig. 126.

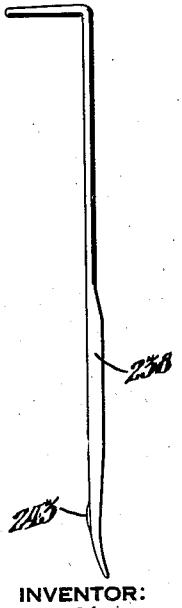


Fig. 128.

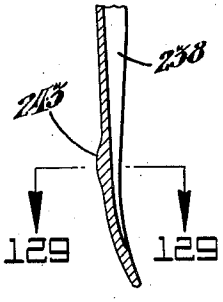
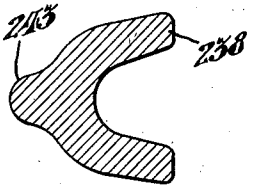


Fig. 129.



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Patented Dec. 31, 1946 2,413,601

UNITED STATES PATENT OFFICE

2,413,601

AUTOMATICALLY PERFORMING WELTING OPERATIONS

Gottlob Bitzer, Lincoln Park, Pa., assignor to Textile Machine Works, Wyomissing, Pa., a corporation of Pennsylvania

Application June 10, 1941, Serial No. 397,452

74 Claims. (Cl. 66—96)

1

My invention relates to straight, or full-fashioned hosiery knitting machines, and more particularly to means for, and the method of, automatically performing the welting operations in producing multi-ply sections in knitted fabrics, such as flat stocking fabrics.

The automatic welt turners heretofore available for use have been found unsatisfactory from a practical and commercial standpoint for one or more of a variety of reasons. More particularly, such welt turners have proven to be too complicated, expensive, cumbersome or inefficient.

It is an object of my invention to provide novel and automatic means for, and a machine method of, automatically performing the welting operations in producing multi-ply sections in knitted fabrics, such as flat stocking fabrics, which will materially improve the practical and commercial position of such means and methods.

Another object of my invention is to improve the efficiency of mechanical welt turning operations to permit increasing the speed of such operations.

A further object of my invention is to provide an improved form of means for use in hooking up and in turning welts.

An additional object is to provide an improved form of transfer device for use in turning welts.

It is also an object to provide an improved means for moving welt bars toward and away from the needle banks.

A further object is to provide an improved means for moving the draw-off hooks toward the needle row.

Another feature of my invention resides in the provision of improved means for drawing off the fabric while knitting the welt, and including means for changing from one draw-off means to a different draw-off means without stopping the machine.

Another object is to provide improved means for laying out the needle bars during the procedure of turning the welt.

With these and other objects in view, which will become apparent from the following detailed description of the illustrative embodiment of my novel automatic welt turning mechanism, shown in the accompanying drawings, my invention resides in the novel method of turning welts, and the new elements, features of construction and arrangement of parts in cooperative relationship as hereinafter more particularly pointed out in the claims.

In the drawings:

Figures 1, 2, 3, 4, 5 and 6, when placed end to end from left to right in the order given, make up a front view of a multi-section straight knitting machine incorporating welt turning mechanism, in accordance with the invention;

2

Fig. 7 is a front view of a leg blank for a full-fashioned stocking, the welt of which was made and turned in accordance with my invention;

Fig. 8 is a sectional view taken substantially on the line 8—8 of Fig. 7;

Fig. 9 is an enlarged side view of a transfer element used for restoring loops of the first course to the needles in turning the welt;

Fig. 10 is a top view of the transfer element shown in Fig. 9;

Fig. 11 is an enlarged side view, but on a reduced scale as compared to Figs. 9 and 10, of a hook used to receive the loops of the first course from the needles;

Fig. 12 is a top view of the hook shown in Fig. 11;

Fig. 13 is a plan view of a welt bar, parts being broken away, for holding a series of hooks of the kind shown in Figs. 11 and 12 and a series of transfer elements of the kind shown in Figs. 9 and 10;

Fig. 14 is an elevational view of the bar shown in Fig. 13;

Fig. 15 is a sectional elevation taken substantially on the line 15—15 of Fig. 14, enlarged relative thereto;

Fig. 16 is a view of the bar taken from the left of Fig. 14, enlarged relative thereto;

Fig. 17 is a plan view similar to Fig. 13 of a modified form of welt bar for holding a series of hooks of the kind shown in Figs. 21 and 22, and a series of transfer elements similar to those shown in Figs. 9 and 10;

Fig. 18 is an elevational view of the bar shown in Fig. 17;

Fig. 19 is a sectional view taken substantially on the line 19—19 of Fig. 18, enlarged relative thereto;

Fig. 20 is an end view of the bar taken from the left of Fig. 18, enlarged relative thereto;

Fig. 21 is an enlarged side view of a modified form of hook employed in the welt bar of Fig. 17;

Fig. 22 is a top view of the hook shown in Fig. 21;

Fig. 23 is an enlarged detail view showing the relation of the needles, transfer elements and welt hooks during one phase of the return of the first course of loops to the needles;

Fig. 24 is an elevational view taken from the left of Fig. 23;

Fig. 25 is a view as shown from beneath the

welt bar of Fig. 17 of the welt hooks and transfer elements at one stage of the welt closing operation;

Fig. 26 is a view similar to a portion of Fig. 25 but at that stage of the welt closing operation shown in Fig. 23;

Fig. 27 is a sectional view taken substantially on the line 27—27 of Fig. 3, enlarged relative thereto;

Fig. 28 is an enlarged front view of the means shown in Fig. 27 for moving welt bars and the hooks and transfer elements thereon toward the needle row;

Fig. 29 is a side view taken substantially on line 29—29 of Fig. 28, certain parts being shown in section;

Fig. 30 is an enlarged detail view of a portion of Fig. 29;

Fig. 31 is a view similar to Fig. 29 but showing certain additional mechanism and with the parts in different relative positions;

Fig. 32 is a view similar to Fig. 30 with the parts in different relative positions;

Fig. 33 is a view similar to Figs. 29 and 31 with the parts in still other relative positions;

Fig. 34 is a view similar to Figs. 30 and 32 with the parts in still other relative positions;

Fig. 35 is a sectional detail view taken substantially on the line 35—35 of Fig. 33;

Fig. 36 is a sectional view taken substantially on line 36—36 of Fig. 29;

Fig. 37 is a detail view on an enlarged scale of a portion of Fig. 31, parts being broken away for purposes of illustration;

Fig. 38 is a sectional detail view taken on the line 38—38 of Fig. 27;

Fig. 39 is a sectional detail view taken on the line 39—39 of Fig. 29;

Fig. 40 is a plan view of a portion of a welt hook advancing mechanism shown in Fig. 27, enlarged relative thereto, certain parts being omitted for purposes of illustration;

Fig. 41 is an end view of the mechanism of Fig. 40;

Fig. 42 is a sectional detail view taken substantially along the line 42—42 of Fig. 40;

Fig. 43 is a view similar to Fig. 40 but showing the same parts thereof with others on a smaller scale, parts being broken away for purposes of illustration and being shown in different positions relative to those shown in Fig. 40;

Fig. 44 is a sectional view taken substantially on the line 44—44 of Fig. 43;

Fig. 45 is a sectional view taken substantially on the line 45—45 of Fig. 43;

Figs. 46, 47, 48, 49 and 50 are views similar to Fig. 45, but each showing the parts in the positions occupied in successively later stages of their cycle;

Fig. 51 is a sectional view of a booster means taken substantially on the line 51—51 of Fig. 6, enlarged relative thereto;

Fig. 52 is a front elevation of the parts shown in Fig. 51;

Fig. 53 is a detail view of a portion of Fig. 52, parts being broken away and parts being shown in section for purposes of illustration;

Fig. 54 is a view similar to Fig. 53, the parts being in different relative positions;

Fig. 55 is a sectional view taken substantially on the line 55—55 of Fig. 52;

Fig. 56 is a sectional view taken substantially on the line 56—56 of Fig. 55;

Fig. 57 is a sectional view taken substantially on the line 57—57 of Fig. 3;

Fig. 58 is a front elevation of the parts shown in Fig. 57;

Fig. 59 is a sectional detail view taken substantially on the line 59—59 of Fig. 57, enlarged relative thereto;

Fig. 60 is a view similar to Fig. 57 with the parts in different relative positions;

Fig. 61 is a view similar to Figs. 57 and 60 but with parts in still other different relative positions;

Fig. 62 is a sectional detail view of a portion of Fig. 57;

Fig. 63 is a sectional view taken substantially on line 63—63 of Fig. 3, parts being omitted for purposes of illustration;

Fig. 64 is a sectional detail view taken substantially on line 64—64 of Fig. 6, enlarged relative thereto;

Fig. 65 is a detail view, taken substantially on the line 65—65 of Fig. 66;

Fig. 66 is a front elevation of the parts shown in Fig. 64, certain of the parts being omitted and others shown in section;

Fig. 67 is a sectional view taken substantially on the line 67—67 of Fig. 64;

Fig. 68 is a top plan view of the parts shown in Fig. 66;

Fig. 69 is a sectional view taken substantially on line 69—69 of Fig. 68, part being shown in dot-and-dash outline for purposes of illustration;

Fig. 70 is an elevation showing parts of cooperating draw-off mechanisms of Figs. 3 and 6, and the operative connection therebetween;

Fig. 71 is an end view of Fig. 70 looking from the left toward the right, parts being broken away for purposes of illustration;

Fig. 72 is a sectional detail view taken substantially along the line 72—72 of Fig. 71;

Fig. 73 is a sectional view taken substantially along the line 73—73 of Fig. 70;

Fig. 74 is a sectional view taken substantially on the line 74—74 of Fig. 70;

Fig. 75 is a sectional detail view taken substantially on line 75—75 of Fig. 72, parts in front of the line of section being shown in dot-and-dash outline;

Fig. 76 is a sectional view taken substantially along the line 76—76 of Fig. 5, showing the means provided for releasing the tension on the fabric;

Fig. 77 is a front view of the mechanism shown in Fig. 76, parts being broken away for purposes of illustration;

Fig. 78 is a view similar to Fig. 76 with the parts in different relative positions;

Fig. 79 is a detail view of certain of the mechanism shown at the lower part of Fig. 77, with the parts in different relative positions;

Fig. 80 is an enlarged detail view taken on the line 80—80 of Fig. 79;

Fig. 81 is a sectional view taken substantially on the line 81—81 of Fig. 5;

Fig. 82 is a view on an enlarged scale similar to Fig. 81, parts being omitted and the parts shown being in different relative positions;

Fig. 83 is a detail view on an enlarged scale taken on the line 83—83 of Fig. 81;

Fig. 84 is a detail view on an enlarged scale taken on the line 84—84 of Fig. 86;

Fig. 85 is a detail view on an enlarged scale taken on the line 85—85 of Fig. 81;

Fig. 86 is a view of certain parts similar to those shown in Figs. 81 and 82 but in a knitting section not having a presser cam, the parts being shown in the same relative positions as in Fig. 81;

Fig. 87 is a detail view of a portion of Fig. 81,

looking in the opposite direction but with the parts occupying the same relative positions;

Fig. 88 is a view similar to Fig. 87 but showing the parts in different relative positions;

Fig. 89 is a view similar to Figs. 87 and 88, the parts being shown in the same positions as in Fig. 82;

Fig. 90 is a sectional detail view taken substantially on the line 90—90 of Fig. 88;

Fig. 91 is a sectional view taken substantially on the line 91—91 of Fig. 6, showing mechanism associated with that shown in Figs. 81 to 90, inclusive;

Fig. 92 is a sectional view taken substantially on the line 92—92 of Fig. 91;

Fig. 93 is a plan view of the parts shown in Fig. 91, certain parts being added;

Fig. 94 is a sectional view taken substantially on the line 94—94 of Fig. 4;

Fig. 95 is a front view of certain of the friction box mechanism shown in Fig. 94;

Fig. 96 is a top plan view of the mechanism shown in Fig. 95;

Fig. 97 is a detail view of a portion of Fig. 96, with the parts shown in different relative positions;

Fig. 98 is a sectional view taken substantially on the line 98—98 of Fig. 96;

Fig. 99 is a view similar to Fig. 98, but with the parts in different relative positions;

Fig. 100 is a sectional detail view taken substantially on the line 100—100 of Fig. 98;

Fig. 101 is a sectional view taken substantially on the line 101—101 of Fig. 6, showing a mechanism associated with that of the knockover bits;

Fig. 102 is a sectional detail view taken substantially on the line 102—102 of Fig. 101;

Fig. 103 is a sectional view taken substantially on the line 103—103 of Fig. 101;

Fig. 104 is a front view of certain of the mechanism shown in Fig. 101, certain parts being shown in section;

Fig. 105 is an enlarged detail view of certain of the mechanism shown in Fig. 101;

Fig. 106 is a sectional view taken substantially along the line 106—106 of Fig. 104;

Figs. 107, 108, 109 and 110 are detail views showing successive steps in the engagement of the loops of the first course of a fabric by the welt hooks;

Figs. 111, 112, 113 and 114 are detail views showing successive steps in returning the loops of the first course to the needles;

Figs. 115, 116 and 117 are detail plan views of parts of Figs. 107, 110 and 112, respectively;

Figs. 118 and 119 are sectional detail views showing the points in course of engaging alternate loops on the needles prior to casting them therefrom;

Fig. 120 is a detail plan view of certain of the mechanism shown in Fig. 119;

Fig. 121 is a sectional view showing the positions of a needle and its cooperating point after the point having the loop thereon has separated somewhat from the needle;

Fig. 122 shows the positions of a needle and its cooperating point when the loop has been stripped off the point by the lower edges of a sinker and divider during the relatively rapid upward movement of the point compared to the needle;

Fig. 123 is a plan view of parts of Fig. 122 illustrating a group of needles and welt hooks, and showing the arrangement of the thread of the first course after alternate loops have been cast off the needles;

Fig. 124 is a view similar to Fig. 49, enlarged relative thereto and showing certain of the mechanism thereof as positioned during a subsequent operation of the machine;

Fig. 125 is an enlarged detail view of certain of the parts shown in Fig. 124;

Fig. 126 is an enlarged view of the loop manipulating point member of Fig. 124;

Fig. 127 is a view of the point member as viewed from the left of Fig. 126;

Fig. 128 is an enlarged sectional view of the lower portion of the point member as shown in Fig. 126; and

Fig. 129 is a sectional view taken substantially along the line 129—129 of Fig. 128, and being enlarged relative thereto.

In the drawings and description, only the means and method necessary to a complete understanding of the invention have been specifically set forth; further information as to the construction and operation of other related, usual and well known knitting machine elements, mechanisms, etc., may be found in one or more of the following publications:

1. Pamphlet entitled—Full-Fashioned Knitting Machines—published and copyrighted by the Textile Machine Works, Reading, Pennsylvania, in 1920.

2. Three catalogs entitled—The "Reading" Full-Fashioned Knitting Machine Parts Catalog—published and copyrighted by the Textile Machine Works, in 1929, 1935 and 1940, respectively.

3. Booklet entitled—The "Reading" High-Production Full-Fashioned Knitting Machine—which forms a supplement to the above noted 1940 Parts Catalog of the Textile Machine Works, and which booklet is a publication of the Textile Machine Works, and was copyrighted by the latter in 1940.

4. Pamphlet entitled—Knitting Machine Lectures—published by the Wyomissing Polytechnic Institute, Wyomissing, Pennsylvania, in 1935.

LIST OF DESCRIPTIVE SECTIONS

For ready reference, the following list gives the titles, and numbers, in Roman numerals, of all descriptive sections, in the order written:

Title	Section
General remarks concerning description of the mechanism	I
General remarks concerning the method of the invention	II
Fabric produced	III
Machine frame	IV
Loop forming and manipulating	V
Idle course mechanism	VI
Yarn laying	VII
Main and auxiliary pattern chains	VIII
Narrowing mechanism	IX
Drop stitch mechanism	X
Carrier rod actuating means	XI
Knockover bit control	XII
Welt bar	XIII
Welt bar operating mechanism	XIV
Control for welt bar operating mechanism	XV
Needle bar layout mechanism	XVI
Control mechanism for needle bar layout mechanism	XVII
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Fabric draw-off mechanism	XIX
Draw-off strap positioning means	XX
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SECTION I

General Remarks Concerning Description of the Mechanism

In the drawings, numerals and letters of the alphabet are both employed to designate parts. Also, the various sub-mechanisms are described, each within a certain series of numerals, such as

in the above sub-heading "Machine frame," wherein the parts are designated by the numeral series 1–25, inclusive, not all of the numerals of this series being necessarily employed. Other sub-headings describing the mechanisms have series containing greater numbers of descriptive numerals, although not all numerals of any series are employed; these series being pointed out at the beginning of each section.

Immediately after the headings of the descriptive sections designated by Roman numerals III to XX, inclusive, reference is made to figures and sheets of the drawings by numerals, enclosed by brackets, to which the subjects of the respective sections relate. It is to be understood that the numbers in the brackets do not necessarily designate all of the figures and sheets of the drawings in which parts set forth in the corresponding sections are shown, but are intended as guides to such figures and sheets in which the parts are clearly shown.

In the description of the machine, wherever a portion is referred to as "right" or "left," unless otherwise indicated, it is to be considered as based on a view of the machine from the front. Likewise a "forward" movement is to be considered as from the back to the front of the machine, and a "rearward" movement from the front to the back of the machine.

Also, since the machine illustrated is in many respects similar to machines of a well-known multi-section type, it necessarily follows that there is much duplication of structure and mechanism, such as two needle banks in each machine section like the needle banks of every other section, narrowing points, yarn carriers and other members, in order that the operations performed by such mechanisms may be performed in all of the blanks knitted by the machine.

Not all of these structures and mechanisms are shown, but a sufficient number of them are shown so that a full and clear understanding of the invention may be had by those skilled in the art, particularly by reference if necessary to publications hereinbefore mentioned.

To make possible a quick and comprehensive understanding of the invention without reading the entire specification, Section XXI hereof is provided in the form of synopsis of the operating phases of the invention. By reference to this synopsis in conjunction with the figures, the different operations which take place during the welt fabric forming cycle of the invention can be quickly found.

SECTION II

General Remarks Concerning the Method of the Invention

In carrying out my process invention, a novel welt bar having a series of hooks held thereon is advanced toward the needles so that the hooks generally extend between the needles in position to receive the loops of the first course as they are pulled from the sinkers and dividers, then the alternate loops of the first course are cast off the needles and the knitting continued, the fabric being drawn off at first by tension applied to the hook bar. After a suitable length of fabric has been knitted, usual welt wires or rods are placed on the fabric and held against movement toward the needles. The motion of the said welt or hook bars is then reversed and a series of transfer members carried on the hook bars is pressed against the previously cast off loops to force the first course toward the needles. Said transfer members have grooved ends which press against said loops. When said previously cast off loops have been pressed back nearly to the normal plane of the needles, the knitting is interrupted for a length of time necessary to tilt the needle bars forward and the needles are then brought up so that the ends of alternate needles press into said grooves in the transfer members and pass through the loops lying thereagainst so that the loops are transferred onto the needles, thus completing the turning of the welt.

SECTION III

Fabric Produced

Figures 7 and 8; Sheet 7

The reference characters used in this section, are the letters A to H, inclusive.

The machine shown can knit only flat fabric, the fabric as knitted being, in general, afterward seamed along two edges to make a tubular article. This is the method commonly followed in making the well known full-fashioned hosiery and it will be assumed that the apparatus as well as the method hereinafter described will be used for directly producing flat fabric blanks adapted to be made into full-fashioned hosiery, although not limited to such field of use. In general the fabric produced by the mechanism herein described is plain knit, being composed of interengaging loops arranged in wales or rows in the direction of knitting and each wale formed on a given needle which draws the loop of a subsequent course through one of a previous course. At times, the loops as formed are afterward modified by transferring or spreading, but fabric containing such special loops, or others, are well known in the knitting and hosiery trades and require no modification of the apparatus and method within the invention.

As shown in Figs. 7 and 8, a flat knitted blank A including a two-ply or double walled welt B is formed by the steps and mechanism hereinafter described. Welt B is first knitted in single ply form and then turned to produce the double walled arrangement shown. After the welt has been turned, knitting proceeds and may be carried out in any usual or desired manner. The blank A shown is a usual form for making full-fashioned stockings and includes, in addition to the welt B, an after-welt C which is a single section of the same weight as each ply of the welt B and which includes a runstop or lace course D, a suitably narrowed leg portion E and an ankle portion F as well as an instep G and heel tabs H. Ordinarily, a blank of the kind shown in Fig. 7 is transferred from a legger to a footer machine for the completion of the foot. However, I do not limit myself as to any operations or mechanisms performed or used after the welt has been turned, or to the type of stocking produced.

SECTION IV

Machine Frame

Figures 1 to 6, 27, 63 and 94; Sheets 1 to 6, 12, 25 and 39

Numerals employed in this section are embraced within a group from 1 to 25, inclusive.

The machine shown in the drawings is, in general, of a well known type, and includes, along with features of novelty, a frame of known form as well as mechanism of known form. The successful operation of the mechanism of the ma-

chine depends upon the stability of the frame. The frames of full-fashioned knitting machines therefore are sufficiently massive to give a solid foundation on which to complete the machine assembly and to maintain the parts in adjusted position during operation, it being required that a full-fashioned knitting machine be not more than several thousandths of an inch out of true for it to function properly.

The machine shown is of the multi-section type, twenty-six knitting sections being shown in Figs. 1 to 6, which are complemental views showing the entire machine. The frame shown comprises heavy transverse members including end frames 2 and intermediate center frames 3, each pair of said center frames embracing two knitting sections. Said frames 2 and 3 are connected to and held in parallel vertical positions by longitudinal connecting members including a front beam 4, a back beam 5, and a center bed 6, see also Figs. 27, 63 and 94. Said center frames 3 are further connected by a front bed or table 7 as well as certain other rods which it is considered unnecessary to mention. The necessary shafts, rods, levers and other mechanical elements needed to carry out the functions of the machine are all mounted on said frame which is sufficiently rigid to ensure that the parts will be held as originally adjusted except for wear.

SECTION V

Loop Forming and Manipulating

Figures 1, 5, 81, 82, 86, 94, 107, 109 and 115; Sheets 1, 5, 34, 35, 37, 39, 45 and 46

Numerals of this section, not hereinbefore employed, are included in a group from 26 to 100, inclusive.

In knitting a flat plain knitted fabric on a given knitting section, the needles employed are arranged in a straight row in a generally vertical plane, the beards of the needles being all set in parallel planes transverse to said vertical plane and on the same side of the row. Yarn is then fed back and forth along the needle row in lengths, a length for each course, and is pushed in between the needles to form loops which are substantially semi-circular in outline. For the first course, the loops are caught on hooks and drawn in the direction in which knitting is to proceed, loops of succeeding courses being drawn through those of preceding courses by the needles.

Some of the most characteristic mechanisms of a full-fashioned knitting machine are those employed in forming and manipulating the loops. In knitting by machine, each needle is utilized to produce a long strip or wale of interengaged loops so that, for knitting articles of material width such as stockings, a bank of needles 26 is provided for each knitting section. The needles 26 of a given bank are of a well-known type known as spring beard needles and are clamped to needle bars 27 in a generally vertical position with their beards all directed toward the rear of the machine, that is toward back beam 5. Needles 26 are carried through a somewhat complicated cycle and, for giving the needles the desired motions, needle bars 27 are supported on links 28 (Fig. 82) pivoted at 31 at the rear ends of generally horizontal levers 29, the forward ends of which are fixed to and supported on a needle shaft 32. The desired vertical components of the motion of the needles and needle bars are occasioned by rocking shaft 32 by well known means shown in Figs. 1 and 94 and comprising levers 33 fixed to shaft 32 at their upper ends and extending downwardly in front of a main cam shaft 42. Levers 33 have cam followers 35 thereon which cooperate with cams 34 on shaft 42 to oscillate shaft 32 and thereby raise and lower levers 29 and needle bars 27. Springs 36 are provided for drawing followers 35 against their cams and thereby causing the raising of needle bars 27, springs 36 being connected between the lower ends of levers 33 and the back beam 5. The desired horizontal components of the needle motion are caused by the oscillations of levers 37 which depend from and are supported on a presser shaft 39 and which have cam followers 41 pivotally mounted thereon at about the level of said main cam shaft 42. Cam followers 41 are maintained in contact with presser cams 43 by springs 44 which connect the lower ends of levers 37 with fixed brackets 45 shown as attached to the back beam 5. As cams 43 rotate in contact with followers 41, cams 43 and springs 44 cause levers 37 and shaft 39 to oscillate and the oscillations of levers 37 are transmitted to needle bars 27 and needles 26 by generally horizontal links 46 which are pivoted to the lower ends of levers 48 on pins 47. Arms or levers 48 are fixed to the lower faces of needle bars 27 and extend downwardly in a generally vertical direction therefrom. The movements of levers 37 are, under most conditions of operation, transmitted to links 46 by pin and socket connections comprising horizontal pins 49 fixed in rearwardly extending projections 52 and extending transverse to links 46. Downwardly opening grooves or sockets 54 are adapted to receive pins 49 and pins 51, carried by levers 38 (Fig. 86), so that links 46 are supported on pins 49 and 51, and the movements of the pins are transmitted to links 46 and levers 48.

In the type of machine shown, the loops are formed in weft yarns 57 (Figs. 107 and 115) which are laid along the noses 53 of sinkers 55 and dividers 56 on the beard side of the needles 26, when said sinkers and dividers are approximately in the positions shown in Fig. 109, that is retracted into sinker-head 58. The yarn is laid by yarn carriers 59 which are reciprocated during the knitting cycle by means hereinafter described.

As the yarn is being fed to the needles, sinkers 55 are pushed forward almost immediately after the passage of the yarn carrier 59 to kink the yarn around the shanks of the needles. It will be understood that the sinkers are arranged to thrust into alternate spaces in the needle rows, there being a divider 56 arranged intermediate each pair of sinkers to thrust into the alternate spaces in the needle row. The sinkers are pushed forward in a wave in each knitting section following the yarn carrier, and it will be clear that the amount of yarn drawn from the carriers 59 per course and per needle depends on the distance of the needles from the front edges of the sinker-heads 58 which extend parallel to the needle rows and in which the sinkers 55 are mounted to move perpendicular to the needle rows. The position of the needle bars with respect to the front edges of the sinker-heads 58 at the time the sinkers are slurred forward is determined by a regulating shaft 61 (Figs. 81 and 82) which has arms 62 fixed thereon which extend upward and to the rear of the lower ends of presser levers 37. At their upper ends, arms 62 have pins 63 thereon which extend parallel to shaft 61 in contact with the rear edges of the lower ends of presser levers 37. By acting on shaft 61 at the proper period

in the cycle by means of one or the other of several cams on shaft 42 and delivering the impulses to shaft 61 through cam followers under the control of a pattern chain, the length of loop of the courses knitted can be controlled and varied as desired within considerable limits. The sinkers 55 are pushed forward by a slur cock cam 64 (Fig. 81) which is reciprocated by the same coulier cam 60 (Fig. 5) as the yarn carriers by means of a cock box 65 mounted to slide on a rail 68 and driven directly by a reciprocatory slur bar or connecting bar 67 which is connected to a a lever operated by the coulier cam in the usual way. The motion of the reciprocatory slur cam 64 is transmitted to the sinkers 55 by vertically pivoted jacks 66 the rear edges of which are contacted by the slur cam 64. At the end of each stroke of the yarn carriers, the dividers 56 are pushed forward by catchbar 69 so that a loop is formed around the shank of each needle as shown in Fig. 107; such forward motion of the horizontally movable catchbar 69 by a rear catchbar mechanism places the groove 71 of the catchbar above the rear vertical ends of the sinkers. The catch bar is then lowered by the front catchbar mechanism (Fig. 94) so that the groove 71 in the catchbar receives the upper ends of the sinkers. The catchbar is then drawn back slightly by the back catchbar mechanism so that the yarn is relaxed enough to permit the subsequent horizontal movement of the needles at the time their beards are carried against the presser edge 72 (Fig. 82) to close the beards on the down strokes of the needles. Before the beards touch the presser edges 72, however, the newly laid lengths of yarn are caught under the needle beards. Then, as the needles proceed downward, their beards are closed and the new loops which have been formed by the sinkers and dividers on the shanks of the needles are drawn down through the old loops which have been hanging on the shanks of the needles below the sinkers and resting on the knockover bits 73. The sinkers and dividers in the meantime have been withdrawn to their rearmost positions, but after the needles have passed below the knockover bits the sinkers and dividers come forward again to strip the latest formed row or course of loops down on the needle shanks as the needles rise again to their highest position. In the meantime, the knockover bits 73 assisted by the usual draw-off tension means have displaced the old loops from the needles.

The lifting and the lowering motion of the catchbar caused by the front catchbar mechanism is derived from a cam 74 on shaft 42. Cam 74 is arranged to contact a follower 75, assuming follower 75 to be in the plane of the cam 74. Follower 75 is mounted to rotate on a lever 76. The upper end of lever 76 is fixed to a front catchbar shaft 77 so that cam 74 is adapted to oscillate shaft 77 by means of the follower 75 and lever 76. The shaft 77 has fixed thereto generally horizontal arms 78 at the rear ends of which are pivoted links 79 the upper ends of which are adapted to lift and lower, to a limited extent, arms 81 which are fixed to and project forward from the catchbar 69. Arms 82 are also fixed to catchbar 69 and extend rearwardly therefrom to a pivotal connection with the upper ends of levers 83 which are form portions of the rear catchbar motion for producing the horizontal movements of catchbar 69. Levers 83 are nearly vertical and are fixed at their lower end to a shaft 84 which also has fixed thereto a generally horizontal arm 85 the forward end of which has pivotally mounted thereon a cam follower 86 which receives motion from a cam 87 on shaft 42. Follower 86 is shown above shaft 42 because this arrangement has been found the better for high speed operation.

As best appears in Fig. 94, the front catchbar shaft 77 has fixed thereto a nearly vertical arm 88. To the upper end of arm 88 there is pivoted a link 89 which runs substantially horizontal and makes a connection with a draw-off mechanism hereinbelow described. When cam shaft 42 shifts from knitting to narrowing position, follower 75 moves from the plane of cam 74 to that of hub portion 91. However, the low spot of said cam has a radius equal to that of the said hub to permit the shift to occur. As the action of link 89 on the draw-off mechanism occurs when the follower 75 is either on the low spot of the said cam 74 or on the hub 91, the position of the link 89 is the same when follower 75 is in its low position in both positions of shaft 42. However, as will appear more fully hereinbelow, no effect is thereby produced on the tension during the knitting position of shaft 42, but the draw-off tension is released to some extent by the action of link 89 during the entire time that the cam shaft 42 is in narrowing position owing to the action of spring 92 which holds shaft 77 as far toward the relaxed position as permitted by hub 91.

SECTION VI

Idle Course Mechanism

Figures 1, 5 and 94; Sheets 1, 5 and 39

Numerals designating parts under this heading, not previously numbered, are embraced within a group from 101 to 125, inclusive, and 176 and 189.

At times, it is desired to operate the main cam shaft for certain purposes but to prevent the needles from knitting. Full-fashioned knitting machines, are consequently provided with idle course mechanisms. The idle course mechanism as now ordinarily provided in the "Reading" full-fashioned knitting machine is adapted to hold the needles immovable in a relatively low position during the period when no yarn is laid to the needles to prevent their going through the cycle which would cause them to cast off their loops. Commonly, the idle course mechanism retains the needles in their low position for one revolution of the cam shaft, but the needles can be so retained for more than one revolution when so desired. A hand operated idle course mechanism may be employed if desired, such mechanism being illustrated on page 129 of the aforesaid parts catalogue for the "Reading" full-fashioned knitting machine, copyrighted in 1940 by the Textile Machine Works.

However, I prefer to make the action of the idle course mechanism automatic and for this purpose I have shown, for each needle lever 33, a lever 113 (Fig. 94) pivoted near its center on a horizontal pivot pin 114 carried by a bracket 112 which is fixed to the front beam 4 of the machine. The lower end or arm of the lever 113 is arranged to be moved in one direction by a spring 122 connected between the lower ends of each lever 113 and a rod 176, see Section VIII. A pattern means, more fully described hereinbelow, moves rod 176 to the left as viewed in Fig. 1, and a spring 189 (Fig. 5), see Section VIII, is employed to move rod 176 in the opposite direction. Spring 189 holds each lever 113 so that its upper end lies

out of the path of the lower end of one of levers 33 with which it is intended to cooperate, said lever 33 forming part of the mechanism for providing the vertical motion of the needles 26. The lower end of each lever 33 is provided with a contact screw 118 designed, when the upper end of lever 113 has been moved into alignment therewith, to contact a contact screw 121 at the upper end of each lever 113 to hold the lever 33 in its outermost or forwardmost position to which it has been moved by the high point of the needle cam 34, the position corresponding to the low point in the path of the needles 26. The button on the controlling pattern chain is so set that it operates rod 176 to the left near the end of the revolution of the cam shaft, immediately preceding the revolution in which no yarn is to be laid, and holds the rod 176 in its left hand position until near the end of the next revolution of the cam shaft. Therefore, as soon as the cams 34 have raised levers 33 to their highest points, screws 121 are moved beneath the lower and rear ends of screws 118 by springs 122, and the levers 33 are therefore held outward so long as the levers 33 rest on levers 113 and are retained in this position. When the button which moved the rod 176 passes out of active position, spring 189 moves rod 176 to the right which in turn moves levers 113 from beneath levers 33 as soon as cam 34 next lifts levers 33, whereupon levers 33 are again operated by the needle cams.

For certain purposes, the idle course mechanism need be active during only one course at a time and the pattern means is therefore arranged so that rod 176 is operated by spring 189 to move each lever 113 out of the plane of its cooperating lever 33 when the needle cam reaches its next high point so that the needles can rise to have yarn laid thereto by the next stroke of the coulier cam. However, as will hereinafter appear, the welt turning cycle employed by me requires that the idle course mechanism remain active for two successive revolutions of the main cam shaft. For this purpose, it is necessary only that the pattern means have buttons arranged to act on rod 176 in successive revolutions of the cam shaft to render each lever 113 inactive for a sufficient length of time.

SECTION VII

YARN LAYING

Figures 5, 94, 96, 98, 99 and 107 to 111; Sheets 5, 39, 41, 42 and 45

Numerals of this section, not hereinbefore employed, are included in a group from 126 to 150, inclusive.

When yarn is fed to the needles, as hereinabove mentioned, a free end of yarn is led from a yarn supply through a yarn guide tube to a position in front of the needles. The free end of the yarn is then attached to a stationary part of the machine, and the yarn carrier in which said tube is fixed is then moved back and forth across the needle bank or row to place lengths of yarn along the needle row on the beard side thereof, one length for each course of loops to be formed.

The yarn carriers 59 (Figs. 107 to 111) which have been referred to are fixed to and moved by yarn carrier rods 128 which are moved in turn by friction boxes. A novel form of friction box 131 within the invention is shown in Figs. 94, 98 and 99 and is described more in detail hereinbelow. Boxes 131 are arranged so that they can be frictionally engaged, whenever they are to operate carrier rods 128, with a reciprocatory full speed friction box rod 132 or a reciprocatory half speed friction box rod 136, which rods are reciprocated by the coulier cam 60 (Fig. 5), the coulier cam being driven from cam shaft 42 at half the speed of the shaft 42 so that a length of yarn is laid to the needles at each revolution of the shaft 42. Means for engaging boxes 131 with a friction box rod comprise handles or levers 137 two of which are pivoted to each box 131 and each of which has a cam portion adapted when the handle 137 is turned to force a plate 138 (Fig. 96) toward the corresponding friction box rod so that a friction leather fixed to the plate may obtain a sufficient grip on the rod to move the box. The friction is only of such degree, however, that the friction box rod may slip when the motion of the box is obstructed. Full speed rod 132 is the one commonly employed. For connecting a friction box 131 to a yarn carrier rod 128, each box has a connecting means, the one shown in Figs. 94 and 98 being a hand operated bar 139, having a dog 142 at its forward end adapted to enter a notch 143 in a dog 144 fixed to a carrier rod 128 for driving the rod 128. It will be understood, however, that automatic means are frequently employed for connecting a friction box to one or another of the yarn carrier rods.

As hereinabove noted, the yarn carrier leads the slur bar and, in order that this may be the case irrespective of the direction of motion of the connecting bar 67, the full-speed friction box rod 132 and connecting bar 67 are given the same "throw" or amount of traverse, an amount greater than the length of each sinker bed, so that the yarn carrier rod and its attached friction box and yarn carrier are stopped before each reversal of motion of the friction rod and connecting bar. The slur cam is thereby carried beyond the yarn carrier and the yarn carrier always leads the slur cam because the yarn carrier starts with the slur cam.

SECTION VIII

MAIN AND AUXILIARY PATTERN CHAINS

Figures 1, 6, 94 and 101; Sheets 1, 6, 39 and 43

New reference numerals hereof are 151 to 200, inclusive.

The sequence of operations in a full-fashioned knitting machine is commonly controlled in considerable degree by patterning means. Such means are used to determine the times at which different mechanisms are thrown into action, for example, when narrowing or lace operations are to be performed, steps which affect the appearance of the finished fabric or article.

In the machine shown in the drawings, a patterning means is shown including two pattern chains, a main pattern chain 156, forming part of a mechanism P (Fig. 1), and auxiliary pattern chains 154 and 157, forming part of mechanisms M and N (Figs. 1 and 6) respectively, mechanisms M and P being at the left end of the machine and mechanism N at the right end of the machine. Chains 154, 156 and 157 are composed of links pivoted together and are mounted on sprockets fixed to shafts at right angles to cam shaft 42 and being driven therefrom in usual manner. The main pattern chain 156 is stepped or racked in each revolution of shaft 42 shortly after the point at which the yarn laying has ended in the knitting cycle and at an equivalent time in the narrowing cycle and controls the racking of, among that of other mechanisms, the auxiliary pattern chains 154 and 157. The pattern

chains 154, 156 and 157 have buttons 161, 158 and 159, respectively, fixed thereon at suitable intervals and which project from the outer face of the chain, the button or buttons for controlling a given mechanism being arranged in a certain track or row longitudinally of the chain. Levers 162 are arranged to cooperate with buttons 158 of chain 156, while levers 163 and 164 are arranged to cooperate with the buttons 159 and 161 of chains 157 and 154, respectively. Levers 162, 163 and 164 are swivelled on and depend from pivots 165, 166 and 152, respectively, and are each, with one exception, arranged to move in one direction one of a group of control rods 171 to 187, inclusive, which extend lengthwise of the machine and which are slidably mounted in brackets 188, carried by the front beam 4. As shown, levers 162 move the rods 171, 173, 174, 176, 177, 178, 179, 180, 183, 184 and 185 to the left; levers 163 move the rods 172, 175, 181 and 187 to the right; lever 164 moves the rod 182 to the left; whereas the rod 186 is moved both to the right and left by auxiliary mechanism hereinafter described. Thus, the rod 172 operates the control for the needle bar lay-out mechanism; the rod 175 controls the operation of the fabric draw-off mechanism; the rod 176 controls the operation of both the idle course and the special friction box mechanisms; the rod 181 controls the operation of the knockover bit mechanism; the rod 183 controls the tension release mechanism of the fabric draw-off means, the rods 185 and 186 operate the control for the welt bar operating mechanism, and the rod 187 controls the operation of the drop stitch mechanism. The remaining rods of the group of control rods 171 to 187 control the operation of other well known mechanisms which are not directly associated with the operation of the mechanism of the present invention, and which are accordingly not herein specifically described. Furthermore, it will be understood it may be necessary to employ additional rods in machines having a larger number of mechanisms than are shown herein. As will hereinafter appear in connection with the individual rods, they each have a spring 189 associated therewith to draw it back to its original position after the button associated therewith has passed out of contact with the lever which acts on the rod. The control rods are generally operated by their buttons and levers in the same revolution in which the device or mechanism controlled thereby affects the knitting or narrowing cycle, but this is not always the case, as will more fully appear hereinbelow.

SECTION IX

Narrowing Mechanism

Figures 1, 2, 3, 4, 6, 7, 27, 81, 119, 121, and 124 to 129; Sheets 1, 2, 3, 4, 6, 7, 12, 34, 46 and 47

The new reference numerals in this section lie between 201 and 250, inclusive.

Full-fashioned hosiery is characterized by the fact that the number of loops per course varies from point to point along the length of the hose in a way to ensure a proper fit. This variation in the number of loops per course, and therefore the circumference of the hose, is accomplished by that part of the knitting machine which is generally known as the narrowing machine. As the ordinary full-fashioned hosiery is knitted from welt to toe, that is from top to bottom, and the variations in the number of loops per course required to provide for fit are therefore mostly in the direction of fewer loops per course, such reduction in the number of loops per course is called "narrowing" and is generally accomplished by interrupting the knitting while one or more loops at the end or ends of a course is or are lifted from the end needle or needles and transferred inwardly by cooperating point members. Auxiliary loop manipulating point members which are also carried by the narrowing machine, are customarily provided to otherwise manipulate selected loops so as to import desired effects to the fabric.

As has been indicated hereinabove, the knitting cycle is carried out when the main cam shaft 42 is in its left hand position when viewed from the front of the machine. A full-fashioned knitting machine also performs a narrowing cycle and this is carried out when the shaft 42 is in its right hand position, the shaft being shifted automatically at desired times under the control of the main pattern chain 156.

The narrowing cycle is distinguished from the knitting cycle by several things, one of which is that no yarn is laid to the needles. This follows from the fact that the right shift of the main cam shaft 42 disengages the clutch for the gears involved in driving the coulier cam. The friction box rod therefore remains stationary. Also, the shift of the cam shaft throws the presser cam 43 (Fig. 81) out of the plane of the follower 41 therefor and moves into the plane of follower 41 a cam 43A (Fig. 93) which controls the presser shaft 39 during the ordinary narrowing cycle and which is formed so as to prevent the needles from going to press, thereby avoiding any danger of a press-off. Other modifications also are introduced into the movements of the needles 26 and knockover bits 73 by special cams which are brought into active position by the shifting of the cam shaft.

The mechanism employed in the "Reading" full-fashioned knitting machine for carrying out the narrowing cycle is partly shown and includes a narrowing machine having a back narrowing shaft 201 fixed to the machine frame and having levers 202 which have fixed thereto at their forward ends a front narrowing shaft 203 (Fig. 27). Said front narrowing shaft is supported by generally vertical links 204 which have a swivelled connection to shaft 203 at their upper ends and are swivelled at their lower ends to pins 205 carried by generally horizontal levers 206. At their forward ends, levers 206 are pivoted on pins 207 fixed to the machine frame and extend rearwardly beyond the pivot pins 205 and have notched rear ends 209 by means of which they may be supported. When the narrowing machine is inactive, the rear ends 209 of levers 206 are supported on the upper ends of rods or levers 208 at a level such that any elements supported from the front narrowing shaft 203 are out of the way of the needles. Rods or levers 208 extend generally upward from pivots 211 in the rear ends of arms 212, the forward ends of which are fixed to a lift shaft 213. Vertical levers 208 also extend below their pivots 211 as shown at 214, and springs 216 between the extensions 214 and downwardly projecting lugs 217 on said arms 212 slightly forward of the pivot pins 211 provide constant turning moments for pressing the upper ends of levers 208 forwardly toward the rear ends of levers 206 as far as permitted by limit screws or bolts 221 fixed in upwardly projecting lugs 222 on arms 212 near but forward of pivot pins 211. A hand operated means 218

(Fig. 2) of the general kind usually employed on full-fashioned knitting machines is provided whereby the lifting shaft 213 may be turned to the position shown in Fig. 27 in which the levers 208 have been moved from beneath the levers 206 and the narrowing machine lowered to rest, through cam followers 223 (Fig. 4) rotatably mounted on levers 206, on supporting disks 224 when the cam shaft is in the left hand or knitting position. When the cam shaft is shogged or shifted to its right hand or narrowing position, narrowing or dipping cams 226 are brought into the planes of cam followers 223. Said disks 224 have sufficient diameter to hold the front narrowing shaft high enough to prevent interference between the narrowing points 231 and the needles 26 and this is true also of the dipping cams 226 at the point at which cam followers 223 first engage therewith. However, as the cams 226 revolve, the points 231 in the narrowing combs are permitted to move down in the usual fashion so that the points press in between certain needles and the loops thereon at the same time closing the beards of said needles. Fig. 119 shows certain points referred to hereinbelow which are similar to points 231. In Fig. 119, the points are shown approximately at the lowest level in their cycle, the sinkers and dividers being at the time moving toward their most retracted position. The dipping or narrowing cams thereupon raise the points, thereby lifting the loops from said certain needles as indicated in Fig. 121, the lower ends of the points being slightly above the knock-over bits, the needles also rising somewhat at the same time as the points due to the action of the narrowing needle cams. The points 231 are thereupon shifted two needles and the points go down again to place the loops carried thereby onto needles already each holding a loop, and the sinkers and dividers come forward above the loops to strip them down on the needles as the needles rise.

The narrowing machine has fixed thereon brackets 227 from which are supported the necessary means for shifting the points 231. For this purpose, horizontal longitudinal rods 228 are mounted to slide in slots in said brackets and have combs 229 having said points 231 thereon adapted to operate on the loops of the needles of the needle groups at the end of the courses to be narrowed when the shaft 203 is dipped. After the initial lift given shaft 203 by the dipping cams 226, rods 228 are shifted inward two needles by well known narrowing head mechanism R, (Figs. 1 and 6) on the ends of the machine and comprising nuts which are shifted in opposite directions by reversely threaded spindles at the proper point in the cycle. Upon the second dip in the cycle of the narrowing machine the loops which were taken up by the narrowing points are replaced on other needles, thereby causing each of certain needles to hold two loops and in this way effecting the narrowing of the fabric.

A loop transferring action in some respects similar to that of narrowing, but which may be distributed throughout the fabric or limited to any desired portion thereof, may be carried out by lace, lock stitch or picot points 237 fixed to and depending from lace, picot or lock-stitch bars 232 on the narrowing machine. Bars 232 are fixed to bent arms 233 which are fixed to a lock stitch shaft 234 which is shown as pivoted in forwardly projecting bracket portions 236 fixed to said brackets 227, the axis of lock stitch shaft 234 being forward of the front narrowing shaft 203 and nearly on the same level. Lock-stitch bars 232 may be swung so that points 237 are out of the way above the level of the shaft 203, but are shown in Fig. 27 as lowered into position for cooperation with the needles 26. Ordinarily half as many points 237 are employed as needles. Therefore, if shaft 203 is dipped and points 237 pick loops off of the alternate needles, and the lockstitch shaft 234 is then shifted a distance of one needle and dipped again, the loops which were picked from the alternate needles by the points will thereby be transferred to the intermediate needles which, in turn, will then each hold two loops whereas said alternate needles will hold none. A lockstitch course is the result. A lace attachment mechanism L (Figs. 3 and 4) suitable for this purpose is more fully disclosed in the patent to G. Bitzer, No. 2,180,220, issued December 5, 1939. The same dipping cams 226 are used, however, in making the lockstitch course as when carrying out a narrowing operation.

At the end of either the narrowing or lockstitch operation the cams 226 lift the followers 223 high enough so that the cam shaft 42 can shift back to its left hand position again bringing said round cam disks beneath the followers 223, whereupon the points 231 or 237 are supported above the needles. The narrowing machine may then be elevated further, if desired, by the manually operated means for raising and lowering the narrowing machine of which lifting shaft 213 forms a part.

Toward the end of the cycle with which this invention is particularly concerned, the welt having been turned, the welt bars of the mechanism hereinafter disclosed are relieved of the draw-off tension, but remain, for a time, with the welt hooks therein still engaged in the fabric as shown in Fig. 124. The welt bars being close to the needles for a time after the welts have been turned, the weight of the welt bars presses down each fabric blank to cause a comparatively sharp slope therein in the section nearer the needle row. This has no effect unless it is attempted to make lace or transfer stitches in the fabric near the lower edge of the turned welt. If this is attempted, the loops which have been lifted on the lace points to be transferred to other needles may be dragged off the lace points by the weight of the welt bars before the transfer can be effected. In order, therefore to permit lace stitches to be made in the after welt (Fig. 7) or single ply section close to the edge of the two-ply section without danger of causing runs, I may provide special lace points 238 as shown in Figs. 124 to 129 inclusive. Points 238 are similar to points 237, but have projections 243 formed thereon which project toward the rear of the machine. Projections 243 therefore are on the surface of points 238 against which the loops draw when held on the points and, being near the lower ends of the points, they are pressed below the loops when the points are forced down over the needle beards so that the loops hang there as shown in Figs. 124 and 125 until stripped off points 238 at the proper point in the cycle by the sinkers and dividers.

SECTION X

Drop Stitch Mechanism

Figures 6, 27 and 118 to 123; Sheets 6, 12 and 46

Numerals employed initially under this heading are included in the group 251–260, inclusive.

I have found that the process of turning the

welt by mechanism is facilitated by dropping every other loop or stitch in the first course and have therefore disclosed a means for this purpose.

Said means herein disclosed is generally of known form and cooperates with the novel features of the mechanism and method also herein disclosed for the general purpose of turning the welt. It will be understood that it has long been the practise in the hosiery trade to turn the welt, although this step has usually been performed by hand instead of by mechanism, the operation of turning the welt not only serving to lock the loops of the first course, held by hooks at the beginning of knitting, but providing a two ply or folded section at the top of the stocking, a feature which is in favor with the trade.

The narrowing machine may also be used as the principal element in a means for casting off or dropping stitches.

In the operation of the machine shown in the drawings, means are provided for casting off from the needles alternate loops of the first course. For this purpose, the picot bars **232** are again used. Also, the front narrowing shaft is dipped when points **237** are in their lowered position in a manner to cause them to pick the loops off of certain needles, dipping cams **226** being again used at this time. For this purpose, the narrowing machine is lowered by hand so that followers **223** support its weight on the round cam disks and the bars **232** are turned down prior to the time cam shaft **42** shifts into the right hand or narrowing position as controlled by main pattern chain **156** of pattern means P. The needle motion for the casting off process is the same as for narrowing or making lock-stitch courses. The cams **226** bring points **237** down from the position of Fig. 118 into the proper relationship with the needles to pick up alternate loops on the points (Figs. 119 and 120) and to raise the points somewhat ahead of the needles until the points **237** are above the level of the knockover bits as shown in Fig. 121. From this point, the needles descend to the position shown in Fig. 122, while the points **237** continue to rise, thereby causing the lower edges of the sinkers and dividers to strip the loops off the points. The change in the motion of points **237** in the casting-off process compared to the motion of the points **237** in making a lock-stitch course is provided by casting off cams **251** (Fig. 27) which are brought into play at the time the needles start down the second time. Said cams **251** act on the narrowing machine through cam followers **252** which are slidably and rotatably mounted on gudgeons **253** fixed near the forward ends of arms **255** which are fixed to and extend forwardly from the lifting shaft **213**. At approximately the time the points **237** and needles are in the positions shown in Fig. 121, that is when the needles are somewhat above the knockover bits and a little above the lower edges of the sinkers and dividers, the pattern chain **157** of auxiliary patterning mechanism N (Fig. 6) operates rod **187** to move the lower ends of levers **257** to the right as shown in Fig. 6 thereby moving forks **254** at the upper ends of levers **257** toward the left and thereby moving cam followers **252** into the planes of said special casting-off cams **251**.

Casting-off cams **251** have a contour including high points **256** such that points **237** rise ahead of the needles but at a time such that the sinkers and dividers come forward above the loops on the points as the sinkers and dividers make their second forward movement in the cycle and therefore strip the loops off the points. The lower ends of the points are, however, at this time far enough above the needles so that the loops are pulled by the draw-off tension above the tips of the needles to the non-beard sides thereof, thus completing the casting off operation as shown in Figs. 122 and 123.

SECTION XI

Carrier Rod Actuating Means

Figures 96, 98 and 99; Sheets 41 and 42

Numerals employed initially under this heading are included in the group **261** to **275**, inclusive.

The yarn carriers which feed the yarn to the needles are fixed to yarn carrier rods or bars of which there are usually seven or more in a given full-fashioned knitting machine. Said carrier rods are moved back and forth parallel to the needle rows, one or more being used at a time as required by the number of yarns being knitted into a given section of fabric, each rod having one yarn carrier per knitting section and one yarn being ordinarily delivered per carrier. The rods are connected when in use to a friction-box, of which several are mounted on a friction-box rod mounted to reciprocate parallel to the needle rows, each box having means whereby it may frictionally engage the friction-box rod or be released therefrom as desired. The said engaging means is adapted to permit the rod to slide therethrough without damage to the engaging means or to the friction-box rod whenever the carrier rod is stopped or held by some other part.

The yarn carriers **59** which lay the yarn to the needles **26** are shown as fixed to yarn carrier rods **128**. Said rods have dogs **144** thereon having transverse slots **143** therein for receiving a driving dog **142**. Dog **142** is fixed to the forward end of a bar **139** mounted on a friction-box **131** so as to be movable transverse to rods **128**. Only one friction box **131** is shown and this is of special construction designed to adapt it to the welt forming and turning cycle according to the invention. However, so far as its general functions are concerned and its relation to the yarn carrier rods **128**, box **131** is a good example of friction boxes in general mounted on two reciprocating friction box rods, a high speed rod **132** and a low speed rod **136** which reciprocates at half the speed of rod **132**, rods **132** and **136** being parallel to carrier rods **128**. When box **131** is attached to either of said rods it reciprocates therewith for a certain portion of the traverse of the rod. For attaching the friction box to the friction box rods, two handles or levers **137** are shown on box **131**. Levers **137** have cam portions on their lower ends adapted to act on plates **138** which lie above and parallel to the rods **132** and **136**. When a lever **137** is thrown to the left as shown in Fig. 96, its cam portion presses the corresponding plate **138** downward against a friction leather (not shown) which lies between the plate **138** and the friction box rod **132** or **136** to thereby frictionally attach the friction box to a rod. The friction box is therefore traversed with the rod as far as it is permitted to do so. However, it is desired that the yarn carrier shall not pass the ends of the knitting field, the yarn carrier ordinarily being stopped so that it lies alongside the last sinker when all the needles are in use or above a divider when less than the full number of needles are in use. For stopping the carrier rods at the proper points, ad-

justable end stops are provided against which the ends of the yarn carrier rods strike to stop the rod in use. As the connection between the friction box and its rods is only a frictional one, the carrier rod and friction box are stopped at the same time, the friction box rod sliding through the box some distance after the box stops.

However, in order to prevent noise and wear which would be caused by the yarn carrier rod striking its end stops at the same speed as the high speed rod 132, an auxiliary half speed rod 261 is connected to the couliering means to move at the same speed as half speed friction box rod 136. Auxiliary rod 261 has fixed thereto two dogs or checks 264 and 266, and box 131 has fixed thereto a tappet or striker piece 267, best shown in Figs. 98 and 99, adapted when in its usual or normal position to engage one or the other of said checks, as the case may be, shortly before the yarn carrier rod 128 strikes the end stop. The motion of the friction box is thereby reduced to one half that of rod 132 before the rod 128 strikes the end stop. The connection between rod 261 and the means for driving it is one permitting a certain amount of slippage so that there is no danger of damage when piece 267 strikes the dog or check 264 or 266. The form of connection between auxiliary half speed rod 261 and the means for reciprocating it is shown and described in detail in Patent No. 2,030,037, February 4, 1936, to Waechtler et al. A further general description of the relative action of the friction box and the auxiliary half speed rod is to be found in Patent No. 2,059,667, November 3, 1936, to Waechtler et al. In order to relieve the end stop and rod 128 of the blow from the mass of the friction box 131, a fixed stop 268 may also be used. Stop 268 is shown as fixed to a bar 271 adjustably fixed in turn in the frame of the machine. A striker or tappet piece 272 on box 131 is arranged so as to strike stop 268 at the same time the rod 128 strikes an end stop.

The bar 139 for connecting box 131 to a rod 128 is shown as hand operated, box 131 being one used in knitting the welts of stockings, for which purpose a change in body yarn in each successive course is not necessary. However, if desired, an automatic means may be employed on box 131 for connecting it to and disconnecting it from a group of yarn carrier rods for laying successive courses of yarn. Striker 272 is slidably mounted in box 131 so that it can be pulled forward by handle 273 to permit piece 272 to clear stop 268 when box 131 is to be laid out at the side of the knitting field. In this position the box 131 may be held stationary by means described hereinbelow.

SECTION XII

Knockover Bit Control

Figures 5, 6, 94, and 101 to 106; Sheets 5, 6, 39, 43 and 44

The reference numerals originating under this title are embraced by the group 276 to 350, inclusive.

Characteristic devices of flat and full-fashioned knitting machines are the knockover bits which are composed of thin metal and which are so arranged that there is one knockover bit beneath each of the sinkers and dividers in the same vertical planes. When the knitting needles draw the loops down off the noses of the sinkers and dividers, the loops fall down onto the knockover bits and are held there until the needles draw

the loops of the new course through the loops of the old course, the knockover bits being given suitable motions whereby they catch the loops and assist the action of the needles in drawing one group of loops through another.

As best shown in Fig. 94, the knockover bits 73 are mounted in beds 277 which pivot about axes 278. Levers 279 depending from pivots 278 serve to turn the knockover bit beds 277 as desired, and arms or levers 279 are given the proper motion from a group of five cams 281, 282, 283, 284 and 285 (Fig. 5) on shaft 42. Cam 282 is provided with a second path 285 for purposes hereinafter set forth. Said levers 279 are operated from cams 281–285 by means including links 287 which are pivoted both to the lower ends of said levers 279 and to the upper ends of generally vertical levers 288 which are pivoted intermediate their ends on a knockover bit shaft 289 mounted in the machine frame. At their lower ends, levers 288 are connected by links 291 to levers 292 which are swivelled at their upper ends on said front catch-bar shaft 77, links 291 being pivoted to both levers 292 and 288. Movement of levers 292 is therefore transmitted to knockover bits 73 through the linkage including links 291, levers 288, links 287 and arms or levers 279. At their lower ends, each of levers 292 is forked to provide space for a long pin or axle 292 on which a rotatable and axially shiftable cam follower 293 is mounted, the follower 293 being adapted to cooperate with cam 281, either path of cam 282, cam 283, cam 284 or cam 285.

The motion of the bits 73 is desirably different under different conditions of operation and I have provided means whereby the motion of bits 73 is controlled automatically. To this end follower 293 is arranged to be shifted lengthwise of pin 292 by means of a fork 294 at the end of an arm 295, the lower rear end of which is fixed to a rod 296 near the back beam 5 of the machine frame. Rod 296 extends along the rear of the machine to a point at which it makes operative connection with a selective shifting means Q shown in Figs. 101 to 106. The connection between rod 296 and means Q includes a member 297 fixed on rod 296 and having a pair of spaced lugs 298 between which extends the rounded lower end of a lever 299, the upper end of which is fixed to a horizontal shaft 301 extending at right angles to rod 296 and above shaft 42. As is clear from Fig. 103, lugs 298 are spaced almost the exact distance equal to the diameter of said rounded end, so that there is a rolling contact between said end and said lugs when the lever 299 is swung to shift rod 296, thereby providing an efficient mechanical transmission for this purpose. Also, to prevent rod 296 from turning on its longitudinal axis, an arm 302 of member 297 is arranged to project upwardly between lever 299 and a lug 303 extending from the side of lever 299.

Shaft 301 extends transversely of the machine between two brackets 304 and 305 on the rear and front beams 5 and 4 respectively of the machine frame, a horizontal brace rod 306 being fixed to said brackets and extending between them above shaft 301. A tension spring 307 is connected to an arm 308 fixed to shaft 301, said spring and arm being so arranged as to urge lever 299 and rod 296 toward the right as viewed in Fig. 103. In order to move rod 296 against the tension of said spring 307, an arrangement is shown comprising a cam 309 on shaft 42 and a roller type follower 311 therefor

rotatably mounted near one end of a lever 312, said spring 307 being connected between said arm 308 and said one end of lever 312. The other end of lever 312 is pivoted to a link 313 (Figs. 102 and 105) the upper end of which is pivoted to the lower end of a link 314, the upper end of which is pivoted in turn to the lower end of a third link 315, the upper end of which is pivoted to the free end of an arm 316. The said links 313, 314 and 315 have their pivots so arranged that they act as a universal joint permitting arm 316 to lie in a vertical plane at right angles to lever 312 and to a short shaft 317 which lies parallel to but at a lower level than shaft 301. As shown in Fig. 102, arm 316 is swivelled on shaft 317 and has a forked portion 318 fixed thereto and offset therefrom in which is pivotally mounted a racking pawl 319. Pawl 319 has a pin 321 fixed thereto between which and a pin on portion 318 of arm 316 is connected a tension spring 322 for holding pawl 319 down in contact with the teeth of a ratchet wheel 323 fixed to shaft 317. Unless prevented, therefore, every time cam 309 is rotated, it will press down follower 311 and thereby raise the front end of lever 312 to swing arm 316 and pawl 319 counterclockwise as viewed in Fig. 102 to rack the shaft 317 counterclockwise. However, a branch arm 324, integral with arm 312 normally is held up by a pattern controlled arm 325 so that cam 309 has slight if any contact with cam follower 311 and the revolutions of cam 309 therefore have no effect so long as this condition continues.

At the front end of shaft 317 is fixed a disk 326 (Figs. 101 and 104). Disk 326 has a series of different length pins 327, 328, 329 and 331 fixed in holes 332 therein so as to project from the front face of the disk parallel to the shaft 317. The majority of the pins are of uniform diameter as to the portions extending outward from the face of disk 326. Some of the pins 329, however, have reduced free ends 333 for purposes that will presently appear. At the forward end of shaft 301, three levers 334, 335 and 336 are shown fixed to said shaft, said levers being arranged to hang down in front of disk 326 into the path of said pins. However, said levers 334, 335 and 336 have different contours (as is clear from Fig. 104) and it will be understood that the pins 327, 328, 329 and 331 are of three different lengths as shown in Fig. 106. Any pin or pins 327, the shortest of said lengths, is adapted to contact only lever 334, the one nearest the front face of disk 326. Also, lever 334 is cut away along the face which contacts the pins farther than either lever 335 and 336, which lever 336, the one farthest from disk 326, is cut away the least of any. Consequently, any pin long enough to contact lever 336 will strike only lever 336 without touching either of the others and thus give lever 336 greater angular movement in the clockwise direction as viewed in Fig. 104 than either lever 334 or lever 335. Thereby, also, the shaft 301 is caused to make its maximum angular motion from its original position, and rod 296, consequently, carries out its maximum longitudinal traverse toward the left as viewed in Fig. 103. Similarly, any pin 327 which is only long enough to contact lever 334 gives rod 296 a less traverse from its original position than one contacting either lever 335 or 336, whereas a pin 328 long enough to contact lever 335, but not 336, gives rod 296 a traverse intermediate that given rod 296 by either a shorter or longer pin. The initial position of rod 296 and shaft 301 is adjustably determined by the contact of an extension or nose 337 on the middle lever 335 with the top of a bolt 338 fixed in a portion of bracket 305, said contact holding shaft 301 against spring 307. In order to prevent overrunning of disk 326 and to assist to assure the proper relative positioning of the parts for accurate shifting of rod 296, disk 326 is shown as provided around its edge with spaced notches 339, and a spring pressed dog or plunger 341 is shown for engaging said notches for the purposes stated. In operation, as is clear from Figs. 6, 94, 101 and 103, spring 307 holds the rod 296 in its right hand position in which fork 294 holds follower 293 on cam 281, the cam for giving the knockover bits the proper motion for plain knitting. When shaft 42 is shifted to the right as viewed in Fig. 5 as occurs now and then in the usual cycle for making full-fashioned stockings, cam 282 is thereby brought into the plane of follower 293 without any change in position on the part of the follower. For the welt turning operations and the special motions of the knockover bits other than ordinary knitting and narrowing, one of levers 163 associated with auxiliary pattern chain 157 is operated by a button 159 to pull a control rod 181 to the right and thereby tensions a spring 342 connected between rod 181 and the lower end of arm 325 (Fig. 102) to remove arm 325 from beneath branch arm 324.

Cam 309 and follower 311 thereupon become active and disk 326 is racked and one of levers 334, 335 and 336 brought into play, lever 334 being adapted to throw follower 293 into the plane of said cam 282 when cam shaft 42 is in knitting position and into the plane of a cam 283 when shaft 42 is in narrowing position, lever 335 being adapted to throw follower 293 into the plane of cam 283 or halfway across cam 282 to track 286 when the shaft 42 is in knitting position and into the plane of cam 284 when the shaft 42 is in the narrowing position, and lever 336 being adapted to throw follower 293 into the plane of cam 284 or 285 depending on the position of shaft 42.

The motion of rod 181 to the right also tensions a spring 189 (Fig. 6), the right end of which is connected to rod 181 and the left end of which is connected to a bracket 188, so that spring 189 throws rod 181 to the left again as soon as rod 181 is released by mechanism N. As rod 181 moves toward the left, lug 343 on rod 181 strikes the lower end of lever 325 to throw it toward the left and to throw the upper end of lever 325 beneath lever 324 again.

The control or patterning rod 181 is operated in the revolution of shaft 42 before the one in which any of cams 281–285 is to affect the knockover bits 73.

SECTION XIII

WELT BAR

Figures 9 to 26, 107, 110, 115, 116 and 117; Sheets 8 to 11, 45 and 46

Reference numbers originating under this heading are 351–375, inclusive.

In cases in which the welt is turned by hand, it has been the custom to attach welt hooks to the loops of the first course by hand, said welt hooks being fixed to a welt bar. The welt bar is then connected to an initial draw-off means which operates until the full length of the welt has been knitted. The welt is then turned by hand, the welt bar being manipulated to transfer the loops held on the welt hooks back to the needles above the loops of the last course of the welt.

Automatic engagement of the loops of the first course by the welt hooks and automatic restoration of the loops of the first course to the needles have led to certain modifications of the welt hooks and welt bar shown herein.

As soon as a length of yarn has been laid by a yarn carrier 59 for beginning a fabric, and has been sunk by the sinkers, it is then divided by the sinkers and dividers jointly to be in readiness for engagement by the beards of the needles as shown in Figs. 107 and 115. After the needles have then engaged the loops, it is necessary to apply a draw-off tension to the fabric. For this purpose, means including welt hooks 351 are commonly initially engaged with the sinker and divider loops of the starting course as for instance is shown in Figs. 110 and 116.

In the arrangement shown in Figs. 11 and 12, welt hooks 351 are employed in groups, one group for each knitting section, and each group of hooks 351 is mounted in a separate welt bar 352, Figs. 13 and 14, hooks 351 having butts 353 and which are secured to the bar 352, as by a clamp member 354 and screws 360 (Fig. 15), so as to extend substantially horizontal when in use and project from one edge of the bar 352 toward the needle row. Each of bars 352 has a pair of wings 355 extending therefrom, one from each end, by which the bars are supported for movement toward and from the needle row. Also, each bar 352 has a pair of extensions 356, as of metal, fixed to its front edge, the edge away from the needle row, said extensions 356 having extensions or goose-necks 357 formed therein, the sides of which are vertical, so that extensions 356 serve as resilient means to transmit to bars 352 thrusts to push the bars toward the needle rows and so that the bars 352 may be pushed firmly against fixed stops to locate them each a predetermined distance from a needle row without danger of breakage to any part.

Fixed centrally to the front edge of each welt bar 352 is also a metal loop 358 whereby the bar may be attached to a draw-off means.

Also clamped in each bar 352 is a group of transfer elements 359 (Figs. 9, 10, 15 and 16) which projects from the rear edge of the bar; that is from the same side as the hooks 351. The transfer elements 359 are secured to the lower face of the bar 352, that is to the face opposite the one to which the welt hooks 351 are secured as by a clamp member 361 and screws 360. Elements 359 lie intermediate hooks 351 but occupy only every other space between the hooks. The rear or free ends 362 of elements 359 project up somewhat above the level of the shanks of hooks 351 so that whenever any loops on hooks 351 slide forwardly thereon under the influence of the draw-off tension after the draw-off tension on the fabric has been transferred from the welt bar 352 to the welt rod hereinafter described, the loops strike the ends 362 and are thereby properly positioned for a transferring operation to restore them to the needles, an operation incident to the ordinary process of turning the welt of a stocking. To prevent the loops from slipping past ends 362 when pressed thereagainst, ends 362 make an abrupt angle with the horizontal shanks of hooks 351. The ends 362, however, incline somewhat toward the needle row in the upward direction so that their angle with the horizontal is less than a right angle and the ends 362 direct the loops downward against the shanks of the needles when the loops are pressed against said ends.

To facilitate a transfer of loops from the shanks of hooks 351 back to the needles, ends 362 are not only inclined but are wide enough so that they may have rearwardly facing grooves 363 therein adapted to receive the tips of the needles, as best shown in Fig. 117.

Experience in the use of welt bars and the hooks and elements therein shown in Figs. 9 to 16, inclusive, has led to certain modifications which, while not essential, give improved results. Such modifications are shown in Figs. 17 to 26, inclusive. Except for a different form of screw 364 used for assembling it, the bar 365, shown in Figs. 17, 18, 19 and 20, is the same as bar 352 shown in Figs. 13, 14, 15 and 16. However, the transfer elements 366 shown in association with bar 365 have the same diameter throughout and have the grooves 367 milled therein instead of drawn or pressed in. The hooks 351 and 368 are secured to the bar 365 as by a clamp 370, and the transfer elements 366 are secured to the bar 365 as by a clamp member 372. The bar 365 is also provided with wings 373, extensions 374 and a loop member 375, corresponding to the parts 355, 356 and 358, respectively, of the bar 352.

Further, it has been found that the tension on the fabric while on hooks 351 is such that the loops nearer the selvages are somewhat distorted as shown in Figs. 25 and 26, views taken from beneath the bar with the fabric on the welt hooks. The result of said distortion has been that sometimes the loops have occupied positions causing the needles to miss the loops when rising through the grooves 367, thereby causing runs in the fabric.

To avoid this intermittent difficulty, bars 365 are shown as having alternate hooks 351 replaced or substituted by hooks 368 (Figs. 21 and 22) of slightly different form in both end portions of the bar as is indicated in Figs. 17, 23, 24 and 25. Hooks 368, instead of being straight from butts to hook portions so that they extend horizontally from the welt bars as do hooks 351, have substantial downward bends 369 at about the points at which the loops of the fabric contact the hooks at the times when the loops have been drawn forward against the ends 371 of the transfer elements. The result is shown in Figs. 23, 25 and 26, it being clear from Figs. 25 and 26 that the needles pass upward through the loops lying against the ends 371 of the transfer elements in spite of the form of the loops in the edge sections of the fabric.

SECTION XIV

Welt Bar Operating Mechanism

Figures 27 to 50; Sheets 12 to 19

The new numbers used as references under this heading are 376–450, inclusive.

The welt bars employed in the machine disclosed herein are originally placed by the operators at or near the front of the machine and mechanical means are provided under the control of the patterning means, as hereinbelow described, for moving the welt bars toward and away from the needles at the proper times in the operation of the machine. The welt bars are attached to a fabric draw-off or tensioning mechanism before the first movement of the welt bars toward the needles. The operations of the bars and the application of tension thereto are therefore largely automatic.

When welt bars 352 are to be operated, they are placed on track members 376 having plane surfaces 377 (Figs. 40, 42 and 44). Wing por-

tions 355 of bars 352 rest on said surfaces 377 and are adapted to move forwardly and rearwardly thereon. Bars 352 are first placed near the forward ends of said track 376, so that the wings extend under inwardly projecting flanges 378 fixed to the outer edges of track members 376 by vertical webs 379 whereby the bars are held against tilting for a portion of their movement toward the needle rows. For moving bars 352, means including pins 381 are provided. Pins 381 rest on said plane surfaces 377 and are adapted to slide thereon in both directions. Further, pins 381 lie at right angles to their paths of movement and are fixed in the ends of links 382 for operating them. As is perhaps best shown in Fig. 44, the ends of links 382 lie adjacent the track members 376, and pins 381 extend in both directions from the links. When the bars 352 are so placed as to cooperate with pins 381, washers 383 fixed to pins 381 lie in juxtaposition to the outer edges of extensions 357 so that the bars 352 are properly centered and the hooks 351 lie each midway between the needles, as in Fig. 43. In order to facilitate placing bars 352 in the right position, washers 383 have bevelled edges on the sides facing toward the centers of bars 352. Links 382 are pivoted to levers 384, said levers being fixed to a shaft 385. Shaft 385 is operated by racks 387 (Figs. 27, 29, 31 and 33) which are mounted to reciprocate in planes at right angles to shaft 385, being guided for this purpose in housings 386 fixed to the machine frame. The driving connection between racks 387 and shaft 385 is furnished by toothed gears 388 the teeth of which mesh with teeth on the racks 387. Racks 387 lie nearly vertical and their lower ends are pivoted to vertical links 389 the lower ends of which are pivoted in turn to the upwardly turned forward ends 391 of levers 392. Near their forward ends, levers 392 have mounted therein bolts 393 which act as shafts for cam followers 394 which are mounted for axial and rotational movement on said bolts, see Figs. 36, 37 and 39. At their rear ends, levers 392 are pivoted at points 396 to the brackets 397 fixed to the machine frame. Levers 392 have downwardly projecting studs 395 fixed therein adapted to contact portions of said brackets 397 to normally support the weight of the levers 392 when they are not in use.

Each follower 394 may be shifted on its shaft 393 to lie in the plane of either a round disk 398 or of any one of a group of cams 399, 401 and 402 (Fig. 28), so as to cooperate with either the round disk or any one of the cams as desired. In case the studs 395 become displaced inward from their normal position, the weight of levers 392 and attached parts will be transferred through follower 394 to round disk 398. This, while increasing the resistance to movement of the follower, will not prevent it from being shifted as desired. Cams 399, 401 and 402 each act to turn shaft 385 to move pins 381 first rearwardly and then forwardly on surfaces 377. Bars 352 having been so placed that pins 381 are adjacent and forward of necks 357, the pins push bars 352 ahead of them in their rearward motion. Cams 401 and 402 each have the same maximum height and turn shaft 385 to throw bars 352 rearwardly far enough so that wings 355 are pressed against stops 403 (Figs. 45 and 49) and thereby placed in a predetermined position with respect to the needle row and held there for a certain length of time depending upon the angular extent of the maximum diameter of said cams. Each cam 402 is formed to maintain its maximum diameter for a greater angular distance than is a cam 401 and the purpose of this difference will hereinafter appear. Cam 399, however, has a less maximum height than either cam 401 or 402 and cam 399 therefore turns the shaft 385 a less angular distance than cams 401 or 402 whereby bars 352 are moved only part way from their forward starting position to their rearward position against limit stops 403. The final positions of a bar 352 when moved by the cam 399 is shown in Figs. 31 and 48.

When the high points of cams 401 and 402 have passed from beneath follower 394, said followers immediately drop down to reverse the motion of shaft 385 and to draw said pins 381 forward and to permit bars 352 to move forward again. However, it is desired that after the point of maximum height of cam 399 passes from beneath cam follower 394 that the lever 392 be held in its elevated position as shown in Fig. 31. For this purpose, I have provided an arrangement best shown in Figs. 27 and 29 to 35, inclusive.

Said arrangement comprises a lever 404 pivoted near its center on a pin 406 fixed in lever arm 392. The length of lever 404 extends generally in the same direction as that of lever 392 throughout the motion of levers 392 and 404, although the angular relation between them varies from time to time. At its left end as viewed in Figs. 29 and 31 lever 404 has a slot 407 extending inwardly from its end. A small bell lever 408 is pivoted on a pin 409 fixed on lever 392, lever 408 having a generally horizontal arm 411 on which is a pin 412 lying in slot 407 so that levers 404 and 408 are connected to move simultaneously, although lever 404 moves clockwise when lever 408 moves counterclockwise and vice versa. At its right hand end as viewed in Figs. 29, 31 and 33, lever 404 has a headed bolt 413 screwed therein as best shown in Fig. 35, and the head 414 of bolt 413 overlies one edge of an elliptical metal loop 416 so as to hold loop 416 close to the lever 404. Loop 416 is fixed to the lower end of an arm 417, the upper end of which is pivoted at 418 to a part fixed to the frame of the machine. At the upper and lower ends of loop 416 are tappet screws 419 and 421, respectively, adapted and arranged to contact with bolt 413 to swing lever 404 at proper times and thereby to swing bell lever 408 so that it may occupy either the position shown in Figs. 29 and 31, or that shown in Fig. 33. Moreover, a releasable snap action means is provided tending to hold bell lever 408 in position either at one end of its path or the other. Said snap action means is best shown in Figs. 30, 32 and 34 and includes a button or plunger 422 slidable in a bore 423 in the generally vertical arm 424 of lever 408 and pressed by a spring 426 in said bore in the direction of said pin 409 which has two segmental cuts 427 and 428 forming an angle, or point 431. Said button 422 has a rounded end adapted to engage the bottoms of said cuts 427 and 428 one at a time, and to push lever 408 in one direction or the other around its pivot pin 409 depending upon which side of angle or point 431 the button 422 contacts the pivot pin 409, the direction of the push reversing with a snap action as the center of button 422 passes point 431. In order to prevent lever 408 from throwing over too far at any time under the action of plunger or button 422, the hub of lever 408 is cut away as best shown at 432 in Figs. 30, 32 and 34, and a pin 433 is fixed to stud 409, Fig. 38, so as to project into the cut-out 432, whereby pin 433 strikes the edge of the cut-out 432 as shown in Figs. 33 and 34 to limit the throw

of bell lever 408 in the counterclockwise direction as shown in Fig. 33. Of course, cut-out 432 and pin 433 will limit the throw in the opposite direction also, but, as will be explained hereinbelow, the action of the parts is intended to be such that there will be no need for pin 433 to contact the right hand edge of cut-out 432.

When follower 394 is over the circular cam or idling disk 398, tappet screw 421 holds the right hand end of lever 404 up in position such that pin 412 is down and plunger 422 presses against the face of segmental cut 427 and therefore tends to throw bell lever 408 clockwise as viewed in Fig. 30, thereby bringing a leftward projecting lug 434 (Fig. 29) near the lower end of arm 424 into contact with a vertical face 436 at the right end of an arm 437 of the bracket 397. Bell lever 408 therefore has no effect when follower 394 is above circular disk 398.

When, however, follower 394 is in contact with cam 399 to throw the link 382 and levers 384 into the position shown in Fig. 31, lever 392 is raised just high enough so that lug 434 can pass above the corner at the upper edge of the face 436 at the right hand end of arm 437. As soon as the lower edge of lug 434 passes above the upper corner of face 436, the clockwise torque exerted on lever 408 by the spring 426 behind button or plunger 422 causes lug 434 to snap above the upper corner of face 436 so that the weight of lever 392 and attached parts will rest on arm 437 as soon as the cam 399 passes its high point. Arm 392, links 382 and levers 384 will therefore remain in the position shown in Fig. 31 as long as nothing is done to disturb levers 392 and 408.

When, however, as occurs in the course of the cycle of the machine as shown, the cam follower 394 is shifted into the plane of cam 402 and lever 392 is thereby lifted to the position shown in Fig. 33 whereby the tappet screw 419 at the upper end of loop 416 contacts bolt 413 to throw the right hand end of lever 404 downward. The left hand end of lever 404 is thereby thrown upward to turn bell lever 408 counterclockwise to cause plunger 422 to pass point 431 from left to right and thereby cause bell lever 408 to snap into the position shown in Figs. 33 and 34 in which lever 408 is quite removed from the upper corner of face 436 and the bolt 413 disengages the tappet screw 419 as shown in Fig. 33. Therefore, when follower 394 rides down on cam 402, bell lever 408 remains in the position shown in Fig. 33 until the lower tappet screw 421 in loop 416 strikes bolt 413. By this time, part of lug 434 is below the corner 436 and therefore lever 408 cannot prevent follower 394 from descending to the full extent permitted by the cam 402 and the links 382 and levers 384 therefore return to the position in which the pins 381 for pushing the welt bar 352 are at the front end of their path (Figs. 27, 41, 46, 47 and 50) as soon as the cam 402 has turned sufficiently for this to happen. Of course, cams 401 and 402 having the same maximum and minimum diameters, the action of lever 408 is the same whether follower 394 is in contact with one or the other of the two cams. Therefore, the supporting mechanism for lever 392 including levers 404 and 408 is effective only after follower 394 has been actuated by cam 399.

As will be evident to those skilled in the art, retaining the welt bars in an intermediate position as shown in Fig. 31 renders the length of welt largely independent of the length of the path of the welt bars on the rails 376. The amount of welt or number of courses knitted before the parts are moved into the intermediate position shown in Fig. 31 is variable at will within very considerable limits by changing the setting of the pattern chain and the amount of welt fabric or number of courses knitted after the parts have been moved into the position shown in Fig. 31 is also variable at will within very considerable limits. Therefore, the welt can be made quite short or quite long compared to the average according to the desire of the operator without materially increasing the area of the cross-section of the machine over one without a welt turning mechanism. This will be clear from an inspection of Fig. 41.

SECTION XV

Control for Welt Bar Operating Mechanism

Figures 1, 3, 6, 27, 28, 37, 39, 51 to 56; Sheets 1, 3, 6, 12, 13, 15, 20 to 22

Reference numerals included in the group 451 to 525, inclusive, have their first use under this sub-title.

In order that the welt bars may be moved and held at the proper times and points, the mechanism for moving the bars is automatically controlled. All automatic control originates ultimately in the patterning mechanism, but in order that the pattern chain mechanism may not be unwieldy, an intermediate mechanism is employed which is controlled from the pattern mechanism and which includes a cam and connections whereby a cam follower in the mechanism for operating the welt bars may be shifted from one cam to another to give the welt bar operating mechanism the correct impulses.

The welt bars 352 having been placed in position so that resilient necks 357 lie against the pins 381 (Fig. 27), the machine is ready to advance bars 352 to receive the loops of the first course of a fabric blank. At such a time, an arrangement controlled from the pattern chain 156 shifts follower 394 from the position in which it overlies disk 393 to one in which it contacts with disk 401. For this purpose a rod 185 is associated with the main pattern chain 156 (Fig. 1) and arranged to be operated to the left by a button thereon, spring 189 being so connected to rod 185 and to a bracket 188 (Fig. 3) as to move the rod to the right as soon as it is released by a button. Rod 185 extends to the right from the left end of the machine and, at the right hand end of the machine controls a booster mechanism O (Fig. 6). For acting on the mechanism O, rod 185 has connected thereto brackets 470 which engage a pin 451 carried in a slot 452 in the lower end of a lever 453 pivoted on a pin 454 carried by a bracket 455 fastened to front beam 4 of the frame of the machine. The upper end of the lever 453 has a pin 456 thereon which is connected to one end of a spring 457 the other end of which is connected to pin 458 near the end of an arm 459. Arm 459 is fixed to a flat cam ring 461 which controls the racking of a cam 462 having several high and low points. As shown in Fig. 56, cam 462 has associated therewith a cam follower 463 which is rotatably mounted on a pin 464 at the end of a horizontal arm 465 of a bell crank 466 pivoted on a pin 467 to a bracket 455 fixed to the frame of the machine. Bell crank 466 has also a generally vertical arm 468 which extends downwardly from pivot 467 as best shown in Fig. 52. At its lower end, vertical arm 468 has a slot 469 through which extends a pin 471 connected to a rod 186 by means of collars 460. Rod 186 extends hori-

zontally parallel to a rod 185 but in the opposite direction, extending from the right hand end of the machine toward the left. At a point 473 removed from the arm 468, rod 186 has an operating connection with depending vertical arm 474 (Fig. 28) of a bell lever 475 which is pivoted to the front beam of the machine and has horizontal arm 476 extending generally parallel to said bed. Left hand end of arm 476 is pivotally connected to the lower end of an operating rod or link 477 the upper end of which is pivoted in turn to the horizontal arm 478 of a bell crank 479 pivoted to a bracket 481 fixed to the frame of the machine. Bell crank 479 also has an arm 482 extending in a generally vertical direction, the lower end of which has attached thereto, as shown in Fig. 37, a vertical bar 483. Bar 483 lies within a groove 484 formed between the body of the cam follower 394 and a flange 485 fixed to but spaced from the follower, see Fig. 39. Consequently, when arm 482 of bell crank 479 is moved in the counterclockwise direction as viewed in Fig. 28, follower 394 is moved from a position above round disk 398 a distance determined by the contour of said cam 462. Cam 462 is so designed that its first step from an initial position in which its follower 463 is in contact with a low spot 486 of the cam brings said follower into contact with a high spot 487 on said cam such that, as hereinabove indicated, follower 394 is moved from round disk 398 past the lower left hand cam 399 into the plane of the intermediate cam 401. The next motion of cam 462 brings it into such position that follower 463 is again in contact with a low spot 488 on the cam 462, and the follower 394 is returned to the position shown in Fig. 28 in which it is aligned with the round disk 398. The energy for the return movement of follower 394 is provided by a spring 189, the right end of which is connected to rod 186 and the left end of which is connected to the bracket 188 so that the spring 189 is tensioned during the cam actuated movement of rod 186. A further step of cam 462 then brings it into position such that follower 463 is in contact with a point 491 of sufficient height to move follower 394 only from the disk 398 into operating position with said lower cam 399. A further step of cam 462 brings it into position such that follower 463 is in contact with a low spot or point 492 such that follower 394 is shifted from cam 399 back to round disk 398. A further step of cam 462 brings it into position such that follower 463 is in contact with high spot 493 such that a follower 394 is shifted from alignment with disk 398 and into alignment with cam 402. A further step of cam 462 brings it into position such that cam follower 463 is on a low spot 494 resulting in the return of cam follower 394 from alignment with cam 402 and into alignment with disk 398. This completes a cycle of operations of the cam follower 394 although it involves a rotation of cam 462 of only 180°, the same cycle being repeated on the other half of cam 462.

As has been indicated, the stepping of cam 462 is controlled from the pattern chain 156 by its control of the flat ring 461. The impulses for racking the cam 462, however, are derived from a cam 495, best shown in Fig. 51, fixed to the main cam shaft 42 and adapted to deliver an impulse for racking cam 462 at each revolution of the main cam shaft. Cooperating with said cam 495 is a roller type cam follower 496 pivotally mounted at the end of a lever 497 pivoted at 498 on said bracket 455 fixed to the frame of the machine. Said follower 496 is mounted beneath cam 495 and at or near the rear end of lever 497 which has connected thereto, near its forward end, the lower end of a spring 499 the upper end of which is connected to a pin 501. Pin 501 is fixed to a pawl 502 which is best shown in Fig. 52 and is pivoted in turn at point 503 to the outer end of an arm 504 which is connected to a ring 505 (Fig. 55) rotatably mounted on the hub 506 of the cam 462. As best shown in Fig. 55, the hub 506 of cam 462 is journalled on a fixed shaft or stud 507 which is fixed to and extends horizontally forward from the upper portion of said bracket 455. Consequently, when high point of said cam 495 presses the follower 496 downward, the forward end of lever 497 is raised, whereupon the upper end of a screw 508 fixed to lever 497 contacts the under face of an ear 509 which projects laterally of and to the rear of said arm 504, thereby raising said arm and turning it clockwise as viewed in Fig. 52. The pawl 502 pivoted to arm 504 is therefore turned clockwise at the same time and a racking dog 511 fixed to pawl 502 and projecting forwardly therefrom thereupon engages a tooth on a ratchet wheel 512 and racks it in the clockwise direction. A bolt 513 fixed to a forwardly projectig arm 514 forming part of said bracket 455 acts as a stop for contacting the end of said pawl 502 to prevent it from overrunning during its racking stroke. A spring pawl or click 515 also fixed to said arm 514 near its forward end prevents ratchet wheel 512 from turning in a counterclockwise direction as viewed in Fig. 52.

The reverse stroke of lever 497 is occasioned by a spring 516 the lower end of which is connected to a bracket 517 (Fig. 51) fixed to the front beam of the machine frame, and the upper end of which is connected to a pin 518 fixed to the lever 497. The movement of lever 497 in response to the action of spring 516 is limited by a screw 519 fixed to lever 497 and adapted to contact with a lug 521 which projects laterally from said bracket 455. When the forward end of lever 497 is drawn down by spring 516, said spring 499 draws pin 501, pawl 502 and arm 504 counterclockwise as viewed in Fig. 52 so that dog 511 may engage another tooth on the ratchet wheel 512. Further, spring 499 holds the pawl 502 and dog 511 down against the ratchet wheel 512 so that the dog 511 may be sure to engage a tooth of the ratchet wheel 512 during each racking stroke thereof.

However, said cam ring 461 has thereon a cam projection or interceptor portion 522 which is adapted to contact the under face of racking dog 511 and to hold it outside of the diameter of the ratchet wheel 512 as shown in Fig. 53. When ring 461 therefore is in the position shown in Figs. 52 and 53 the cam 462 cannot be operated from cam 495 and cam 462 remains stationary. The disabling position of said cam projection or interceptor portion 522 corresponds to the position of said control rod 185 when no button on main pattern chain 156 is active, lever 453 being turned to its relatively counterclockwise position shown in Figs. 52 and 53. In order that lever 453 may turn cam ring 461 clockwise as the lever itself turns counterclockwise, ring 461 has a second arm 523 which is adapted to contact said pin 456 at the upper end of lever 453 to turn the ring 461 as the lever moves in the counterclockwise direction due to the action of spring 189 in moving rod 185 to the right. As previously indicated, the clockwise movement of lever 453

turns ring 461 counterclockwise to the position shown in Fig. 54 by pulling on pin 458. The clockwise movement of arm 453 being inaugurated by a button on chain 156 acting on rod 185, the racking of cam 462 is therefore under the control of the pattern chain.

SECTION XVI

Needle Bar Layout Mechanism

Figures 5, 81 to 90 and 111, 112 and 113; Sheets 5, 34 to 37 and 45

Reference numbers originating under this heading are 526 to 575, inclusive.

The ordinary full-fashioned knitting machine has a hand operated means whereby the needle bar may be tilted forward for the purpose of straightening and replacing needles. Said tilting of the needle bar throws or tilts the upper ends of the needles forwardly. It has been found that so tilting the needles is of assistance in the step of returning the loops of the first course to the needles and it has been the custom to tilt the needles forward by hand to facilitate turning the welt. I have disclosed herein an automatic means for this purpose under the control of the patterning means.

To facilitate the entrance of the tips of the needles into grooves 363 of the transfer elements 359, I have shown means for tilting the needles 26 forward to the positions best shown in Figs. 111, 112 and 113 at the time the first and last courses of the welt are to be interknitted. A mechanism for this purpose is shown in Figs. 81 to 90, inclusive. As is well known, the horizontal position of the needles 26 and needle bars 27 is varied during knitting by rocking needle bars 27 about pivots 31 (Fig. 81). The rocking motion of bars 27 is produced by swinging arms or levers 48 which depend from bars 27, the lower ends of which are moved back and forth by links 46 pivoted to the arms 48 at points 47. Links 46 extend forwardly and each of them is provided along its lower edge or side with a U-shaped notch 54 (Fig. 82) adapted to fit over and engage a pin 49 on presser lever 37 so that link 46 and arm 48 will follow the back and forth movements of lever 37. Link 46 has also a notch 526 on its lower edge and a handle 527 at its front end whereby the operator may lift link 46 to disengage pin 49 from notch 54 and shift link 46 rearwardly enough to permit pin 49 to enter notch 526 whereby needles 26 are swung and held far enough forward to permit making repairs. During knitting, only notch 54 is ordinarily used. However, to provide for the forward motion of the needles needed to permit proper cooperation of the needles 26 with the transfer elements 359, pin 49 is disengaged from notch 54 and link 46 moved rearwardly relatively to pin 49 so that the pin 49 lies against the vertical front face 528 (Fig. 89) of a square shouldered notch 529 which is ordinarily found on the lower edge of link 46, adjacent notch 54. For this purpose, pin 49, as best shown in Figs. 87, 88 and 89, has pivoted thereon near its free end an elongated metal loop 531 provided with an elongated slot 532. In the arrangement shown in Fig. 90, link 46 has a pin 533 fixed therein parallel to pin 49, pin 533 projecting through slot 532 so that by turning loop 531, pin 49 on lever 37 and link 46 can be moved relatively to each other.

For swinging or turning loop 531 on pin 49, means is provided including an arm 534 having a U-shaped notch 535, best shown in Fig. 87, therein adapted to engage a pin 536 fixed in one side of loop 531. As best shown in Fig. 82, arm 534 forms the major part of a bell crank 537 pivoted at 538 to an arm 539.

In Figs. 84 and 86, I have shown a lever arrangement similar in many respects to a portion of that shown in Figs. 81, 82 and 83 and having the same functions, but modified to adapt the mechanism to the knitting sections having no presser cams. In such knitting sections, the presser lever is modified to have the form shown at 38 in Fig. 86, the lower end of which terminates about at the level of link 46 and in which pin 51 is fixed, pin 51 having the same functions as pin 49 in supporting link 46 and serving as pivot for loop 541, which has the same functions as loop 531 but is on the opposite side of link 46. Pin 51 is long enough so that loop 541 at the end of pin 51 is off-set from the part of lever 38 nearer to it to permit a link 46 to lie between the two. In Fig. 86, pin 542 therefore, while acting similarly to pin 533 extends in the opposite direction from link 46. Also, pin 543 of Fig. 86 extends on the opposite side of loop 541 from link 46 as compared to pin 536 of Figs. 81 and 87. Pin 543 is long enough so that an arm 544 (Fig. 84) adapted to cooperate therewith is straight instead of bent as in the case of arm 534 (Fig. 83). Pin 542 extends through the opening in the loop 541 and can function in Figs. 84 and 86, as does pin 533 in Figs. 82, 83 and 87, to produce a relative motion between link 46 and lever 38, when loop 541 is swung about its pivot 51.

Arm 539 has a lug 545 projecting from the side thereof which is closer to bell crank 537, and bell crank 537 has a short arm 546 which projects alongside arm 539 substantially at right angles to arm 534 and which carries a tappet screw 547 adapted to contact lug 545. The weight of arm 534, aided by a spring 548, tends to turn bell crank 537 in the counterclockwise direction as viewed in Fig. 81 to throw screw 547 against lug 545, the lug acting as a stop, although arm 546 is free to turn in the clockwise direction as viewed in Fig. 81. By adjusting the screw 547, the arm 534 is held so that pin 536 enters notch 535 when arm 539 is turned counterclockwise from the position shown in Fig. 81. Arm 539 is fixed to a rod or shaft 549 which has also fixed thereto an arm 551 which is best shown in Fig. 82 and which extends generally downward from shaft 549.

As is clear from a comparison of Figs. 83 and 84, arm 539 of Fig. 83 lies on the opposite side of link 46 and arm 534 compared to the relative arrangement of arm 552, arm 544 and link 46 in Fig. 84, although the functions of arms 539 of Fig. 83 and arm 552 of Fig. 84 are identical. Also it will be noted that spring 548 is on the opposite side of arm 534 in Fig. 83 compared to the relative positions of spring 553 and arm 544 in Fig. 84, but the springs have the same function in both cases and no change is required in arm 544 on this account but only in the point of connection of the spring. It is clear, however, from Figs. 83 and 84 that arm 534 of Fig. 83 is bent while arm 544 of Fig. 84 is straight in plan view.

Near its lower end said arm 551 is provided with an elliptical slot 554 which permits limited motion relative to arm 551 of a pin 555 which is mounted in the upper end of a fork 556 at the upper right hand end of an arm 557 forming part of a Z-shaped lever 558 pivoted on a pin 559 mounted in a bracket 561 (Figs. 5 and 82) fixed to the front bed 4 of the machine frame, whereby lever 558 may oscillate transversely of the main cam shaft 42. Arm 557 also has a prong

562 extending upwardly to a level higher than pin 555 and lying between said pin and shaft 42 and adapted to contact a stop 563 on a prong 564 projecting from the hub of arm 551 generally in the direction of shaft 42. When the upper end of prong 562 is in contact with stop 563 as shown in Fig. 81, arms 551 and 557 are locked so that shaft 549 cannot turn to let arm 534 descend to engage pin 536. Shaft 549 is normally held by a spring 565 in the axial position in which arms 551 and 557 lock the shaft against turning.

When shaft 549 has been shifted axially, prongs 562 and 564 are no longer in the same plane and shaft 549 is then free to turn counterclockwise from the position of Fig. 81 so that lever arm 534 may be lowered into the position of Fig. 88 in which its notch 535 will engage pin 536. As soon as arm 557 is free to turn, a spring 566 connected between a depending portion 567 of lever 553 and a bracket 568 fixed to the back beam 5 tends to swing lever 553 in the clockwise direction, as in Fig. 82, and therefore to turn shaft 549 counterclockwise so as to swing arm 534 downward. The movement of the parts is controlled, however, by the contact of cam follower 569, pivoted to lever 553, with a cam 571 fixed on main cam shaft 42. Cam 571 is so formed that lever 553 is permitted to turn clockwise as viewed in Fig. 81 to bring notch 535 of arm 534 into engagement with pin 536. Further movement of lever 553 and shaft 549 is then permitted by cam 571, forcing lever arm 534 leftward as viewed in Figs. 81 and 82 with the result of turning loops 531 and 541 from their forwardly inclined positions to ones in which they are nearly vertical as shown in Figs. 82 and 89. Owing to the interconnection of links 46 with levers 37 and 38 supplied by loops 531 and 541 in connection with pins 49, 533, 536, 51, 542 and 543, links 46 are thereby moved into the position relative to levers 37 shown in Figs. 82 and 89, the same thing, of course, occurring with respect to links 46 and levers 38. When the relative positions of links 46 have been thus changed with respect to levers 37 and 38, the result is that the lower ends of arms 48 are swung rearwardly because the levers 37 are held firmly by springs 44 so that they cannot move forwardly except by the action of the presser cams on their followers 41. Rearward movement of links 46 tilts needles 26 forwardly as shown in Figs. 82 and 111, the result desired. As cam 571 returns to the angular position shown in Fig. 81, arms 534 first draw links 46 back into the position in which pins 49 and 51 occupy notches 54 and then rise to the positions shown in Figs. 81 and 86. When this has been done shaft 549 is shifted longitudinally by spring 565 so that prongs 562 and 564 again lie in the same plane transverse to shafts 42 and 549 as shown in Fig. 85, and shaft 549 is locked against angular movement and so remains until the needle tilting mechanism is to be operated again.

SECTION XVII

Control Mechanism for Needle Bar Layout Mechanism

Figures 6, 81, 82, 91, 92, 93, 111, 112, 113 and 114; Sheets 6, 34, 35, 38 and 45

Reference numerals appearing for the first time in connection with the ensuing description of the control mechanism for needle bar layout mechanism are included in the series 576–625, inclusive.

The mechanism for tilting the needle bars requires the application of more power than is conveniently supplied by a pattern chain directly, and a control mechanism is therefore disclosed herein having a cam follower which is thrown into contact with its cam by a pattern chain and which is connected to the needle bar layout mechanism to deliver a thrust to said layout mechanism from said cam whenever the two are in contact to throw the layout mechanism into operating position. Said control mechanism and the layout mechanism both return automatically to inoperative positions after each operation.

I have shown a pattern controlled means for shifting shaft 549 in the direction of its axis in Figs. 91, 92 and 93. For this purpose, the shaft 549 has fixed thereto two spaced thrust receiving blocks 576 and 577 (Fig. 93) which project generally downward from the shaft as best shown in Fig. 91. Blocks 576 and 577 have their adjacent sides parallel and vertical to form guides for a thrust delivering or crosshead block 578 which is mounted therebetween and has sliding contact therewith. Block 578 is pivotally mounted at the forward and lower end of a lever arm 579 by means of a headed pin 581 which extends through an eye 582 at the end of lever 579, block 578 being fastened in the arrangement shown to pin 581 by means of a set-screw 583 or other suitable means. Lever 579 is pivoted near its middle on a bolt 584, the lower end of which engages and is held in a socket member 585 which is mounted to turn on a horizontal bolt 586 which provides an axis for socket 585 parallel to the cam shaft 42, bolt 586 being mounted on a standard 587 which projects vertically from the front beam 4 to which it is bolted. The socket member 585 has an arm 588 fixed to one side thereof which extends upwardly and rearwardly from socket 585 and carries at its rear end a cam follower 589 mounted to revolve in a vertical plane and to cooperate with a peripherially extending face 591 of a two-faced cam 592. Cam face 591 has a high point 593 adapted to raise cam follower 589 to its inoperative position shown in Fig. 91 and thereby to turn lever 579 to a position in which it is unable to effect movement of shaft 549 and shaft 549 remains locked against turning by the contact of prong 562 and screw 563, as shown in Fig. 81. For latching lever 579 in the position in which follower 589 is held off of all but the high point of cam face 591, a lever 594 is provided which is shown as pivoted at 595 on a horizontal axis at right angles to cam shaft 42 and supported by the standard 587. Lever 594 carries a flange or lug 596 near its upper end to which is adjustably bolted a contact plate 597, the lower edge of which is adapted to override and rest on a substantially horizontal projection 598 fixed to one side of lever 579 on the same side of the pivot of lever 579 as the block 578. A tension spring 599 connected between lever 579 and pin 601 fixed to standard 587 applies a torque to lever 579 in the direction to press projection 598 against plate 597. At the same time, a tension spring 602 connected between a pin 603 fixed to an arm 604 (Fig. 91) on standard 587, and an arm 605 fixed to the hub portion 606 of lever 594 applies a torque to lever 594 in the direction to maintain plate 597 above projection 598 (Fig. 92).

When it is desired to throw the needles into the extreme forward position shown in Figs. 82, 111, 112 and 113, a button on the auxiliary pattern chain 157 (Fig. 6) operates to move a pattern rod 172 (Figs. 91, 92 and 93) to the right as viewed in Fig. 92, and tensioning spring 189 which is con-

nected between rod 172 and a bracket 188 fixed to the machine frame, spring 189 tending to move rod 172 to the left. Said movement of rod 172 to the right as viewed in Fig. 92 transmits a pull to the lower end of lever 594 by means of a spring 607 which is connected between a collar 608 fixed to rod 172 and a pin 609 fixed to the lower end of lever 594. The pull of spring 607 tends to swing plate 597 out from over projection 598 and it results that, as soon thereafter as the high point 593 strikes follower 583, lever 588 is lifted somewhat against the pull of spring 599, the top of lever 594 then swings counterclockwise from its position shown in Fig. 92 because spring 607 overpowers spring 602. Spring 599 is then free to turn lever 579 counterclockwise from the position viewed in Fig. 91 so that socket 585 also turns counterclockwise and follower 589 is kept down on the face of cam 592. Therefore, a cam follower 611 at the left end of lever 579, as viewed in Fig. 91, moves to a position alongside a cam track 612 on the transverse or vertical face of cam member 592. Follower 611, cam face 612 and lever 579 then cooperate to throw rod or shaft 549 in the direction of its own axis to thereby move prong 564 out of the plane of prong 562 as shown in Fig. 82, at the same time tensioning spring 565 which tends to return rod 549 to its original or normal position. Tension spring 566 connected between said rearwardly and downwardly extending arm 567 of lever 558 and the machine frame, thereupon turns lever 558 in the clockwise direction as soon as permitted by cam follower 569 and permits arm 534 to drop so that the notch 535 engages pin 536 with the results hereinabove set forth.

At the said point in the cycle at which the needles are tilted forward and the welt bars 352 are in their extreme rearward positions, the pattern chain permits spring 189 to move levers 113 to release levers 33 so that cam followers 35 can follow the needle cams. Therefore the needles move up into the grooves 363 in the rear ends 362 of transfer elements 359 so as to insert the beards of the needles between the thread of the first course and the bottoms of said grooves. This operation is shown in Figs. 111, 112 and 113. The needles then continue to rise so that, the sinkers and dividers having come forward, the loops of both the first course and the last course of the welt are forced down on the shanks of the needles by the sinkers and dividers as shown in Fig. 114. In order that the needles may be held in the proper position throughout the upstroke of the needles when passing from the position shown in Fig. 111 to that shown in Fig. 114, special cams 613 (Fig. 93) are employed to position the presser levers 37 and 38 in connection with cam followers 41 (Figs. 82 and 93) journalled on the lower portion of presser lever 37 and the tension springs 44 which are connected between the levers 37 and the frame of the machine at a level below that of the followers 41. Ordinarily, followers 41 cooperate with presser cams 43, but, when rod or shaft 549 is shifted by the lever 579 and cam follower 611, fork members 616 (Figs. 82 and 93) fixed to shaft or rod 549 shift cam followers 41 into position to cooperate with cams 613 to guide the needles into cooperation with the grooves 363 in the ends 362 of transfer elements 359.

After the needles have been guided up through the grooves 363 in transfer elements 359 by the combined action of the needle cams 34 and cams 613, and the cam 571 has arrived again at the angular position shown in Fig. 81, the pattern chain 157 having permitted control rod 172 to move to the left again to the position shown in Fig. 92, and the high point 593 of cam 592 having lifted lever 579, by acting on it through follower 589 and arm 588, to the level shown in Fig. 91, spring 565 moves shaft or rod 549 so that prongs 562 and 564 are again in the same plane and spring 602 swings lever 594 clockwise to the position of Fig. 92 so that plate 597 slides above lug or lateral extension 598 on lever 579 so that the parts are locked in the positions shown in Figs. 81 and 91 until pattern chain 157 again operates rod 172.

SECTION XVIII

Friction Box Control

Figures 1, 4, 82, 94 to 100; Sheets 1, 4, 35, 39 to 42

Reference numerals used first in the description under this heading are 626 to 675, inclusive.

Most of the friction boxes employed in a full-fashioned knitting machine are held stationary for a full revolution of the cam shaft only when disconnected from the friction box rod, or when a friction box rod is stationary as in the narrowing cycles. In the mechanism herein disclosed I have found it convenient to hold the friction box initially employed stationary throughout two revolutions of the cam shaft when the cam shaft is in its knitting position, without disconnecting said box from the friction box rod. I have therefore disclosed herein a special friction box for laying the welt which is adapted to be engaged by holding means under the control of the pattern means for holding the box stationary while engaged to the friction box rod.

It is customary to allocate a certain friction box to lay the yarn for the welt of a stocking, the welt being ordinarily of heavier yarn than the leg portion. In the arrangement shown, a special friction box 131 is used for laying the yarn for the welt.

As the needle bars are rocked forward as shown in Fig. 82 to facilitate transfer of the loops of the first course back to the needles when the welt bars 352 are thrust to the rear as far as possible, it is necessary to prevent yarn from being laid at this time. This result is accomplished in the arrangement shown by holding the friction box 131 stationary. An automatic means is shown for this purpose in Figs. 4 and 94 to 100, inclusive, comprising rod 176 which controls the idle course mechanism simultaneously with its control of the means for holding stationary the friction box 131. Rod 176 is shown as extending from the pattern mechanism P (Fig. 1), at the left end of the machine and which includes pattern chain 156. Near the right end of the machine, rod 176 has attached thereto two lugs 626 spaced to have driving engagement with the rounded upper end of a bent lever 627. As best shown in Fig. 94, lever 627 extends downwardly to clear the lower ones of the group of pattern rods in front of the front beam and then rearwardly and upwardly to a point of connection with the front end of a shaft 628. Near its front end, shaft 628 is journalled in a bracket 629 fixed to the machine frame and shaft 628 is journalled near its rear end in a bracket 631, also fixed to the machine frame. At its rear end, shaft 628 is shown as having a lever 632 fixed thereto and best shown in Fig. 95. At its left end as shown in Fig. 95, lever 632 is connected to the lower end of a long vertical link 633 by means of a short link 634, the pivots at the ends of link 634 being

set at right angles to provide a universal joint. At the upper end of link 633 is a short link 636 connecting link 633 to a forwardly projecting arm 637, link 636 forming with link 633 and arm 637 a universal joint similar to the one at the lower end of link 633. Arm 637 is shown as integral with a hub 638 swivelled on the supporting bar 271 (Figs. 93 and 99) and between two collars 639 (Fig. 96) fixed against longitudinal movement on the rod. Also shown integral with hub 638 is an arm 641 on which is a stop screw 642 parallel to the full speed and the slow speed friction box rods 132 and 136 respectively, and adapted to assist, when arm 641 has been lowered to the proper level, a stop screw 268 in holding the friction box 131 stationary. Said screw 268 projects in the opposite direction to screw 642 and is fixed to an arm 643 which is also fixed to bar 271 and a companion bar 644. As shown, arm 646, which includes the striker piece 272, is fixed in a groove 647 (Fig. 100) in box 134. When rod 176 is operated by mechanism P, the shaft 628 and arm 632 are turned so as to draw link 633 downward. Arm 641 is thereupon drawn downward to the degree required to hold arm 646 between the two screws 642 and 268 so that friction box 131 is held stationary as long as rod 176 is held in its left hand position when viewed from the front of the machine.

However, another usual feature of said "Reading" machine is the half speed shock absorber hereinabove described and comprising a pair of dogs 264 and 266 best shown in Fig. 96 and fixed to rod 261 so connected to the couliering cam as to reciprocate at half the speed of the full speed friction box rod 132. Dogs 264 and 266 are fixed to rod 261 in such positions that a portion of the friction box 131 overtakes one of dogs 264 and 266 as it approaches one or the other end of its stroke. If, however, box 131 is held at one end of its stroke, a smash would occur when rod 261 reverses its direction, that is to say, in the position of the parts shown in Fig. 97, dog 264 would interfere with the part of the friction box 131 which had contacted it by overtaking it on the next preceding stroke. In order to prevent such a smash, an arrangement is shown in which the part on the box 131 intended to contact the dogs 264 and 266 is retractable out of the way of the dogs. In the arrangement shown for this purpose, said arm 637 has a high lug 648 fixed thereto extending upwardly therefrom and best shown in Figs. 98 and 99. Pivoted at the upper end of lug 648 is a long pawl 649, a spring 651 being connected between lugs on pawl 649 and hub 638 to draw the pawl 649 normally in the direction toward arm 637 and box 131, the clockwise direction as viewed in Figs. 98 and 99. The clockwise motion of pawl 649 is limited as shown by a second lug 652 on arm 637 and a tappet or stop screw 653 on pawl 649 adapted to rest on the upper end of lug 652 when link 633 holds arm 637 in its upper position. However, lug 648 and pawl 649 are long enough so that, when link 633 is drawn down and thereby pulls arm 637 clockwise from the position viewed in Fig. 98, the free end of pawl 649 strikes the upper face of arm 646 and contacts the left end of a plate 654, slidably mounted on top of arm 646. As the clockwise movement of arm 637 and lug 648 continues, the free end of pawl 649 is forced forward, or to the right as viewed in Fig. 99, along the upper face of arm 646 and pushes plate 654 ahead of it thereby carrying forward a bolt 656 fixed to the striker piece 267. The bolt 656 extends downward through a slot 657 in arm 646 and, at its lower end, bolt 656 is threaded into the striker piece 267 which is mounted to slide transversely of rods 132 and 261 in a groove 658 in the lower face of arm 646. A spring 659 connected between an upwardly projecting handle 273 on arm 646 and said bolt 656 normally holds piece 267 toward the left as shown in Fig. 98 in which position the projecting left end of piece 267 is adapted to contact dog 264. However, when pawl 649 is operated, said pawl overcomes said spring 659 to throw the striker piece 267 to the right to the position shown in Fig. 99 in which dog 264 clears the left end of piece 267 and can pass the bolt and friction box without interference when the friction box 131 is held stationary. The movement of the striker piece 267 is limited in both directions by a horizontal bolt 661 fixed in friction box 131 parallel to rods 132 and 261 and which extends through a slot 662 in an enlarged portion of piece 267 at the forward end thereof.

SECTION XIX

Fabric Draw-Off Mechanism

Figures 1, 3, 5, 6, 27, 43, 45 to 50, 63, 64 and 66 to 80; Sheets 1, 3, 5, 6, 12, 17 to 19, and 25 to 33

Original numerals here are embraced by the numbers 676 to 850, inclusive.

It is necessary that a draw-off tension be applied to the fabric as it is knitted on any knitting machine. In full-fashioned knitting machines, both weight and cam energized spring means have been employed for applying draw-off tension to fabrics during knitting. In the machine disclosed herein, I have included three draw-off means, two weight operated and one spring operated; one weight draw-off means going into operation at the time of hooking up the first course, a second weight means taking over automatically the function of applying the draw-off tension from the weight means first employed, and the spring means automatically taking over, from the weight means employed secondly, the function of applying draw-off tension to the fabric. Said first weight means acts on the fabric through one shaft and said other two tension means act on the fabric through a second shaft.

For most of the period during which the welt hooks 351 are connected to the loops of the first course of the welt, the draw-off tension is applied through welt bars 352. After the welt has been turned, the tension is applied through welt wires or rods 676, see Figs. 47, 48, 49 and 50. I have therefore shown two draw-off mechanisms, one for acting on the bars 352 and one for acting on the rods 676. Further, in order to provide a substantially continuous application of draw-off tension to the fabric and to facilitate transferring the tension from said welt bars to said welt rods without stopping the machine, I have shown a third mechanism for applying a draw-off tension to the welt rods before the welt bars have been disconnected from the fabric.

Prior to the action of shaft 385 and associated levers and links acting through pins 381 in pushing bars 352 toward the needle rows, draw-off straps 677 are attached by hand to the metal loops 358 fixed centrally of the front edges of bars 352. For this purpose, straps 677 have hooks 678 attached to their free ends, said hooks being readily engaged in said loops by the attendant. Straps 677 extend forwardly and are connected to drums 679 (Figs. 27 and 43) fixed to a rotatably mounted shaft 681 extending along the

front of the machine. At the left end of the machine as viewed from the front, shaft 681 has fixed thereto a wide faced wheel or pulley 682 (Fig. 1) which is shown as connected directly to shaft 681, although a ratchet or pawl may be employed between the shaft 681 and wheel 682 if desired. For turning wheel 682 and thereby shaft 681, a rope or cable 683 has one end fixed to the wheel, and the wheel and shaft are then turned in the direction to unwind straps 677 while at the same time winding up rope 683. Rope 683 runs rearwardly and upwardly over a rotatably mounted sheave 684 and then downward, its rear end having a weight (not shown) fixed thereto below sheave 684. As the shaft 681 is turned to wind up rope 683 and to unwind straps 677, the weight is raised from a stop position and rope or cable 683 therefore exerts a tension in the draw-off direction until the weight has been allowed to return to said stop position.

Therefore, as bars 352 are pushed toward the needle rows, the pull of the weight comes on the bars and is placed on the loops of the first course as soon as the pins 381 have been shifted forward again, and remains on the fabric until the weight goes out of action.

When knitting has progressed under the pull of the weight until the welt bars 352 have arrived approximately at the point shown in Fig. 47, welt rods 676 are inserted in the machine in grooves 685 provided in the inner vertical sides of track or bridge members 376. Grooves 685 run generally parallel to the lengths of the members 376 but curve upwardly at their rear ends and at the rear ends of members 376 where they are also enlarged as shown at 686 to form mouths adapted to promote insertion of welt wires 676 in grooves 685. Wires 676 having been inserted in grooves 685, they are pressed past spring stops 687 placed near the rear ends of the horizontal portions of grooves 685, each stop 687 having one end fixed to the bottom of a track member 376 by a screw 688 or equivalent means and projects upwardly and forwardly from its point of attachment through an aperture 689 (Figs. 45 and 46) in the bottom of a groove 685. Each stop 687 lies normally against the rear face of its aperture 689, but the aperture is wide enough to permit it to spring forward to permit a wire 676 to press past it in the forward direction. A wire 676 having been pressed past or placed in front of a pair of stops 687 cannot pass them in the rearward direction and the attendant assembles each in the position shown in Fig. 47 so that each end of a wire 676 lies against a spring stop 687. The wires 676 are then in the proper position to apply a draw-off tension to the fabric as soon as a tension in the forward direction is applied to the wires.

For this purpose, I have shown a second or intermediate weight operated draw-off means K comprising straps 691 having hooks 692 at their rear ends. At their front ends, straps 691 are fastened to elongated drums 693 fixed on a shaft 694. As best shown in Figs. 6, 66 and 67, shaft 694 has mounted thereon at its right end a wide wheel or pulley 695 to the cylindrical face of which is attached a cable 696, or equivalent means, which is arranged to run up over a guide pulley 697 (Fig. 63) and a sheave 698 and thence down to a weight 699. Cable 696 is attached to pulley 695 in such a way that the cable is wound up and the weight is lifted when shaft 694 is turned the way required to unwind straps 691 from drums 693. Therefore, hooks 692 having been drawn rearwardly to the position shown in Fig. 47, they are in position to apply the pull of weight 699 to the fabric as soon as the hooks are released.

Pulley 695 is not rigidly connected to shaft 694 but is swivelled thereon between a collar 701 and a gear wheel 702 which are fixed to shaft 694 close to wheel or pulley 695, one on each side thereof and shown as fastened to the shaft by screws 703 and 704, respectively. The torque produced on wheel 695 by cable 696, or the like, is transmitted to the shaft 694 in the draw-off direction by a pawl 705 pivotally mounted on the side of wheel 695 by a headed pin 706 which extends through the wheel 695 parallel to its shaft 694 near the rim of the wheel and is fastened to the wheel by a screw 707. A notch 700 is formed in the collar 701 (Fig. 69) into which the pawl 705 is arranged to fall to transmit the torque of rope 696 from the pulley to the shaft 694 in the draw-off direction or from the shaft to the pulley when the shaft is turned to wind up the rope but leaving the pulley 695 free to turn on the shaft 694 whenever the shaft is driven in the draw-off direction by gear 702 after the rope has become slack.

As best shown in Fig. 67, pin 706 extends through pulley 695 and projects therefrom at 708, on the side toward gear 702 for a purpose which will presently appear. For turning gear 702 and shaft 694 in the direction to wind rope 696 on wheel 695, a pinion 709 is provided having teeth meshing with those of gear 702. Pinion 709 is swivelled on a pin 711 fixed by screws 712 in a bracket 713 mounted on the machine frame, a handle 714 being provided for turning pinion 709 in the desired direction. Handle 714 is swivelled on pin 711 by a hub portion having teeth 715 (Figs. 68 and 70) adapted to engage teeth 716 on the hub of pinion 709 when handle 714 is pushed toward pinion 709 along pin 711 so that teeth 715 engage teeth 716 when it is desired to turn pinion 709. A spring 717 is coiled around pin 711 in position to hold teeth 715 normally disengaged from teeth 716 so that handle 714 may remain idle while shaft 694 is being turned by the weight 699.

As the fabric is drawn forward during the period straps 691 and hooks 692 are acting on the welt wires 676, weight 699 will reach a point at which it will no longer deliver a torque to wheel 695 and shaft 694. A third draw-off means J (Fig. 63) is therefore provided for picking up the drive of shaft 694 before weight 699 has become ineffective and for continuing the rotation of shaft 694. To prevent delay and loss of output in changing over from draw-off means K to draw-off means J the change over is made automatic. For this purpose, a trigger means is provided arranged to render an actuating pawl 718 (Fig. 71) of the spring type draw-off means J inactive until released by means associated with the second or intermediate draw-off means K.

As shown in Figs. 71, 74 and 75, the pawl 718 is mounted to oscillate about shaft 694 as an axis and except, when disabled by a cam piece 719, to apply a spring tension to shaft 694 in a way to create a torque on said shaft in the draw-off direction. Said disabling cam 719 is fixed to an arm 721 swivelled on shaft 694, and arm 721 is pivotally connected to a rod 722 whereby arm 721 may be swung around shaft 694. The connection between rod 722 and arm 721 is such that when rod 722 is lowered, a high section 723 of cam piece 719 is brought under a pin 724

fixed to pawl 718 parallel to but spaced from its pivot at 725 so as to throw pawl 718 out of operation. When rod 722 is raised, however, high section 723 is moved out from under pin 724 and pawl 718 may drop into active position. I have therefore provided means for holding rod 722 in its low position and releasing said holding means by a trigger action initiated by said projecting portion 708 of pin 706. At its lower end, rod 722 (Fig. 70) extends through a ring 726 which is between two collars 727 fixed to rod 722, the upper one of collars 727 normally resting on ring 726 so that the ring supports the weight of rod 722. Ring 726 is fixed to the free end of a generally horizontal arm forming part of a bell lever 728 pivoted on a pin 729 and having a generally vertical arm extending downward from said pivot pin. The lower end of the vertical arm of bell lever 728 is round as shown at 731 and lies between two collars or stops 732 fixed to a control rod 175. As viewed in Fig. 70, rod 175 is mounted in brackets 733, fixed to the front beam 4, so as to slide parallel to said front beam 4. A spring 189, best shown in Fig. 6, is so connected between rod 175 and a bracket 188 fixed to the machine frame, as to normally draw rod 175 to the left as viewed in Figs. 6 and 70. As shown, however, rod 175 is latched in a right hand position so that rod 722 is down and cam piece 719 toward the left as viewed in Fig. 71 to hold pawl 718 in elevated and therefore inoperative position. To hold rod 175 against spring 189, rod 175 has a collar 734 fixed thereon which is latched by a square shoulder portion 735 at the lower end of a bolt or short rod 736 which is mounted for vertical movement by and in a cylindrical guide 737 which is fixed to front beam 4. Bolt 736 has a pair of stop nuts 738 fixed thereon and arranged to rest on the top of guide 737 to support the weight of bolt 736 and that of a rod 739 pivotally connected to the upper end thereof by a yoke 741.

As wheel 695 is turned by cable 696 and projection 708 reaches the position shown in Fig. 73, projection 708 initiates the release of pawl 718 by coming into contact with the upper end of a lever 742 which is pivoted on a pin 743 fixed to a bracket 744 (Fig. 64) rigid with the machine frame. Pivoted to pin 743 is also a lever 745. At its lower end, the lever 745 has a hollow hub 746 (Fig. 70) in which is secured a pin 747 by a screw and washer arrangement 748 (Fig. 71) so that pin 747 swivels in hub 746. The part of pin 747 which projects from hub 746 as shown in Fig. 70 has a transverse aperture in which said rod 739 is slidably mounted. The upper end of rod 739 is notched as shown at 749 (Fig. 71). Except when disturbed by said projecting portion 708 of pin 706, a spring 751 connected between a pin 752 fixed to the machine frame, and a lug 753 fixed to the lever 745 at a point below pin 743 maintains the upper end of rod assembly 739 spaced from a square pin 754 (Fig. 71) at the forward end of an arm 755, the spacing of the rod 739 from pin 754 being determined by the tappet screw 756 at the upper end of lever 745 which bears against the fixed bracket 744. As soon, however, as pin projection 708 begins to turn lever 742 counterclockwise about pin 743 from the position of Fig. 71 to the position of Fig. 73, the lever 742 presses the lever 745 in the counterclockwise direction about pin 743, the lower end of lever 742 being off-set into the plane of lever 745 as best shown in Fig. 70 and having a tappet screw 757 therein for contacting lever 745 below pin 743 for this purpose. The pin 747 at the lower end 746 of lever 745 is thereby swung counterclockwise about pin 743 as viewed in Figs. 71 and 73 and the upper edge of notch 749 in the upper end of rod 739 thereby brought above the upper edge of square pin 754; a screw 758 in lever 745 below the level of pin 743 being arranged to limit the swing of lever 745 by contacting fixed member 744. Said arm 755, to which pin 754 is fixed at the outer and forward end of the arm, is itself fixed to the presser shaft 39. Shaft 39 is operated by a cam on the main cam shaft, usually cam 43, during each revolution thereof so that during the next knitting revolution after the parts have reached the position shown in Fig. 73, arm 755 is turned to raise pin 754 and thereby lift rod 739 so as to disengage the end 735 of bolt 736 from collar 734. Rod 175 is therefore moved to the left as viewed in Fig. 70 by its spring 189, thereby throwing the spring type draw-off means J into operation.

As indicated hereinabove, mechanism J acts on take-off shaft 694 through a racking pawl 718. Pawl 718 is mounted to pivot on a pin 725 (Fig. 71) which is fixed in one arm of a two-armed lever 759 (shown partly broken away in Fig. 71) which is swivelled on shaft 694 and oscillated on said shaft by a reciprocatory rod 761 which is pivotally connected to the other arm of lever 759 by means of a pin 762, so that pawl 718 tends to turn shaft 694 in the clockwise direction as viewed in Fig. 71, this being the direction of rotation of shaft 694 required to draw the fabric forward as knitted. Pawl 718 acts on the teeth of a ratchet wheel 763 fixed to shaft 694 whenever the machine is running and the pawl 718 rests on the wheel 763. As a spring 764 is connected between a handle 765 on pawl 718 and a pin 766 on the rear portion of lever 759, pawl 718 is drawn down onto wheel 763 as soon as the high part 723 of the member 719 has been moved from under pin 724. Said cam or block member 719 having been moved to permit pawl 718 to act on the teeth of wheel 763, a means is needed to prevent wheel 763 from turning during the idling stroke of pawl 718 as well as on the one intended as the racking stroke thereof. Therefore, I have provided a holding pawl means 767 to cooperate with ratchet wheel 763, and arm member 721 has a second radially projecting cam portion 768 thereon arranged to hold pawl means 767 inactive at the same time that racking pawl 718 is held inactive. For this purpose, cam portion 768 is arranged to act directly on a pin 769 fixed to a lug 771 on the upper portion of a lever 772 which is journalled on a pivot pin 773. Lever 772 also has an arm 774 which extends below pin 773 and which carries at its lower end a laterally extending lug 775. As is clear from Fig. 71, holding pawl means 767 is pivoted on the same pin 773 as the lever 772 and the means 767 also extends below the pin 773. At its lower end, pawl means 767 is connected to a pin 776 by means of a tension spring 777 acting to urge the upper end of holding pawl means 767 toward ratchet wheel 763. When, however, rod 722 is in its lower position and racking pawl 718 is held inoperative by cam piece 719, lug 775 on lever 772 holds holding pawl means 767 away from ratchet wheel 763 by pressing the lower end 778 of means 767 counterclockwise as viewed in Fig. 71, lever 772 being then held in the proper position to cause lug 775 to disable pawl means 767 by the action of cam portion 768. Therefore, when the rod 722 is held in its lower position and pawl means 767

is disabled, the take-off shaft 694 is free to turn to release any tension there may be on the fabric. When rod 722 is in its upper position, both pins 724 and 769 are permitted by the cam portions 719 and 768 on member 721 to move toward shaft 694 so that pawls 718 and 767 move into cooperative relation with the ratchet wheel 763.

However, pawls 718 and 767 can be thrown out of action by hand when desired. For this purpose, pawl 718 has a handle 765, best shown in Fig. 71, wherby the convex surface 781 of pawl 718 may be swung counterclockwise into contact with the concave surface 782 of the upper end of lever 772, thereby turning lever 772 counterclockwise which results in the throwing of the holding pawl means 767 out of action by the action of lug 775 as hereinbefore set forth. Further, when shaft 42 is in its narrowing position, as well as when the catch bar is in its lowered position during the knitting cycle, pawl means 767 may be thrown out of action by a control means, portion of which is shown in Fig. 71 and which includes a link 89 which connects a lug 783 (Fig. 72) on one side of lever 772 with the lever or arm 88 on front catch-bar shaft 77. When the arm 88 is turned counterclockwise by the cam means, link 89 moves lever 772 counterclockwise so that pawl means 767 is thrown out of action by lug 775 as hereinbefore stated. This is due to the fact that the cam follower 75 for the catchbar mechanism rides on the cam 74 when the main cam shaft 42 is in the knitting position and on the hub 91 of the said cam when the cam shaft 42 is in the narrowing position, the low spot of cam 74 having a radius equal to that of the said hub 91 so that follower 75 can readily shift from the cam to the hub when the shaft shifts. It is when the cam follower 75 is in its low position that the catchbar mechanism moves link 89 so that the link pulls pawl means 767 out of action. When the cam shaft 42 is in knitting position, however, this action or situation exists during only a very short portion of the cycle and occurs shortly after the racking pawl 718 has started its racking or tensioning stroke and the pawl means 767 is restored to engagement with ratchet 763 before racking pawl 718 reaches the end of its racking stroke, so that the temporary throwing out of pawl means 767 by link 89 has no effect on the racking action of pawl 718. During the time the cam shaft 42 is in the narrowing position, the hub 91 of cam 74 being substantially round, the catchbar mechanism and link 89 remain in substantially the same position throughout a revolution of the cam shaft and pawl means 767 has no effect on the ratchet wheel 763 and the ratchet wheel can follow the movements of pawl 718 throughout the narrowing cycle, thereby relieving the tension on the fabric sufficiently to facilitate the narrowing operation.

It will be understood that whenever pawls 718 and 767 are in active position with relation to ratchet wheel 763, the wheel is racked due to the oscillation of lever 759 on which racking pawl 718 is mounted. Lever 759 is oscillated by the reciprocation of rod 761 which is actuated by a cam 784 (Fig. 63) on cam shaft 42 through mechanism including a cam follower 785 on a lever 786 fixed to a rock shaft 787.

A tension spring 788 connected between the free end of lever 786 and a fixed bracket 789 urges cam follower 785 toward cam 784. Motion of shaft 787 is transmitted to rod 761 by a lever 791 which is fixed to shaft 787 and has a fork at its forward or free end extending beneath the protruding ends of a pin 792, forming part of a clevis 793 connected to the lower end of rod 761. Clevis 793 is connected by the pin 792 to a yoke 794. When cam 784 presses follower 785 downward, rod 761 is lifted and racking pawl 718 moved oppositely to the draw-off direction to obtain a fresh hold on the ratchet 763. When cam follower 785 is drawn up by spring 788, pressure is taken off the pin 792 and yoke 794, while clevis 793 and rod 761 are then urged downward by springs 795, suitable connections between springs 795 and yoke 794 being provided for this purpose. Further, the upper ends of springs 795 are fixed to a bracket arm 796 and the lower ends of springs 795 are connected to one end of each of levers 797 (Fig. 3) which are pivoted on a pin 798 intermediate their ends. The other ends of levers 797 bear on the yoke 794 so that the tension as applied by the springs 795 to the take-off shaft is released as the yoke 794 is lifted by arm 791 acting on clevis 793, whereas the tension of springs 795 is applied to take-off shaft 694 in the draw-off direction through rod 761 as soon as the upward pressure on clevis 793 is relaxed. Said mechanism J is not novel with me, but cooperates usefully and novelly with other draw-off means forming part of the apparatus shown. It will be understood further that said mechanism J is being manufactured by the Textile Machine Works and is shown and described in pages 101–110 of the Parts Catalogue of said Textile Machine Works, copyright 1940, referred to hereinabove as well as in pages 28 and 29 of a book "The 'Reading' Full Fashioned Knitting Machine—A Technical Description of its Construction and Operation," by F. K. Fogleman, copyright 1940, by Textile Machine Works. After the machine has finished a blank and it is desired to begin another welt, mechanism J is thrown out of action to permit the take-off to be performed by other means.

The throwing out of action of mechanism J by the patterning means is caused by the action of the control rod 175 by which it is thrown into action. For throwing mechanism J out of action, a button on auxiliary pattern chain 157 of mechanism N moves a lever 163 to draw rod 175 to the right as viewed in Figs. 6 and 70 so as to pull rod 722 down to thereby disable racking pawl 718 and holding pawl means 767 by means of disabling cams 719 and 768 on arm 721. When rod 175 has been drawn to the right by mechanism N, shoulder portion 735 drops down in the path of collar 734 so that spring 189 cannot throw rod 175 to the left again until bolt 736 has been lifted by rod 739. Of course, before rod 175 can be latched by rod 739, wheel 695 must have been operated by hand to move free or projecting end 708 of pin 706 counterclockwise from the position shown in Fig. 73.

I have found it advantageous to relax the draw-off tension on the fabric whenever the narrowing machine is to be operated. The spring type draw-off mechanism J is provided with means for relaxing the tension under the control of the pattern means, but the narrowing machine operates not only when the fabric is to be narrowed but also if stitches are to be cast off or transferred, actions which occur when the two weight operated draw-off means which act on shafts 681 and 694 are in operation. For releasing the tension produced by weights acting on shafts 681 and 694, I have shown in Figs. 5, 76, 77, 78, 79 and 80, a mechanism which is of the type disclosed in the patent to E. Richter, No.

1,824,501. In the arrangement herein shown for this purpose, main cam shaft 42 has a cam 799 fixed thereon arranged to revolve in contact with a cam follower 801 which is pivoted at the lower end of a depending arm 802 of a T-shaped lever 803 which includes also a generally horizontal arm 804 pivoted to a stud 805 on one of the center frames 3 near the rear end of arm 804. At each revolution of shaft 42 and cam 799, follower 801 is swung forward and back thereby causing the forward end of lever arm 804 to oscillate up and down around the shaft 805. At its forward end, arm 804 (Fig. 76) is forked as shown at 806 (Fig. 77) and a pin 807 is mounted in said fork to provide an axis or pivot for two levers 808 and 809 extending in a generally vertical direction although having a somewhat S-shape and being pivoted on pin 807 near their mid points. The upper ends of levers 808 and 809 are provided with toothed racks 811 and 812, respectively, adapted and arranged to cooperate with toothed wheels 813 and 814 fixed to shafts 681 and 694 respectively.

About midway between the pivot pin 807 and the rack 811 or 812, each lever 808 and 809 is provided with a hook-shaped lug 815 extending rearwardly and upwardly therefrom and connected to one of a pair of tension springs 816 and 817 which extend rearwardly and downwardly from the lugs 815. At their rear ends, springs 816 and 817 are connected to lugs 818 and 819, respectively, at the rear end of lever arm 804 so that levers 808 and 809 are continuously under tension tending to turn them counterclockwise about pivot pin 807, as viewed in Fig. 76, to throw the racks 811 and 812 toward wheels 813 and 814. Two stop screws 821 are fixed in lugs 822 projecting upwardly from lever arm 804 near the center thereof, screws 821 limiting the movement of the upper ends of levers 808 and 809 in the direction toward the wheels 813 and 814. Normally, however, levers 808 and 809 are held in the position shown in Fig. 76 in which the racks 811 and 812 cannot contact with wheels 813 and 814. For this purpose, the lower bent ends of the levers 808 and 809 are provided with pins 823 and 824 which project laterally from said levers parallel to shaft 42 and a pair of levers 825 and 826 (Figs. 77, 79 and 80) are pivoted upon bolts 827 and 828 fixed to the front beam 4 at right angles thereto. Levers 825 and 826 extend generally vertical so that their upper ends swing in planes parallel to pins 823 and 824. Also, the upper ends of levers 825 and 826 carry plates 829 and 831 which can move in front of pins 823 and 824 when the cam follower 801 is on the low portion of cam 799 and the pins 823 and 824 are therefore in their most rearward positions owing to the fact that lever arm 804 and levers 808 and 809 have swung downwardly and in a clockwise direction around pivot 805. When plates 829 and 831 are in front of pins 823 and 824, the passage of the high portion of cam 799 in contact with cam follower 801 merely causes the levers 808 and 809 to swivel on their pivot pin 807, thereby to draw away from their stops 821 as shown by the position of lever 809 in Fig. 78. If however, plate 829 or 831 has been drawn away from in front of its corresponding pin 823 or 824 when the high point of cam 799 passes under the follower 801, the corresponding lever 808 or 809 can move counterclockwise relatively to the pivot pin 807 so that its upper end will come into contact with one of wheels 813 or 814 in the manner illustrated in Fig. 78 in connection with lever 808. By the time cam 799 has again turned so that follower 801 is on the low portion of the cam, one of the stops 821 moves the one of the levers which has been active away from its wheel so that the holding plate for the given lever can be restored to contact with the pin at the lower end of the lever.

For moving levers 825 and 826 so as to contact and release the pins 823 and 824 respectively, levers 825 and 826 are extended downwardly below their pivots 827 and 828, the lower end of lever 825 extending between two lugs 832 which are fixed to a patterning rod 183. Rod 183 being in the rear of most of the rods in the group, lugs 832 are apertured to permit two of the rods in front of it to slide therethrough. Similarly, the lower end of lever 826 extends between two lugs 833 which are fixed to a patterning rod 175. When the lever 808 is to act on shaft 681 to relieve the tension on the fabric, button on chain 156 of the main pattern mechanism P moves rod 183 to the left as viewed in Figs. 77 and 79 to thereby swing the upper end of lever 825 and its attached plate 829 to the right to release the pin 823, as best shown in Figs. 79 and 80. Rack 811 can thereupon cooperate with wheel 813 in the manner shown in Fig. 78. A spring 189 (Fig. 76) serves to return rod 183 to its initial position so that lever 825 can again hold the pin 823 to render lever 808 inactive as shown in Fig. 77. Similarly, when lever 809 is to act on shaft 694 to release the fabric tension, a button on the auxiliary pattern chain 157 of the pattern mechanism N acts to draw pattern rod 175 to the right as shown in Fig. 77 thereby throwing the upper end of lever 826 to the left as viewed in Figs. 77, 79 and 80 to disengage plate 831 from pin 824, the lever 809 thereupon acting through its rack 812 and wheel 814 in a manner similar to that previously described with respect to the action of rack 811 on wheel 813. A spring 189 acts to draw rod 175 to the left as viewed in Figs. 77 and 79, to restore the parts to the inoperative position shown in Fig. 76. To limit the angular motion of levers 825 and 826 in each direction, a plate 834 is provided which is also fixed to the front beam 4 and which projects between levers 825 and 826. At its upper end plate 834 has a screw 835 arranged to contact the lever 825 when the lever is turned counterclockwise as viewed in Fig. 77. Below its pivot 827, lever 825 has a lug 841 fixed thereto which carries a tappet screw 836 arranged to contact the lower end of plate 834 to limit the clockwise movement of lever 825. Also, lever 826 has a stop screw 837 therein arranged to contact plate 834 to limit the motion of lever 826 in the clockwise direction as viewed in Fig. 79. Below its pivot 828, lever 826 has a lug 838 thereon which carries a tappet screw 839 arranged to contact the lower end of plate 834 to limit the movement of lever 826 in the counterclockwise direction as viewed in Fig. 79.

SECTION XX

Draw-Off Strap Positioning Means

Figures 1, 3, 6, 31, 40, 41, 43, 46 to 48, and 56 to 68; Sheets 1, 3, 6, 14, 16 to 19, and 22 to 28

New reference numerals are in the series of 851 to 925, inclusive.

In operating the usual full-fashioned knitting machine, the attendant introduces welt wires or rods into the folds of the welts at the time he turns the welts and attaches straps from a fabric tensioning or draw-off means to the ends of the wires which protrude from the folds of the welts. In the machine disclosed herein, I have included

means whereby the hooks at the ends of the straps which cooperate with the welt wires are run toward the needle rows and held in position against a draw-off tension such that, when released, the said tension pulls the hooks into engagement with the wires. I have, further, so coordinated the means for moving the draw-off hooks toward the needles with the means for moving the welt bars that a movement of the welt operating mechanism releases the draw-off hooks from their holding means so that they can move under the influence of the draw-off tension to engage the welt wires.

As it is desirable that the tension be applied to the welt rods or wires 676 of all the knitting sections simultaneously, I have provided means whereby the hooks 692 may all be held against the pull of the weight 699 (Fig. 63) of draw-off mechanism K in the position shown in Fig. 47 and then released simultaneously. Said means further is arranged to move the hooks 692 rearwardly at the same time the weight 699 is raised. To these ends, the shaft 694 has swivelled thereon a small gear or pinion 851 the right hand side of which, as viewed from the front of the machine, shown as integral with one shouldered part 852 of a clutch 853 best shown in Figs. 67 and 68. The other shouldered part 854 of clutch 853 is fixed to shaft 694 by a screw 855, see Fig. 66. A spring 856 coiled around shaft 694 acts to normally maintain clutch parts 852 and 854 separated as shown in Figs. 67 and 68, so that the shaft 694 may turn without affecting gear 851, but when part 852 has been moved so that its shoulder 857 overlaps shoulder 858 on part 854 axially of shaft 694, then turning shaft 694 by handle 714, pinion 709 and gear 702 will also turn pinion 851. For moving pinion 851 so that said clutch parts are in driving engagement, a handle 859 is provided mounted on a pivot pin 861 above pinion 851 and extending transverse to shaft 694. The portion of handle 859 below pivot 861 is in the form of a fork 862 the two arms of which embrace pinion 851 on opposite sides. Therefore, by throwing over handle 859 from right to left as viewed in Fig. 66 at the same time that handle 714 is being used to turn shaft 694, the operator may put pinion 851 into operation.

When pinion 851 is rotated, its rotation is transmitted by interengaging teeth from pinion 851 to a pinion 863 which is mounted on a pin 864 parallel to shaft 694 and journalled in bracket parts 865 and 866 (Figs. 67 and 68) supported in turn from the frame of the machine. From pinion 863, the motion is transmitted to a gear 867 on a shaft 868 which is journalled in brackets, part of one of which is shown at 869 (Fig. 64). It will be noted, however, that, as shown in Fig. 65, the shoulders 857 and 858 of clutch 853 are relieved so that shaft 694 turns somewhat before shaft 868 and shaft 694 therefore pulls on rope 696 and weight 699 to relieve shaft 868 entirely of the torque from the weight, so that this torque does not need to be transmitted through gears 863 and 867, and the driving torque is accordingly reduced. Shaft 868 has thereon a series of sprocket wheels 871, two for each knitting section. On each wheel 871 is a perforated metal band or belt 872 perhaps best shown in Figs. 40 and 43, which extends around the wheel and runs rearwardly therefrom so as to embrace the front bed 7 and to run around a small pulley 873 (Fig. 57) which is mounted to revolve on an axis parallel to shaft 868 and front bed 7 and immediately in the rear of said front bed. Each band 872 has its ends connected by a tension spring 874 so that it may act efficiently as a belt but may be readily installed or replaced and may be able to yield to abnormal stresses without danger of breakage. As shown, bands 872 are assembled so that springs 874 will be in their lower runs or lengths below front bed or table 7, and table 7 has grooves 879 in the lower rear corner thereof whereby the lower runs of belts 872 may move without friction and without springs 874 catching on the table, while lugs or dogs 875 lie in their upper runs above table 7 and project upwardly and rearwardly from the surfaces above the table 7, as viewed in Figs. 41, 46 and 62, for the purpose of engaging objects to be moved by the welts. In order that belts 872 may exert a considerable pull and that all of them may operate on external objects simultaneoulsy and without slippage, each wheel 871 on shaft 868 has a series of knobs or projections 876 extending outwardly from its surface and adapted and arranged to register with apertures 877 in bands 872 which are best shown in Fig. 43. The purpose of belts 872 being to operate straps 691, the hooks 692 at the free ends of straps 691 are formed on loops 878 provided with apertures 879 best shown in Fig. 62 arranged to receive dogs 875. Therefore, the operator having placed loops 878 in the position shown in Fig. 62 in which dogs 875 project through apertures 879, shoulder portions 857 and 858 of the clutch 853 being in engagement, as soon as shaft 868 is turned by the handle 714 in the counterclockwise direction as viewed in Figs. 46 and 47, the belts 872 are operated by sprockets 871 to run dogs 875 and hooks 692 rearwardly toward the needle rows from the position shown in Fig. 46 to that shown in Fig. 47. As the belts 872 arrive at the position shown in Fig. 47, they are latched in this position for a time by a lever 881 which is pivoted on a pin 882 to a bracket 883 forming part of a bracket 884 fixed to the bottom and front sides of table 7 and in which shafts 868 and 385 are also journalled. In order to permit belts 872 to be latched by the levers 881, shaft 868 has a wheel 885 fixed thereto which has a notch 886 in its rim, and the lever 881 has a shoulder 887 adapted and arranged to engage in notch 886 to latch the wheel 885 against turning in the clockwise direction as viewed in Fig. 47, a spring 888 being provided and connected between hook lug 889 or the bracket 884 and the pin 891 on the lever 881 for the purpose of drawing shoulder 887 on lever 881 against the rim of wheel 885 so that shoulder 887 slips into notch 886, and thereby latches the wheel 885, shaft 868 and belts 872 against the pull of straps 691 as soon as the wheel 885 is in the proper angular position to permit such an action.

However, when the pins 381 have been moved forward from the position shown in Fig. 47 to that shown in Fig. 48, the draw-off tension of straps 691 should be applied to the welt wires, and levers 881 should therefore be thrown out of latching position, intermediate the point in the cycle shown in Fig. 47 and that of Fig. 48. To this end, I have provided shaft 385 with a cam projection 892, and lever 881 is provided with a cooperating cam projection 893. Cam 892 is so placed on shaft 385 that it is at the left of and in contact with the cam 893 when the parts are viewed as in Fig. 47 and pins 381 are in their forward positions. When the pins 381 are thrown forward by the operation of shaft 385, cam 892 passes by cam 893 from left to right, thereby depressing lever 881 and unlatching wheel 885 and

shaft 868, and throwing the take-off tension of straps 691 and hooks 692 on the welt wires 676.

However, the draw-off tension having been applied to the welt wires 676, it is then desirable to run the dogs 875 on belts 872 forward and out of the way of welt wires as quickly as possible. For this purpose, as best shown in Figs. 57, 58, 60 and 61, I have provided a means which comprises a pinion 894 on shaft 868 which engages a toothed gear segment 895 fixed to the upper end of an arm 896 which is pivoted on a pin 897 and carries at a point below pin 897 a pin 898 which serves as shaft for a cam follower 899. At the lower end of arm 896, a spring 901 is connected to the arm and to a portion of the machine frame in position to apply a moderate pull on arm 896 in the direction to swing follower 899 toward the main cam shaft 42. The pull of spring 901, however, is carefully adjusted so that it is not able to move arm 896 against the friction of the parts connected to the arm, and the arm will therefore remain in any angular position in which it may be set until moved by some force other than that of the spring. When the dogs 875 (Fig. 41) are to be moved rearwardly, shaft 868 is turned by operating handle 714 (Fig. 66) whereupon segment 895 is turned by pinion 894 so as to bring follower 899 against disk 902. To bring dogs 875 forward again, follower 899 is shifted by the fork 903 into position to contact the edge of a cam disk 904. Cam 904 swings the lower end of arm 896 forward and the upper end of said arm rearward to run the shaft 868 so as to turn belts 872 to bring dogs 875 forward quickly to the position shown in Fig. 61, the dogs being drawn forward and separated from hooks 692 almost instantaneously and leaving the hooks under the influence only of the draw-off straps 691.

For moving fork 903 to shift follower 899 at the proper time, a mechanism is shown in Figs. 3, 57, 58 and 59. For this purpose, the same patterning rod 186 which controls the follower 394 is employed. As best shown in Fig. 59, rod 186 has a block 905 fixed thereto and arranged to slide on a flat surface 906 at the lower offset end of a bracket 907 (Figs. 57 and 58), the upper end of which is secured to the front beam 4 of the machine frame. Block 905 has an inclined portion 908 at its upper right hand corner extending upwardly and toward the left from its right hand vertical face, forming a cam surface. A roller type follower 909 is so mounted that it lies in contact with the cam surface 908 when the parts are in the position shown in Figs. 3, 57, 58 and 59. If now rod 186 is moved to the right from the position shown in said figures, roller type follower 909 is wedged up and rests on a top horizontal surface 911 of said block 905. The movement of the axis of roller 909 so produced is transmitted to cam follower 899 through a bell crank 912 which is pivoted on the bracket 907 on a pin 913 and has two arms one of which is inclined downwardly from said pivot point and has a pin 914 adjustably mounted at its lower end to serve as a pivot for said roller 909. The other arm of bell crank 912 lies generally in a vertical plane but is bent rearwardly at its upper end and is there formed into the said fork 903 whereby follower 899 is shifted. A spring 915 connected between pins, one on the upper end of bracket 907 and the other on a lug 916 fixed to the side of the upper arm of bell lever 912, urges lever 912 in the counterclockwise direction as viewed in Fig. 58 and serves both to maintain follower 909 in contact with surfaces 908 and 911 and to move fork 903 to the left as viewed in Fig. 58 when rod 186 and block 905 have moved back to the position shown in said figure after a right-hand movement. Follower 899 is thereby brought back into the plane of circular disk 902 when rod 186 and block 905 have resumed their original left hand position.

The operation of rod 186 is, of course, caused by mechanism O (Fig. 6) as hereinabove described, being controlled by rod 185 of chain 156 of the main pattern mechanism P (Fig. 1).

After the points 237 have cast off alternate loops of the first course, the knitting of the welt proceeds. After a certain length of welt fabric has been knitted, the operator turns handle 714 so as to operate shafts 694 and 868 to simultaneously wind up weight 699 and to operate belts 872 to carry draw-off hooks 692 toward the needles by dogs 875. The operator then places welt wires or rods 676 on top of the fabric slightly in front of the position of the hooks 692 shown in Fig. 47 in which the hooks are held by the dogs 875 on belts 872. The pull of weight 699 is then disconnected by the operator from the shaft 868, which operates belts 872. This is done by operating the throw-over handle 859 (Figs. 64 and 66) so that the pull of weight 699 is solely on shaft 694, the draw-off drums 693 of which are connected to draw-off hooks 692 by straps 691. The pull of weight 699 is resisted temporarily by latching levers 881 (Fig. 47) which engage the notches 886 in wheels 885 on the shaft 868 to which are connected the sprocket wheels 871 for driving belts 872, the dogs 875 of which engage the hooks 692 on straps 691 to sustain the tension of the weight 699 on shaft 694 to which straps 691 are connected through the drums 693.

Soon after the pull of weight 699 has been taken up by the latch levers 881, rod 185 of pattern means P is operated by a button on the chain 156 to cause cam 462 of booster mechanism O to be moved or racked so that the point of contact of the cam with follower 453 (Fig. 56) is shifted from the low point 488 to the high point 491. The booster mechanism O thereupon shifts rod 186 so as to move cam follower 394 from the plane of the disk 398 into that of the cam 399. The rack 387 is thereby operated to throw the pins 381 and the hook-up bars 352 into the positions shown in Figs. 31 and 48 in which the bars 352 lie in an intermediate position. As shown in Fig. 31, the parts 436 and 424 thereupon cooperate to latch lever 392 on the outer corner of the arm 437 on bracket 397 so that cam follower 394 does not descend immediately from the position in Fig. 31 when cam 399 passes out from beneath the follower. Pins 381 and hook-up bars 352 are therefore held in the position shown in Fig. 31 for several courses.

As the shaft 385 operates to move pins 381 from the position shown in Fig. 47 to that shown in Figs. 31 and 48 the cam projection 892 on shaft 385 presses downwardly on cam projection 893 on lever 881 so as to unlatch the lever, thereby releasing the straps 691 from the holding action as applied by the belts 872. The straps 691 thereupon immediately engage the welt rods 676 through hook 692 to press the fabric into the position shown in Fig. 48 in which the loops of the first course of the fabric are drawn forward along the shanks of the welt hooks 351 against the ends 362 of the transfer elements 359. However, at the time that the hooks 692 are released to engage the welt rod 676, it is also desired that the dogs 875 on the belts 872 should be moved rapidly

out of the way of the hooks. Therefore, at the same time that the rod 186 is operated to initiate the movement of the welt bars into the position of Fig. 48 and to release the belts 872 from the latch levers 881, said rod 186 also moves lever 912 to cause cam follower 899 to be shifted from the plane of disk 902 into the plane of cam 904. Therefore as soon as the latch levers 881 have been thrown out of latching position, racks 895 operate shaft 868 to move the dogs 875 forwardly out of the path of the hooks 692 to the position shown in Fig. 61. The cam follower 394 having been latched up in the position shown in Fig. 31 the knitting proceeds for a number of courses with the parts in the positions shown in Fig. 31, but in the meantime, the patterning rod 185 is operated again to cause cam 462 of the booster mechanism O to shift from the high point 491 (Fig. 56) to the low point 492 thereby causing rod 186 to shift cam follower 394 to the disk 398 in which position the follower 394 remains until another operation of rod 185 inaugurates an operation of booster mechanism O. The bars 352 therefore remain in the intermediate position shown in Figs. 31 and 48 until another operation of rod 185 and booster mechanism O, in other words until the time for the welt to be turned.

SECTION XXI

Operation

The method of operation of the herein disclosed mechanism will be obvious to those skilled in the art from the foregoing description, but the operation will now be described for purposes of convenience with especial reference to diagrammatic figures 107 to 123 inclusive, and to the pattern rods controlling the individual operations from the time of engaging the needles with the yarn for the first course to the time of restoring the first course to the needles. Some description of operations previous to laying yarn for the first course and of operations following the turning of the welt will also be given.

Setting up the machine

In the interval between the procedure in which the last course of one blank is knitted and the procedure in which yarn is laid for the first course of another blank, it has been found expedient to effect several revolutions of the cam shaft in which no yarn is laid, on account of there being no yarn carrier rod connected to a friction box, so that the friction box may be brought into proper relation to the yarn carrier rod desired to be used in laying yarn for the first course and connected thereto. Advantage is taken of said camshaft revolutions in which no yarn is laid to place the kockout bit mechanism in the position desired for operation during the first course. Therefore, in the first of said idle revolutions of the cam shaft the finished blank is pressed off the needles.

In the second of said idle revolutions of the cam shaft, the pattern mechanism N moves the knockover bit control rod 181 to the right, as viewed in Fig. 6, thereby placing the spring 342 under tension. This occurs shortly after the needles begin their downward movement and are approximately at that point in their cycle corresponding to the point in the revolution of the cam shaft 42 shown in Fig. 101, so that an instant later, as the high point of cam 309 turns into contact with the follower 311, the spring 342 is able to draw the lever 325 from beneath the lever 324. A moment later, the low point of cam 309 comes into contact with the follower 311 and the spring 307 therefore draws the follower up and moves lever 324 and pawl 319 downward. As cam 309 continues to turn, its high portion again comes into contact with follower 311 thereby forcing pawl 319 up and racking shaft 317 and disk 326. Disk 326 is thereby moved from the position occupied by it during the press-off revolution, in which a vacant hole 332 was presented to the levers 334, 335 and 336, to a position in which a pin 328 of medium length, Figs. 104 and 106, is presented to levers 334, 335 and 336. The presentation of pin 328 to the levers 334, 335 and 336 results in contacting pin 328 with lever 335, thereby operating rod 296 to shift cam follower 293 (Fig. 94) from the plane of cam 281 to the plane of cam 283 (Fig. 5). The cam 309 remaining stationary during the first portion of this revolution, follower 293 remains in this position until after the laying of the yarn of the first course.

In the second of the setting up courses preliminary to laying the yarn for the first knitting course, the pattern rod 185 of the main pattern mechanism P (Fig. 1) is operated thereby initiating the movement of the booster mechanism O (Fig. 52). The movement of rod 185 is from right to left thereby drawing the cam piece 522 from beneath the racking pawl 502. This occurs somewhat before the moment at which the high point of cam 495 comes in contact with the follower 496. A hub 506 on axle 507 is thereby racked turning the booster cam 462 from a position in which its follower 463 is in contact with low point 486 to one in which follower 463 is in contact with high point 487. The bell-lever 468 is therefore operated to throw rod 186 from left to right and to shift follower 394 (Fig. 28) from the plane of the round disk 398 into the plane of the cam 401. The shift of follower 394 occurs while the follower is on the low point of the cams, and follower 394 is held positively or rigidly in its operative position by the cam 462, the rod 186 and associated elements until another movement of cam 462.

In this revolution, the friction box rod 132 moves from left to right, the machine is stopped and the friction box rod is then connected to the carrier bar 128 through the box 131 by the action of the attendant in throwing dog 142 on bar 139 into engagement with dog 144 on yarn carrier bar 128, see Fig. 98.

Procedure in which yarn is laid for the first course

The machine having been started again, the cam shaft makes a revolution in which the coulliering means drives the rod 132 to cause bar 128 to lay yarn for the first course. The cam followers 293 and 394 having been set by their respective control mechanisms, the follower 293 of the knockover-bit mechanism is on its lowest cam 283, thereby providing space for the insertion of welt hooks 351 between the needles without interference with knockover bits 73 or the sinkers. Also, as the cam 401 turns to bring its high point beneath the follower 394, the rack 387 is raised to turn shaft 385. The welt bars 352 having been previously placed so that extensions 356 are in contact with and rearwardly of pins 381 at the forward ends of the paths of said pins, bars 352 being properly centered with respect to said pins and the needle row, the lifting of the follower 394 throws rack 387 upwardly, thereby turning shaft 385 in a counterclockwise direction from the position as viewed in Fig. 27, to the position shown in Fig. 45. Levers 384 are thereby swung counterclockwise and links 382 moved

to press the pins 381 toward the needles, carrying the bars 352 back into contact with the stops 493. Hooks 351 are thereby brought into position one centrally between each two needles 26 shown in Fig. 108 to receive the loops of the first course. However, after the loops of the first course have been drawn down onto the hooks 351 as shown in Fig. 109, the high point of cam 401 moves out from under the follower 394 so that rack 397 moves the pins 381 forward again, leaving the yarn under tension applied by hooks 351 and caused by a weight on cable 683 acting through shaft 691 and straps 677.

Also in the revolution of the cam shaft in which yarn is first laid, the pattern chain 156 of mechanism P, acting shortly after the needles begin their downward movement, presents another button 159 to the lever 162 for rod 185 and thereby continues to hold rod 185 to the left. Similarly in this revolution, chain 157 of mechanism N presents a button 159 to continue holding rod 181 to the right. The continuance of rod 185 in its left position causes the racking of cam 462 of booster mechanism O so as to shift the point of contact between cam 462 and its follower 493 from high point 487 to low point 488, thereby moving cam follower 394 from the cam 401 back to the round disk 398 just prior to the beginning of the next revolution of the cam shaft. Further, the continuance of rod 181 in its right position in this revolution of the cam shaft causes the racking of the disk 326 which determines which of the knockover-bit cams is to become active. Disk 326 is thereby moved into a position in which a low pin 327 is presented to the levers 334, 335 and 336 during the next revolution of the cam shaft.

Also during the revolution of the cam shaft in which the yarn is first laid, the pattern mechanism P initiates an action of the shogging mechanism for moving main cam shaft 42 into its right or narrowing position.

Dropping loops in first course

During the action following the procedure in which the yarn was laid for the first course and hooked up by welt hooks 351, loops are dropped or cast off from alternate needles. The cam shaft 42 having been shifted or shogged to the right into its narrowing position, the gears for transmitting the power for the yarn laying action are thrown out of cooperative relationship so that no yarn is laid. Also, in this revolution of the cam shaft, the shifting of the shaft brings into action a different set of cams for controlling the action of the needles etc., during the narrowing cycle.

Disk 326 having been shifted due to the action of rod 181 in the previous revolution of the cam shaft in causing follower 311 to again cooperate with cam 309, rod 296 is moved to the right (Fig. 103) a distance equal to the width of one of the knockover bit cams due to the cooperation of short pin 327 with lever 334. This movement of rod 296, however, practically coincides with the movement of the main cam shaft 42 to the right so that the follower 293 remains in active cooperation with the low cam 283 throughout this revolution of the cam shaft.

Also during the revolution of the cam shaft in which the yarn is first laid, pattern chain 157 throws control rod 187 to the right, as viewed in Fig. 6, and pattern chain 156 throws control rod 183 (Fig. 76) to the left and releases rod 185 (Fig. 52). Spring 189 therefore moves rod 185 from left to right, thereby moving cam 522 so as to prevent any racking of cam 462 until chain 156 again moves rod 185 to the left. Also, at the same time, for the third successive revolution of the cam shaft, chain 157 presents a button 159 to the lever 163 whereby mechanism N operates rod 181, thereby initiating another racking movement of disk 326.

The motion of rod 183 acts on lever 825 at a time when the cam follower 801 is on the round portion of cam 799. The pin 823 at the lower end of lever 808 is thereby released by the plate 829 on lever 825 just before the high point of cam 799 contacts the follower 801. Spring 816 therefore swings the rack 811 at the upper end of lever 808 against the toothed wheel 813 in time so that, as the follower 801 is lifted by the high point of cam 799, the rack 811 turns the shaft 691 to release the tension on the fabric.

The shaft 42 having been shifted to its right or narrowing position, the narrowing or dipping cams 226 lower the front narrowing shaft 203 thereby carrying the lace or picot points 237 downwardly, said points being fixed in the bar 232 supported from said shaft 203. The movement of points 237 is illustrated diagrammatically in Figs. 118 to 122, inclusive. From the position of Fig. 118, points 237 go down more rapidly than the needles 26 and, tension having been released as above described, the points press between the loops and the needles so that, as the points and needles go below the knockover-bits 73, see Figs. 119 and 120, the loops are pressed upward onto the points 237. The points and needles then rise somewhat and separate from each other as shown in Fig. 121. The needles then move downwardly again and the sinkers and dividers come forward above the loops as shown in Fig. 122. At about this time in the revolution of the cam shaft, the rod 187 having moved the follower 252 to the left and the shaft 42 having moved the drop stitch cam 251 to the right, follower 252 is in cooperative relation with cam 251, and said cam acting through lever 255, shaft 213 and link 208 of Fig. 27 causes the narrowing shaft to be lifted quickly to carry the points 237 up ahead of the needles. The sinkers and dividers therefore strip the loops off the points 237 and, cam 799 having reached the position in which follower 801 is on a round portion of the cam, the tension is restored to the fabric in time for the loops which had been on the points 237 to be drawn forward above needles 26 to the front of the needle row as shown in Fig. 122.

The shogging mechanism includes cam means which restores the cam shaft 42 to its left or knitting position near the end of this, the second cam shaft revolution of the welt knitting cycle. The return shift of cam shaft 42 occurs at about the time when the follower 223 (Fig. 4) is in contact with the high point of cam 226, so that a set of round disks 224 are again brought beneath the cam followers on the levers 206, thereby sustaining the narrowing machine and the front shaft 203 thereof by means of levers 206 and links 204 whereby the points 237 are retained above the level of the path of the needles. If desired, front narrowing shaft 203 can be elevated further by a hand operated mechanism.

Intermediate procedure in welt knitting cycle

The gearing between the main cam shaft 42 and the yarn laying mechanism having been restored to cooperative relationship by the return of the cam shaft 42 to knitting position, yarn is laid after

the second revolution of the cam shaft, i. e., the one following the revolution in which the alternate loops were dropped from the needles. Within this revolution of the cam shaft, a movement of the mechanism for racking disk 326 having been initiated in the preceding course, disk 326 is so positioned in the first part of this revolution that a pin 329 (Fig. 106) of medium length having a cut-away portion at its end is presented to the levers 334, 335 and 336. Owing to its length, said pin 329 cooperates with the middle lever of the three, No. 335, and owing to the cut-away portion, rod 296 moves cam follower 293 only to a position such that the central plane of the follower coincides with the line of division between knockover bit cam 282 and knockover bit cam 283. Therefore, the follower 293 cooperates with the lower track 286 on cam 282 so long as follower 293 remains in this position.

Shortly after the needles start their downward movement, in this revolution of the cam shaft, pattern chain 157 moves to release rod 181. Spring 189 moves rod 181 to the left and lug 343 presses against the lower end of lever 325 whereby lever 325 is pressed back under lever 324 as soon as the high point of cam 309 contacts the follower 311 of the mechanism for racking the disk 326. Disk 326 therefore remains in the said position in which the action of knockover bits is controlled by pin 329 until after another operation of the rod 181. This condition continues for approximately eighteen revolutions of the cam shaft 42.

At about the same time that chain 157 releases rod 181, chain 156 releases rod 183 so that an associated spring 189 causes rod 183 to move to the right to turn lever 825 into position to latch lever 808 in the position in which it is unable to interfere with draw-off shaft 681. Rod 183 is not operated again until after the beginning of another welt, lever 808 therefore remaining latched for the remainder of the period required to knit the blank. In the last revolution of the hereinbefore referred to eighteen revolutions of the cam shaft 42, rod 181 causes lever 325 to move out from under lever 324, thereby permitting disk 326 to be racked. Disk 326 having been racked, it is thereby brought into a position such that a pin 331 of maximum length is brought into active position and cooperates with lever 336 whereupon rod 296 is thrown its maximum distance to the left to bring follower 293 (Fig. 94) into position to cooperate with cam 284 (Fig. 5). The chain 157 then releases rod 181 so that spring 189 moves rod 181 to the left and lug 343 on said rod swings lever 325 under lever 324 as soon as cam 309 lifts lever 324 to its maximum height. Disk 326 is therefore held stationary until another operation of rod 181.

After a certain length of fabric has been knitted, the operator begins to prepare for conditions after something more than half the courses for the welt have been knitted and throws over handle 859 (Fig. 66) to connect shaft 868 to shaft 694. He then operates the handle 714 to drive shafts 694 and 868 to wind up weight 699 (Fig. 63) and to drive belts 872. Owing to the lost motion in clutch 853, shaft 694 carries the entire pull of weight 699 during the winding up of the weight 699. The operator having first engaged the metal loops 878 (Fig. 62), integral with the hooks 692 and attached to straps 691, to the belts 872 by means of the dogs 875 on said belts, turning handle 714 moves the dogs 875 rearwardly and carries the hooks to the position shown in Fig. 47.

The operator then places welt wires or rods 676 on top of the fabric slightly in front of the position in which hooks 692 are held by the belts 872. As the operator releases the handle 714, the shaft 694 turns back slightly under the pull of weight 699 due to the lost motion in clutch 853, so that the pull of the weight is then on shaft 868 as well as on shaft 694. However, at this time the operator then disconnects shaft 868 from shaft 694 by throwing over the handle 859 of clutch 853 so that the pull of weight 699 is directed solely on shaft 694 but is transmitted to the dogs 875 on belts 872 through the straps 691 and is transmitted to shaft 868 by belts 872. The pull of weight 699 is, however, resisted temporarily by latching lever 881 which engages in the notch 886 in the latching wheel 885 on shaft 868, the belts 872 being geared to shaft 868 by sprocket projections 876 on wheels 871 fixed on shaft 868 and said projections 876 engaging in apertures 877 in belts 872.

At about said point in the knitting of the welt courses, chain 156 of the pattern mechanism P operates rod 185, and chain 157 of pattern mechanism N operates rod 181. Rod 185 causes cam 522 to be moved, thereby permitting cam 462 to be racked. Cam 462 having been racked, the point of contact between the cam and its follower 463 is caused to be moved from the low point 488 to the high point 491, thereby causing rod 186 of booster mechanism O to shift the cam follower 394 from the plane of round disk 398 to the plane of the relatively low cam 399.

The cam 462 having been racked, the shaft 385 is thereupon operated by rack 387 somewhat before the last part of the welt has been knitted, to throw the pins 381 rearwardly to an intermediate position shown in Figs. 31 and 48, at the same time causing cam 892 on the shaft 385 to push downwardly on the cam 893 on the lever 881 to disconnect the lever 881 from the wheel 885, thereby throwing the draw-off tension of weight 699 on the welt wires 676 as is shown in Fig. 48 and drawing the loops of the first course forwardly on the shanks of hooks 351 against the grooved rear ends 362 of transfer elements 359. Another effect produced automatically by turning shaft 385 and pins 381 to the position shown in Fig. 48 is that, after the high point of cam 399 passes under follower 394 and the follower starts down on the cam, the said shaft 385 and pins 381 are latched in this position for a time by the action of the latching lever 424 which engages a bracket arm to hold the lever 392 and cam follower 394 suspended. The pins 381 are therefore held fixedly in the position shown in Figs. 31 and 48 for a number of courses.

The welt rods 676 being now the means for transmitting the tension of the draw-off straps 691 to the fabric, it is necessary to move dogs 875 on belts 872 quickly out of the way of the hooks 692 at the rear ends of straps 691. For this purpose, the same motion of the booster operated rod 186 which carried the cam follower 394 into the plane of cam 399 is employed. Rod 186 moves block cam 905 fixed thereon (Figs. 3 and 59) beneath follower 909, causing the follower to swing lever 912 and to thereby shift the cam follower 899 (Figs. 3, 57 and 58) from the plane of the round disk 902 into the plane of the cam 904, whereupon rack 895 is operated from the position of Fig. 60 to the position of Fig. 61 to turn shaft 868 to drive the upper runs of belts 872 rapidly forward to the position shown in Fig. 61, so that the dogs 875 are moved out

of the path of the hooks 692. It will be understood that arm 896 then is held by friction so that it remains in position to hold follower 899 beyond the path of cam 904 until the operator again turns shaft 868. As this happens only once in a complete cycle of operations, only one of the three times in a cycle that rod 186 is operated by cam 462 has any effect on belts 872.

During the same revolution of the cam shaft 42 in which pins 381 are moved to the said intermediate position, the pattern chain 156 operates rod 185 to the left to permit or cause cam 462 to be racked to bring follower 463 into contact with low point 492 instead of high point 491, so that rod 186 may be moved by its attached spring 189 to shift cam follower 394 back into the plane of disk 398, lever 392 remaining suspended until another operation of cam 462.

After the operation in which the follower 394 was left suspended, pattern chain 156 releases rod 185 so that spring 189 moves the rod to the right, thereby placing cam 522 (Fig. 53) in position to prevent further racking of cam 462 until chain 156 again moves rod 185 to the left.

Knitting then continues under the influence of draw-off mechanism K applied through straps 691 while lever 392 is held in elevated position and the knockover bits 73 are actuated by cam 284.

While the machine is knitting with the parts in the position shown in Fig. 31, the draw-off straps 677 of the initial fabric tensioning means do not tension the fabric during the knitting of the remainder of the blank and knitting then proceeds under the tension of straps 691 due to the torque on shaft 694 caused by weight 699.

Second to last course before idle courses

After all but two of the courses have then been knitted which are required to supply both plies of the double wall welt, soon after the needles start down in the next to the last course of the welt, pattern mechanism N acts through a button 159 on auxiliary chain 157 to move rod 181 to the right, thereby again moving lever 325 out from under lever 324, and causing the racking of disk 326. A second pin 329 of medium length with a cut-away portion at its end, is thereby brought into position to cooperate with one of levers 334, 335 or 336.

Last course before idle courses

Disk 326 having been racked, owing to the length of the pin and the fact that it is cut away, pin 329 contacts lever 335 to move rod 296 over a distance to the right such that, the cam shaft 42 being in its left or knitting position, cam follower 293 is thereby moved such a distance to the right that it cooperates with the lower cam track 286 of cam 282 to control the knockover bits 73 throughout the knitting of the last course of the double ply section B. This is because cam track 286 raises knockover bits 73 to catch the loops and then lowers bits 73 to a low level and maintains them low to accommodate the loops and prevent tearing as the needles move rearwardly later in the revolution of the cam shaft due to the action of the presser cams.

During the knitting of the last course of the welt, mechanism N acts and presents a button to the lever 163 for rod 181 which holds rod 181 to the right, thereby causing disk 326 to be racked again. At the same time mechanism P acts through chain 156 to move rod 176 to the left. When the needles reach their low position after pulling the loops of the last course of the double ply section through those of the next preceding course, springs 122 (Fig. 6) having been placed under tension by rod 176, as soon as needle operating levers 33 have moved upwardly and forwardly enough to permit it, idle course levers 113 are thrown by springs 122 beneath the lower ends of levers 33, whereby the needle bars are held down. While pattern rod 176 is moved positively to the left, its return movement is caused by springs 189. However, levers 113 move beneath needle levers 33 while the followers 35 are on the high points of the needle cams 34, so that the weight of levers 33 holds the levers 113 against the action of the springs 189, and levers 33 and 113 are held, once levers 113 are beneath levers 33, until the needle cams reach their high point in the next revolution of the cam shaft, irrespective of the action of rod 176 and chain 156. The same movement of pattern rod 176 which latched the needle levers 33 also latched the friction box 131 at the right end of its path through lever 627, shaft 628, link 633 and connected parts.

First idle course

Disk 326 having been racked, a pin 328 of medium length without a cut-away portion, is presented in active position and cooperates with lever 335 to throw follower 293 into position to cooperate with cam 283. This controls the knockover bits 73 during both idle courses.

During the first idle course, the rod 176 has moved to latch the needle levers 33 and the friction box for the first of two idle courses, chain 156 presents another button 158 to the lever 162 for actuating rod 176, thereby retaining rod 176 in its left and active position. At about the same time, chain 157 moves to carry a button 159 out of contact with the lever 163 for actuating rod 181, thereby releasing rod 181 so that its spring 189 moves it to the left as viewed in Fig. 6, and permitting lever 325 to swing under lever 324 and preventing racking of disk 326 until another movement of rod 181 to the right. Rod 181 remains in its left hand position until a point in the revolution of the cam shaft in which the welt is turned during the second idle course. Thus cam 283, the lowest of the knockout bit cam group, controls the knock over bits 73 throughout both idle courses. Further at about the same time in this revolution, chain 156 draws rod 185 to the left, thereby causing the racking of cam 462, whereby the point of contact of the cam with follower 463 is shifted from low point 492 to high point 493. Rod 176 is held in its left hand position until the first part of the revolution of the cam shaft for the second idle course. Therefore, the levers 33 and the friction box 131 are held in latched position for another revolution of the cam shaft. It will be seen that the needles remain latched down during the periods in both idle courses in which the needles would normally be moving down and would go to press. There is therefore no danger of a press off.

Turning welt—second idle course

Cam 462 having been racked, rod 186 is thereby moved to throw follower 394 from disk 398 to cam 402. Cam 402 throws rack 387 during the first part of the second idle course to turn shaft 385 through an angular distance enough to move pins 381 rearwardly their maximum amount, and to bring bars 352 against stops 403 a second time in the cycle. The loops of the first course are thereby pushed by the grooved ends 362 of the

transfer elements 359 to the position shown in Fig. 111.

During the second idle course, pattern chain 156 releases rod 176 and pattern chain 157 acts to move rod 181 to the right. However, the spring 189 does not throw rod 176 to the right as yet, the weight of levers 33 remaining on levers 113. Also, rod 181 being at the right, spring 342 withdraws lever 325 from beneath the lever 324 thereby causing or permitting the racking of disk 326.

Also, in the second idle course, the pattern rod 172 is operated from chain 157. Also, at the same time, chain 156 presents another button 158 to the lever 162 for the rod 185 to hold rod 185 in its left position, thereby causing a racking of cam 462 and turning the cam so that its point of contact with follower 463 shifts from high point 493 to low point 494.

The movement of rod 172 initiates a movement of a tilting bar mechanism shown in Figs. 81 to 90, inclusive. Rod 172 removes lever 594 from beneath lever 579 so that it is operated by lateral cam track 612 of cam 592 to throw rod 549 longitudinally against the pull of its spring 565 (Fig. 3) and to release the shaft 549 from latching engagement between arms 562 and 564, at point 563, and also shifts follower 41 into engagement with special cam 613 (Fig. 93). Rod 549 thereupon turns under the influence of the spring 566 guided by the cam 571, moving levers 534 and 544 downward and then rearward to engage loops 531 and 541 and to tilt the needles forward. At about the time this forward tilting motion is accomplished, the needle cams 34 reach the points in their revolution at which they lift their followers to the tops of their paths thereby releasing the weight of needle levers 33 from the levers 113 and permitting spring 189 to move rod 176 to push levers 113 out from under the needle levers 33. When rod 176 moves and releases the needle levers 33, it also releases the friction box 131. This can be done at this time without causing difficulty because the friction box is at the right, having been latched against its right stop, the friction box rod 132 is moving from left to right and thereby holds box 131 against its right hand stop 268 (Fig. 96).

The needles having been released for vertical movement, but still being retained in tilted position, they can rise and easily push through the grooves in the ends of the elements 359 (as shown in Figs. 112 and 113) to thereby transfer the loops of the first couse back to the needles.

As the needles rise, the sinkers and dividers begin to come forward so that the loops are stripped down on the needles to the position shown in Fig. 114. During the rising motion of the needles, beginning shortly after the parts reach the position shown in Fig. 113, cam face 612 begins to shift the rod 549 back toward the position in which arm 564 is in the same plane as the arm 562. At this time also, cam 571 raises arm 557 of lever 558 so that latching of shaft 549 can again take place. In the meantime, the motion of lever 553 has swung lever 551 to operate shaft 549 which in turn operates levers 539, levers 539 operating levers 534 and 544 to move the links 46 back into normal position as shown in Figs. 81 and 86 to thereby swing the needles into vertical position. Also, the high point of cam 402 has sufficient angular extent to hold follower 394 up and thereby pins 381 at their rearmost position until the needles have passed up through the loops on the transfer elements. As the follower 394 passes off of a high point of cam 402, pins 381 are drawn forward. The cam 402 is sufficiently high so that the link 417 prevents the latching lever 408 from interfering with the cam follower 394 as it rolls down off the high point of the cam 402 to its lowest position, carrying pins 381 to their most forward position.

Cam 462 having been racked, in the latter portion of the second idle course, i. e., the cam shaft revolution in which the loops of the first course are returned to the needles, rod 185 and connected parts shift the follower 394 from the cam 402 back to the round disk 398. Follower 394 then remains idle until another welt cycle.

Procedure after welt has been turned

Disk 326 having been racked, a third pin 329 is presented to the levers 334, 335 and 336 and cooperates with the lever 335 to move the parts including the rod 296 to bring the follower 293 into position in which it cooperates with the low cam track 286 on cam 282 in the first portion of this cam shaft revolution, so that the action of knockover bits 73 is controlled by cam track 286 until after another movement to the right of rod 181. During the revolution of the cam shaft following the one in which the welt is turned, yarn is fed to the needles and knitting is continued.

Following the turning of the welt, rod 185 is released by movement of pattern chain 156 of mechanism P, and rods 181 and 172 are released by a movement of pattern chain 157 of mechanism N. The release of rod 185 permits the spring 189 to move the disabling cam 522 into position to prevent the racking of cam 462. The cam followers 394 which control the movement of the pins 381 for pushing rearward the welt bars 352 therefore remain stationary in alignment with round disk 398 until after another movement of rod 185 in an ensuing cycle. Rod 172 having been released, as soon as high point 593 of the radial cam track 591 on cam 592 comes under follower 589, lever 579 is turned cclockwise as viewed in Fig. 91 to permit spring 189 for rod 172 to move the rod to the left so that spring 602 can swing lever 594 clockwise as viewed in Fig. 92 to latch lever 579 in the inactive position shown in Fig. 91 whereby the needle tilting mechanism is retained inoperative until another rightward movement of rod 172 in an ensuing cycle.

Rod 181 having been released by chain 157, spring 189 moves rod 181 to the left, bringing lever 325 beneath lever 324 whereby racking of disk 326 is prevented until after another operation of rod 181 by the pattern mechanism N. Rod 181 and disk 326 remain in this position for ten or more courses. During this period, the welt hooks 351 remain caught in the fabric and float along with it as it is knitted.

The tension having been applied to the fabric through the welt wires 676 and the straps 691, knitting proceeds under the tension supplied by weight 699 until the projecting portion 708 of pin 706 on pulley 695 releases the latch or trigger connection at shoulder 735 between bolt 736 and rod 175, thereby permitting the actuating pawl 718 of spring type draw-off mechanism J to become active. At this time or very shortly thereafter, the weight 699 of intermediate draw-off mechanism K reaches the end of its path, and it thereupon remains idle until handle 714 is used again in winding its cable and operating the belts 872. However, the attendant, as soon as spring-type mechanism J starts, may throw out the pawl 705 which serves, when active, as a drive between the cable wheel or drum 695 and the shaft 694.

In either case, the spring type mechanism J remains as the sole draw-off means until the completion of the blank. If pawl 705 is not thrown out, it still does not hinder shaft 694 from turning in the draw-off direction when weight 699 is stationary. Bars 352, however, ride along on the fabric until an attendant has opportunity to disconnect straps 677 from metal loops 358 on bars 352 and to disconnect hooks 351 on bars 352 from the fabric. This can be done conveniently as soon as the welt hooks 351 have moved beyond knockover bits 73. The attendant places the bars 352, as they are disconnected from the fabric, in their forward positions on tracks or rails 376 against pins 381. Straps 677 are reconnected to bars 352 and wound at the convenience of the operative so that they will be tensioned upon the next movement of pins 381 toward the needles. During this period and following it, the draw-off tension is supplied by the spring tension means J which is controlled so as to release the tension automatically whenever main cam shaft 42 is moved to its right or narrowing position. Such release is produced by rod 89 which acts on the holding pawls 767 of the spring draw-off mechanism J through lever 772 when cam shaft 42 is in its narrowing position. Rod 89 receives its impulse for said releasing action from the front catchbar shaft 77, the tension release being slight and only temporary as will be clear from the description of the draw-off or spring tension means J hereinabove.

When welt bars 352 have been removed from the fabric, the cycle with which the present invention is primarily concerned is completed. However, it is necessary that the mechanism for controlling the knockover bits be able to maintain such control throughout the entire blank; that is, in the arrangement shown, until the completion of the heel tabs. The action of the knockover bit control mechanism for the remainder of the blank will therefore be described.

The removal of the bars 352 from the fabric changes the angle of the fabric with respect to the knockover bits. However, before said removal would normally occur, chain 157 of auxiliary pattern mechanism N moves rod 181 to the right, thereby swinging lever 325 out from under lever 324 so that disk 326 is racked, this racking operation bringing into active position another high pin 331 on disk 326. Said pin 331 cooperates with lever 336 and rod 296 to throw follower 293 to the left its maximum traverse. The cam shaft 42 being in the left or knitting position, the follower 293 then cooperates with cam 284 to control knock over bits 73 (Fig. 5). In the next revolution of the cam shaft, pattern chain 157 releases rod 181 in time for spring 189 to throw rod 181 and lug 343 to the left to swing lever 325 beneath lever 324 before disk 326 can receive another racking impulse from cam 399. The disk 326 therefore remains with said pin 331 in position to hold follower 293 in contact with cam 284 until after another movement of pattern rod 181 to the right.

During or soon after the last course of the after welt is knitted, the pattern chain 157 again moves rod 181 to the right to cause disk 326 to be racked. Disk 326 is thereby moved so that a second vacant aperture 332 is presented to the levers 334, 335 and 336. No pin being active, the rod 296 is controlled by contact of lug 337 on lever 335 with stop bolt 338 and therefore rod 296 is moved by spring 307 so that follower 293 is moved into and remains in active cooperation with cam 281 until the next

racking of disk 326. In the next revolution of the cam shaft, the one in which fine yarn for the leg section is first knitted, pattern chain 157 releases rod 181 in time for spring 189 to throw rod 181 and lever 325 to bring said lever beneath lever 324, thereby retaining disk 326 in such position that follower 293 remains in contact with cam 281. In the arrangement shown, cam 281 continues to control the action of the knockover bits 73, except at the times narrowing is carried out, until the point in the knitting at which reinforced portions are to be made. During narrowing, rod 296 and follower 293 remain in the same position, but cam shaft 42 shifts to the right. Follower 293 therefore cooperates with the higher track of cam 282 during periods of narrowing the leg.

During the knitting of the remaining sections of the blank, those requiring reinforcement, the knockover bits 73 are controlled by high pins 331 acting on lever 336 between the last mentioned aperture 332 in disk 326 and the aperture 332 which was presented to levers 334, 335 and 336 at the finish of the preceding blank. The pins 331 and lever 336 coact as before, throwing follower 293 into the plane of cam 284 while cam shaft 42 is in knitting position. When shaft 42 moves into narrowing position, follower 293 remaining in the same plane, follower 293 cooperates with cam 285. Of course, the pins between the two unfilled apertures being of the same height, their action is the same and the same effect on the cycle could be obtained by making disk 326 smaller and using only one pin 331 between the two unfilled apertures, the single pin 331 being then used for a longer period. However, the disk 326 shown is adaptable for carrying out cycles requiring more steps of the disk than that described herein, such, for instance, as one for a single unit stocking; that is, a stocking knitted from beginning to end on one machine. Further, by using a round rotatable member for selecting the cam for the knockover bits, not only can the pins be easily shifted and/or changed to adapt the knockover bit control to different cycles, but the knockover bit control mechanism automatically moves from the correct position for finishing one blank to the correct position for setting up for the next blank.

SECTION XXII

Definitions

In the accompanying description and claims, the term "welt" means the two ply upper or edge part of a fabric or article, such as a stocking fabric or stocking.

The expression "hooking up" means the step of engaging and applying a draw-off tension to the loops of the yarn of the first course after said loops have been formed by pressing the yarn between the needles of a needle row.

"Turning the welt" means the step of restoring the loops of the first course of a knitted fabric to the needles to form a folded two ply fabric, such as is ordinarily found at the upper end of a full-fashioned stocking.

"Welt turning apparatus" means a mechanism forming part of a knitting machine and capable of restoring to the needles of the machine the loops of the first course of a fabric, after a suitable number of intervening courses have been knitted and the fabric thus formed has been folded.

"Casting-off" means the step of removing or dropping from the needles certain loops which

had been formed, but which had not been interengaged with a preceding course.

"Welt bar" means a bar having secured thereto instrumentalities for engaging certain loops of the first course of knitted fabric, and for reengaging said loops on the needles during the welt turning operation.

"Transfer elements" means elements utilized to transfer the free loops of the first course of a knitted fabric onto the needles after a suitable number of courses have been knitted, and for facilitating the reengagement of said first course with the needles.

"Cam energized spring means" is a mechanism including a spring which is stretched or compressed by a cam actuated element.

It will be plain from the foregoing that the welt turning and associated mechanisms herein described may be substituted in whole or in part for the equivalent mechanisms of the automatic machine shown in Ischinger Patent No. 2,101,048, and that said automatic machine embodies mechanisms of the type to which those of this application may be applied.

Of course, the improvements specifically shown and described by which I obtain the above results, can be changed and modified in various ways without departing from the invention herein disclosed and hereinafter claimed.

What I claim is:

1. The method of hooking up and turning the welt during the knitting of a full-fashioned stocking comprising advancing welt hooks between the needles to engage the loops of the first course as they are drawn down off the ends of the sinkers and dividers, casting off loops from alternate needles, drawing off a number of subsequent courses of the welt fabric by tension applied to said hooks, placing a welt rod on the partially knitted welt fabric, reversing the direction of movement of said first course by pressing against its yarn with the grooved ends of transfer members moving in alinement with alternate needles to draw the welt fabric around the welt rod, and finally transferring the loops of the first course back to the needles by thrusting alternate needles into said grooves to pick the loops from said members and thereafter withdrawing said members and hooks.

2. In a welt turning apparatus for a knitting machine having knitting needles, a welt bar having hooks supported thereon and arranged to move intermediate the knitting needles and approximately equal to the needles in number, and transfer members extending from the same side of said bar as said hooks but extending a less distance from the bar and secured in said bar in alinement with alternate needles only and having grooved ends adapted to engage loops previously held by said hooks and to receive needles in their grooves on the upstroke of the needles to transfer loops back to the needles.

3. In a flat knitting machine having a needle row, a welt bar having a series of hooks fixed thereon and extending therefrom so as to lie in a substantially horizontal plane when in use and a series of transfer members fixed thereon and extending therefrom in the same general direction as said hooks but not so far and arranged so that the ends of said transfer elements extend across the plane of the hooks, said elements being approximately half as numerous as said hooks and distributed uniformly in the direction parallel to the needle row, said elements also being grooved and adapted to receive needles in their grooves on an up stroke of the needles.

4. In a flat knitting machine in combination, a needle row, a series of hooks adapted to receive bights of the loops of the first course of a given fabric, means to cast off alternate loops of said course, means to apply a draw-off tension to said hooks, a series of transfer elements having grooved ends directed toward said needle row and in alinement with said cast off loops, and means to move said elements toward said needle row to engage said cast off loops and to then move the elements into position in which the needles are adapted to engage said grooves and pick the loops off said elements.

5. A welt bar for a flat knitting machine having a series of hooks arranged in coplanar relationship thereon for engaging the loops of the first course and arranged substantially horizontal when in use, and a series of transfer elements arranged in coplanar relationship and being shorter than said hooks projecting between and at an inclination to said hooks, the free ends of said elements being grooved and forming an acute angle with the plane of said hooks whereby said ends may be pressed against loops held on the shanks of the hooks without danger of the loops slipping past the said ends of the transfer elements.

6. A welt bar for flat knitting machines having welt hooks projecting from one side thereof and resilient members projecting from the opposite side thereof adapted to receive a thrust for moving said bar into position to receive loops from the knitting needles.

7. In a multi-section flat knitting machine in combination, a plurality of needle rows, a series of draw-off straps having hooks thereon adapted to engage welt wires, means to move said hooks toward the needle rows to points between the welt wires and the needle rows, means to place tension on said straps, means to hold said hooks against said tension, means to release said holding means and to approximately simultaneously withdraw said moving means away from the needle rows to permit said hooks to engage the welt wires and to freely apply the tension on said straps to the welt wires.

8. In a multi-section flat knitting machine in combination, a plurality of needle rows, a series of draw-off straps having hooks thereon adapted to engage welt wires, means to move said hooks toward the needle rows to points between the welt wires and the needle rows, means to place tension on said straps, means to hold said hooks against said tension, means to release said holding means and to positively withdraw said moving means away from the needle rows to permit said hooks to engage the welt wires and to freely apply the tension on said straps to the welt wires.

9. In a multi-section flat knitting machine in combination, a plurality of needle rows, a series of draw-off straps having hooks thereon adapted to engage welt wires, means to move said hooks toward the needle rows to points between the welt wires and the needle rows, means to place tension on said straps, means to hold said hooks against said tension, means to release said holding means and to rapidly withdraw said moving means away from the needle rows to permit said hooks to engage the welt wires and to freely apply the tension on said straps to the welt wires.

10. In a multi-section flat knitting machine in combination, a plurality of needle rows, two shafts extending parallel and in front of the

needle rows, draw-off straps having hooks thereon connected to one of said shafts, means adapted to apply a turning moment to said shaft in the direction to wind said straps thereabout, belts having means thereon adapted to engage said hooks and adapted to be moved by the other of said two shafts, means whereby said shafts may be turned simultaneously in the direction to unwind said straps and to move said engaging means toward the needle rows, and means whereby said shafts may be moved independently of each other.

11. The combination in a flat knitting machine of a needle row, a hook-up bar having a series of welt hooks projecting from one side thereof, a means for pushing said bar toward the needle row, a stop means for limiting the movement of said bar toward the needle row, and a resilient means intermediate said bar and said pushing means.

12. The combination as set forth in claim 11 and in which the means for pushing the hook-up bar toward the needle row includes guide pins each having a tapered washer thereon, the washer on one pin tapered in the opposite direction from that on the other pin to assist in centering the bar on the pushing means and thereby centering the bar with respect to the needle row.

13. In a full-fashioned knitting machine, in combination, a shaft having drawing-off straps connected thereto, means for applying a torque to said shaft in the draw-off direction, a second shaft having means associated therewith adapted to connect with the free ends of said straps, gearing between said shafts, and means adapted to turn said shafts in a direction to unwind said straps and to move the free ends thereof toward the needle row, said gearing having a lost motion means therein whereby said first shaft moves to unwind said straps to some extent before beginning to turn said second shaft whereby said shafts are turned without tension on said straps.

14. In a full-fashioned knitting machine, in combination, means for pushing hook-up bars toward the needle row comprising levers pivoted together in pairs, three cams and connections between said cams and said levers for imparting a pushing action to said levers, one of said cams adapted to move the levers for pushing said bars into the hook-up position, another of said cams being adapted to move said bars a less distance toward the needle row, and the third one of said cams being adapted to move said bars the same distance as said first cam toward the needle row and to maintain them in said position longer for a transferring operation, means whereby said levers are locked against movement away from the needle row in the position to which they are moved by said second cam, and means whereby the operation of said third cam unlocks said levers to permit their movement away from the needle row.

15. In a full-fashioned knitting machine, in combination, means for pushing hook-up bars toward the needle row comprising a shaft and one of each of a plurality of pairs of levers fixed thereto, the other lever of each pair being pivoted to the one fixed to said shaft, and having a pushing means at its free end, and means for turning said shaft comprising an additional lever pivoted at one end on a fixed axis and having a cam follower at the other end, three cams adapted to cooperate individually with said follower, and locking means including two levers pivoted on said cam follower lever and arranged to be locked and unlocked by impulses caused by movement thereof in response to impulses delivered thereto from said cams, said locking means acting to hold said cam follower lever in a fixed angular position in which it is placed by the second of said cams to act thereon and being unlocked by the action of the third of said cams to act thereon.

16. In a full-fashioned knitting machine, in combination, means for hooking up the first row of loops formed on the needles and means for continuing knitting after said hook-up operation including an auxiliary draw-off means and a duplex draw-off means including a shaft and having both weight and cam energized spring turning means for the draw-off shaft, and automatic means to shift from said weight means to said spring means.

17. In a full-fashioned knitting machine having a needle row, in combination, a draw-off means comprising straps having hooks at one end thereof and connected to drums at their other ends, a shaft for said drums, and means for drawing said hooks toward the needle row including said shaft.

18. In a full-fashioned knitting machine having a needle row, in combination, a duplex draw-off means comprising straps and both weight and cam energized spring means for producing draw-off torque, means adapted to be geared to said draw-off means for moving the free ends of said draw-off straps toward the needle row, and latch means associated with said strap moving means for temporarily resisting the torque of said weight means.

19. In a full-fashioned knitting machine in combination, a needle row, a hook-up bar, means for pushing said bar toward the needle row for hooking up, means for pushing said bar toward the needle row to a position short of said hook-up position, means for pushing said bar toward the needle row for a transferring operation, a duplex draw-off means including both weight and cam energized spring torque means for producing a draw-off torque, straps forming part of said draw-off means, means adapted to be engaged to said draw-off means for moving said straps toward the needle row, means for latching said straps to resist the torque of said weight means when said bar is in said position short of hook-up position, and means for releasing said latch means prior to when said bar is pushed into position for the transferring operation.

20. In a full-fashioned knitting machine in combination, a revolving cam, a cam follower adapted to be shifted into and out of cooperative relation with said cam, a means for shifting said follower comprising a lever having a roller journaled thereon, and means whereby said roller and lever may be given a uniform movement comprising a rod arranged to move back and forth in the direction of its axis, a block fixed on said rod having a surface inclined to said axis and arranged to press against the roller when the rod is moved in one direction and said block having a surface parallel to the axis of said rod onto which said roller is adapted to ride after a certain movement of said rod, and means for supporting said block on the side opposite said roller.

21. In a full-fashioned knitting machine in combination, a duplex draw-off mechanism including both weight torque means and spring torque means and a shaft, a pawl and connections whereby said pawl is influenced by the spring portion of said second torque means to

urge said shaft in the draw-off direction, a member adapted to disable said pawl, connections including a rod for holding said member in disabling position, a spring for throwing said rod in the direction to permit said pawl to function, a patterning means for moving said rod against said spring, a latch means for holding said rod against the pull of said spring, and means whereby said weight torque means releases said latch.

22. In a full-fashioned knitting machine, the combination as set forth in claim 21 and in which the means whereby the weight torque means releases the latch for the rod includes an oscillatable shaft having an arm thereon arranged for lifting action when said shaft begins to move, a jointed rod having a portion adapted to move into latching position with respect to said rod and having a portion on the other side of the joint therein from said portion and adapted to engage said arm, means whereby said second portion normally remains out of engagement with said arm, and an arm moved by said weight means for throwing said second portion into engagement with said arm.

23. In a full-fashioned knitting machine in combination, a duplex draw-off mechanism including both weight torque means and spring torque means, a common shaft to which both said torque means are adapted to deliver power, and an overrunning clutch between said weight torque means and said shaft whereby said spring torque means may operate said shaft without affecting said weight torque means.

24. In a full-fashioned knitting machine in combination, a duplex draw-off mechanism including both weight torque means and spring torque means, a common shaft to which both said torque means are adapted to deliver power, means whereby said spring torque means may be held out of operation, pattern means whereby said holding out means may be put in holding out condition, means whereby said weight torque means releases said holding out means to permit said spring torque means to become operative, and an overrunning clutch between said weight torque means and said shaft whereby said spring torque means may operate said shaft without affecting said weight torque means.

25. The method of turning a welt in the manufacture of a fabric on a full-fashioned knitting machine comprising thrusting welt hooks from a forward position to one between the needles and receiving the loops of the first course on said hooks, knitting subsequent courses of loops while maintaining a forward draw-off tension on said hooks, thrusting said hooks part way toward the needles from the position which they had obtained during the knitting of said courses, knitting further courses under a forward draw-off tension while said hooks are in said part way position, holding the loops of the first course against the draw-off tension by means of transfer elements during the knitting of said further courses, thrusting said transfer elements and hooks toward the needles until the hooks occupy the positions in which they first received the loops of the first course, and transferring the loops of the first course from the hooks back to the needles while the loops are against said transfer elements.

26. In a knitting machine having a needle bar, a needle tilting means for swinging the bar forwardly away from the knitting position comprising two levers mounted for limited angular movement and one biased to turn clockwise and the other counterclockwise, and means associated with said levers for swinging the needle bar.

27. In a knitting machine having a needle bar, a needle tilting means as set forth in claim 26 and in which the two levers have means adapted to interengage to latch the levers against turning.

28. In a knitting machine having a needle bar, a needle tilting means comprising two levers mounted for limited angular movement and having means fixed thereon whereby a angular movement of one lever turns the other in the opposite sense, spring means connected to said one lever for turning it in one direction, cam and follower means associated with said one lever for turning it against the pull of said spring, an arm fixed to said other lever, a lever pivoted on said arm having only a limited angular movement in one direction with respect thereto, and means adapted when said first two levers are turned by said spring to cooperate with said last mentioned lever to swing said needle bar forwardly from knitting position and adapted when said first two levers are turned by said cam and follower means to swing it back to knitting position.

29. In a knitting machine having a needle bar, a needle tilting means as set forth in claim 28 and in which the other of the two levers is adapted to move longitudinally of its axis, means for moving said other lever of the two longitudinally first in one direction and then in the other, and latching means between the two levers acting to prevent angular movement thereof in one direction but releasing them for angular movement when said other lever of the two is moved longitudinally in said one direction and again preventing angular movement of the two levers when said other lever of the two is moved longitudinally in said other direction back to its first position.

30. In a knitting machine having a needle bar, a lever depending from said bar, means for oscillating said lever to provide horizontal motion to said bar including a generally horizontal link, an oscillatory shaft and a lever depending from said shaft, a pattern chain, and means controlled by said pattern chain for shifting said link relatively to said last mentioned lever to swing said needle bar forwardly.

31. In a knitting machine having a needle bar, a lever depending from said bar, an oscillatory shaft, a lever depending from said shaft, a link connected to said levers, cam means for swinging said second mentioned lever for providing horizontal movement to said needle bar, a pattern chain, and means controlled by said pattern chain for shifting the point of connection between said link and one of said levers but without breaking the connection, whereby the needles may be tilted.

32. In a knitting machine having a needle bar, a means for providing horizontal motion to said bar including a generally horizontal link and a depending oscillatory lever, connection between said link and said depending lever including a pin movable in a slot in a pivoted member, and means for swinging said member to change the angular relation between said needle bar and said depending lever.

33. In a knitting machine having a needle bar, means for causing horizontal movement of said bar including a generally horizontal link, an oscillatory shaft, a lever connected to said link and depending from said shaft, and a connection between said link and said lever comprising a slotted

loop pivoted on said lever, a pin on said loop, a pin on said link engaging in the slot in said loop, a pattern chain, and means controlled by said pattern chain for swinging said loop to change the angular relation between said bar and said lever.

34. In a knitting machine having a needle bar, a needle tilting means comprising two levers mounted for limited angular movements and having means fixed thereon whereby an angular movement of one lever turns the other in the opposite sense, means connected to said one lever for turning it first in one direction and then the other, means on said levers for preventing an initiation of said angular movements when the levers have a certain relative position, means for shifting said levers relatively to each other to permit said angular movements, and for reutrning them to the position in which angular movements are prevented by said means, a patterning means and means thrown into operation by said patterning means for causing said shifting means to operate and for interrupting the action of said shifting means until another operation of said patterning means.

35. In a knitting machine in combination, a hook-up bar, means for moving said hook-up bar rearwardly on the machine comprising a plurality of cams, means for selecting one of said cams including a power actuated cam, a plurality of knockover bit cams, means for selecting a given knockover-bit cam including a second power operated cam, control rods for said selecting means, and a patterning means arranged to shift said control rods to cause said selecting means to be activated by said power operated cams to coordinate the knockover-bit motion with a given rearward motion of said hook-up bar.

36. In a knitting machine in combination, means including a cam follower for moving a hook-up bar rearwardly on the machine, means whereby draw-off hooks may be moved rearwardly on the machine, a control rod, means including a second cam follower for giving said hook moving means a motion the reverse of that in which the hooks are moved rearwardly, and means whereby a movement of said rod shifts both of said cam followers into active position.

37. In a knitting machine in combination, a means for automatically carrying out successive operations comprising a rearward motion of welt hooks to points between the needles followed by a period of knitting, a forward motion of welt hooks to points in front of the needles followed by a period of knitting and a rearward motion of the welt hooks to points between the needles, and means acting after said last mentioned motion of the welt hooks to engage the needles with loops already on the hooks.

38. A flat knitting machine comprising a plurality of knitting sections, a needle row for each of said sections, a series of hooks adapted to receive bights of the loops of the first course of a given fabric in each needle row, means in each of said sections to cast off alternate loops of said first course, means in each of said sections to apply a drawn-off tension to said hooks; a series of transfer elements in each of said sections having grooved ends directed toward said needle rows and in alignment with said cast off loops, and means in each of said sections to move said elements toward said needle row to engage said cast off loops and then move the elements into position in which the needles are adapted to engage said grooves and pick the loops off said elements.

39. A flat knitting machine comprising a plurality of knitting sections, each of said sections having a series of hooks arranged in coplanar relationship for engaging the loops of the first course and arranged to be substantially horizontal when in use, and each of said sections having a series of transfer elements arranged in coplanar relationship and being shorter than said hooks projecting between and at an inclination to said hooks, the free ends of said elements being grooved and forming an acute angle with the plane of said hooks whereby said ends may be pressed against said loops held on the shanks of the hooks without danger of the loops slipping past said ends of the transfer elements.

40. A flat knitting machine having a plurality of knitting sections and each of said sections having a welt bar provided with welt hooks projecting from one side thereof and resilient members projecting from the opposite side thereof adapted to receive a thrust for moving said bar into position to receive loops from the knitting needles.

41. A flat knitting machine comprising a plurality of knitting sections, a needle row for each of said sections, a hook-up bar for each of said sections having a series of welt hooks projecting from one side thereof, and means in each of said sections for pushing said bar toward the needle row, a stop means for each of said sections for limiting the movement of said bar toward the needle row, and a resilient section intermediate each of said bars and its pushing means.

42. A flat knitting machine comprising a plurality of knitting sections, a needle row for each of said sections, a hook-up bar for each of said sections having a series of welt hooks projecting from one side thereof, means for each of said sections for pushing a hook-up bar toward the needle row, a stop means for limiting the movement of each of said bars toward the needle row, and resilient means intermediate each of said bars and its pushing means, each of said pushing means including members tapered in the opposite direction to assist in centering a hook-up bar on the pushing means and thereby centering the bar with respect to the needle row.

43. A full-fashioned knitting machine comprising a plurality of knitting sections, a needle row for each of said sections, means for pushing hook-up bars toward all said rows comprising a shaft, a plurality of pairs of levers fixed thereto, one pair for each knitting section, a link pivoted to each of said levers at one end and having a pushing means at its other and free end, and means for turning said shaft comprising an additional lever pivoted at one end on a fixed axis and having a cam follower at the other end, three cams adapted to cooperate individually with said follower, and locking means including two levers pivoted on said cam follower lever and arranged to be locked and unlocked by impulses caused by movement thereof in response to impulses delivered thereto from said cams, said locking means acting to hold said cam follower lever in a fixed angular position in which it is placed by the second of said cams to act thereon and be unlocked by the action of the third of said cams to act thereon.

44. A full-fashioned knitting machine comprising in combination a plurality of knitting sections each including a needle row, means for hooking up the first row of loops formed on each

of said rows, and means for continuing knitting after said hook-up operation including an auxiliary draw-off means arranged to act on the fabric being formed on each of said rows, a duplex draw-off means having both weight and cam actuated spring turning means for withdrawal of fabric, and automatic means to shift from said weight means to said spring means.

45. A full-fashioned knitting machine comprising in combination a plurality of knitting sections each having a needle row, a draw-off means for fabrics on said needle rows including straps for each of said sections, said straps having hooks at one end thereof and connected to drums at their other ends, a shaft for said drums, and means for drawing said hooks toward the needle rows including said shaft.

46. A full-fashioned knitting machine comprising in combination a plurality of knitting sections each including a needle row, a duplex draw-off means for fabrics on said needle rows comprising both weight and cam actuated spring means for producing draw-off torque, means adapted to be geared to a part of said draw-off means for moving the free ends of draw-off straps toward the needle rows, and a latch means associated with said strap moving means for temporarily resisting the torque of said weight means.

47. A full-fashioned knitting machine comprising in combination a plurality of knitting sections each including a needle row, hook-up bars for said sections, means for pushing said bars toward the needle rows for hooking up, means for pushing said bars toward the needle rows to a position short of said hook-up position, and means for pushing said bars toward the needle rows for a transferring operation, a duplex draw-off means arranged to operate on fabrics being knitted on said rows and including both weight and cam operated spring torque means for producing a draw-off torque, straps forming part of said draw-off means, means adapted to be engaged to said straps for moving them toward the needle rows, means for latching said straps to resist the torque of said weight means, and means for releasing said latching means when said bars are pushed into said intermediate position.

48. A full-fashioned knitting machine comprising in combination a plurality of knitting sections each having a needle row, a draw-off means for cooperating with fabrics on said rows, and mechanism for moving portions of said draw-off means into position to cooperate with the fabrics, said mechanism including a revolving cam, a cam follower adapted to be shifted into and out of operative relation with said cam, means for shifting said follower comprising a lever having a roller journaled thereon, and means whereby said roller and lever may be given a uniform movement comprising a rod arranged to move back and forth in the direction of its axis, a block fixed on said rod having a surface inclined to said axis and arranged to press against the roller when the rod is moved in one direction, said block having a surface parallel to the axis of said rod on which the roller is adapted to ride after a certain movement of said rod, and means for supporting said block on the side opposite said roller.

49. The method of turning welts in the manufacture of fabrics on a multi-section full-fashioned knitting machine comprising simultaneously thrusting a plurality of welt hook bars, one for each of said fabrics, from a forward position to one in which the hooks on said bars extend between the needles and receiving the loops of the first course of each fabric on said hooks, knitting subsequent courses of loops while maintaining a forward draw-off tension on said hooks, thrusting said bars part way toward the needles from the position which they had attained during the knitting of said courses, knitting further courses under forward draw-off tension while said bars are in said part way position, holding the loops of the first course of said fabrics against the draw-off tension by means of transfer elements on said bars during the knitting of said further courses, thrusting said bars toward the needles until the hooks occupy the positions in which they first received the loops of the first course, and transferring the loops of the first course from the hooks back to the needles while the loops are against said transfer elements.

50. A full-fashioned knitting machine comprising in combination knockover-bit mechanism including multiple cams and a single follower for operating said knockover-bit mechanism under different conditions, pattern control means for moving said follower into position for cooperating with any one of said cams, a multiple cam mechanism for moving hook-up bars and having a single follower, means for moving the follower of said last mechanism into position to cooperate with any one of said second group of cams, and a pattern means controlling said last means and arranged to coordinate said two mechanisms.

51. A full-fashioned knitting machine as set forth in claim 50 and in which the mechanism for moving the follower for the hook-up bars includes an auxiliary cam and racking means therefor.

52. A hook-up bar for flat knitting machines having a plurality of generally horizontal hooks projecting from one edge thereof, at least certain of said hooks bending downwardly intermediate their ends compared to the others and arranged alternately with hooks not so bent.

53. A flat knitting machine comprising a needle row, a hook-up bar having a plurality of generally horizontal hooks projecting from one edge thereof, means whereby said bar may be advanced to position said hooks intermediate the needles in said row to receive the first course of loops, means for casting alternate loops of said first row off of the needles, said bar having a series of transfer elements thereon projecting intermediate said hooks in alternate spaces between the hooks, said elements having grooved ends directed toward the needles whereby the needles may rise through said grooves to pass through loops of the first course held on said hooks and lying against said grooved ends alternately, some of said hooks in the sections nearer the ends of the bar being bent downward intermediate their ends compared to the others at points near the line of said grooved ends.

54. In a full-fashioned knitting machine in combination, a selecting mechanism comprising a rotatable member, a cam rotating in a plane at right angles to the plane of rotation of said member, connections for transmitting a racking influence from said cam to said rotatable member, a group of pins of different lengths projecting from said member substantially parallel to its axis of rotation, a shaft parallel to the axis of rotation of said member, a plurality of levers fixed to said shaft and having surfaces for

cooperating with said pins arranged in different angular positions, the one of said surfaces most advanced in the direction opposite that of rotation of said member being farther from the side of said member from which said pins project, whereby a longer pin moves said shaft a greater angular distance, and means actuated by said shaft for shifting a second member parallel to the axis of rotation of said cam.

55. In a full-fashioned knitting machine in combination, a selecting mechanism as set forth in claim 54 and including an arm fixed to a part of the connections for racking the first member and a pivoted arm movable back and forth in the path of said arm to hold it in a position at one end of its path to thereby interrupt racking of the first member, and a pattern actuated means for withdrawing said pivoted arm from the path of said first arm.

56. In a full-fashioned knitting machine in combination, a selecting mechanism comprising a rotatable member, a cam rotating in a plane at right angles to the plane of rotation of said member, connections for transmitting a racking influence from said cam to said member, a plurality of pins of substantially the same length but of different diameters projecting from said members substantially parallel to its axis of rotation, a shaft parallel to the axis of rotation of said member, a lever fixed to said shaft and having a surface for cooperating with said pins whereby a pin having a larger diameter moves said shaft a greater angular distance than one of lesser diameter, and means actuated by said shaft for shifting a second member parrallel to the axis of rotation of said cam.

57. In a full-fashioned knitting machine in combination, a selecting mechanism comprising a rotatable member, a power driven cam, connections for transmitting a racking influence from said cam to said rotatable member, a group of pins projecting from said member substantially parallel to its axis of rotation, a shaft parallel to the axis of said member, a plurality of levers fixed to said shaft and having surfaces for cooperating with said pins, said surfaces arranged in different angular positions when the levers are at rest, said pins adapted to cooperate some with one of said levers and some with another so as to turn said shaft different distances depending upon which of said levers is actuated by a pin and means actuated by said shaft for shifting a member controlled by said mechanism various distances depending on the angular movement of said shaft.

58. The method of knitting and turning a flat knitted two ply welt comprising advancing welt hooks between the needles to engage and hold loops of the first course, knitting a portion of the welt while drawing off fabric by tension applied to said hooks, placing a welt wire on the fabric and applying a tension thereto, thrusting said first course part way toward the needles from its position at the time of placing the welt wire on the fabric and holding the first course in such part way position while knitting an additional portion of the welt, and again advancing the hooks between the needles and restoring loops of the first course to the needles.

59. In a method of knitting on the needle row of a flat knitting machine and turning a welt including forming and then catching loops of the first course on welt hooks, and knitting a portion of the welt while drawing off fabric by tension on said hooks, the steps of thrusting said hooks with loops of the first course thereon toward the position in which the loops were formed and holding the hooks at a line in front of said position but closer thereto than their position at the end of knitting said portion, folding the fabric around a welt wire or rod and knitting another portion of the welt while drawing off the fabric by tension on said wire and while maintaining the hooks stationary with respect to said position.

60. In a welt turner for a full-fashioned knitting machine, welt bar operating means comprising bar operating levers, three cams for operating said levers of which one is lower than the others, a cam follower selectively operated to cooperate with any one of said cams as desired, a lever on which said follower is mounted forming part of the operating connection between the active one of said cams and said bar operating levers, and latch means for supporting said last mentioned lever including a fixed stop, a latch lever adapted to engage said stop pivotally mounted on said last lever, said latch lever associated with means to bias it first in the direction to engage said stop and then in the opposite direction depending on the angular position of the latch lever with reference to its pivot, and a link pivoted at one end to a fixed point and having connections with said latch lever causing such lever to engage said stop to support the follower carrying lever after the follower carrying lever has been operated by the lower one of said three cams and to prevent the latch lever from engaging its stop after the follower carrying lever has been operated by any one of the other two of said three cams.

61. In a welt turning mechanism for full-fashioned knitting machines, means for advancing a welt-hook bar to present welt hooks between the needles to engage loops of the first course thereby, a draw-off for said bar, a second draw-off for a welt wire including hooks and straps attached thereto, belts having hooks thereon adapted to engage said strap hooks to move such hooks toward the needles into position to pull on the welt wire when released by said belt hooks, means whereby said belts may be operated to move said strap hooks into said position, means for latching said belts against the draw-off tension, means for again moving said welt bar toward the needles, means for unlatching said belt during said second mentioned movement of the welt bar, and means for moving said belts to remove said belt hooks from the path of said strap hooks so quickly as to prevent interference between the two sets of hooks including a shaft for the belt having a gear thereon, a lever having a gear portion thereon arranged to drive said gear, a cam for actuating said lever, a cam follower on said lever shiftable into and out of the plane of said cam and pattern controlled means for shifting said follower to operate said lever and belt at the desired times.

62. In a full-fashioned knitting machine, in combination, a needle row, a hook-up bar, means for pushing said bar toward the needle row for hooking up, means for pushing said bar toward the needle row to a position short of said hook-up position, means for pushing said bar toward the needle row for a transferring operation, and a duplex draw-off means including both weight and cam energized spring torque means for producing a draw-off torque following the second and last pushing up operations.

63. In a flat knitting machine having a means for knitting and narrowing fabric including a needle bar, the combination of means for laying

yarn for a first course for a welt to needles of said bar, a welt bar having horizontal hooks along one side thereof, means to move said bar so as to engage loops of the first course by said hooks and to knit welt courses thereto while said first course loops are engaged by said hooks, means for moving said bar to a position in which said hooks lie between the needles, and means for closing the welt while said hooks are between the needles including means for tilting the needle bar forwardly beyond the position assumed by it in a narrowing cycle.

64. In a flat knitting machine having means for knitting and narrowing fabric including a needle bar, the combination as set forth in claim 63 together with means for casting off alternate loops of the first course from their needles before knitting to the remaining loops thereof.

65. A welt bar for flat knitting machines, said bar having a series of welt hooks and a series of elements, the free ends of said elements being grooved.

66. A welt bar for flat knitting machines, said bar having a series of welt hooks and a series of transfer elements, said transfer elements being shorter than said hooks and having grooves at the free ends thereof.

67. In a full-fashioned knitting machine in combination, a hook-up bar, means for moving said hook-up bar toward the needle row including a plurality of cams, means for selecting one of said cams including a cam member, means for actuating said cam member, and pattern means for determining the operation of said actuating means.

68. In a full-fashioned knitting machine in combination, a needle row, a pair of draw-off straps having hooks thereon for engaging a welt wire to draw off the fabric, means applying a tension to wind said straps in the draw-off direction, and means separate from said straps and engageable with means on said straps for drawing them toward the needle row and for holding them temporarily stationary against said draw-off tension, and means for driving said drawing means first in one direction and then in the other to first move the strap hooks toward the needle row and then to automatically move the drawing means away from the needle row rapidly enough to avoid interference between the strap hooks and the drawing means when the strap hooks are free to be moved by the draw-off tension.

69. In a straight knitting machine adapted to knit fabric blanks, the combination of a shaft having a fabric reeling means thereon, a ratchet means for turning said shaft including a toothed wheel on the shaft, a pawl and a spring for urging the pawl in the direction to draw off fabric, mechanical means for imparting energy to said spring, and means for controlling said ratchet means acting to throw said pawl into active relation to said wheel at an intermediate point in the knitting of a given fabric including a shielding member adapted when in one position to prevent engagement of said toothed wheel by said pawl and also including a generally vertical reciprocable member controlling said shielding member both to permit engagement and to prevent engagement of said toothed wheel by said pawl.

70. A full-fashioned knitting machine comprising a pair of straps for a knitting section, said straps having welt wire engaging hooks thereon, a draw-off shaft to which said straps are connected, means to move said hooks toward the needle row and to simultaneously turn said shaft contrary to the draw-off direction, means to latch said hooks in position to engage the welt wires after such wires have been placed on the fabric, and means to simultaneously unlatch said hooks for applying a draw-off tension from said shaft to the welt wires.

71. A full-fashioned knitting machine comprising a needle row, means including a welt bar for hooking up a first course on the needles, means for moving said welt bar in the draw-off direction during the knitting of a welt, means to hold a welt wire temporarily in a position above the welt fabric, a pair of straps having welt wire engaging hooks thereon, a draw-off shaft to which said straps are connected, means to move said hooks in the direction opposite said draw-off to a position intermediate said needle row and said temporary position of the welt wires and to releasably latch the hooks in said intermediate position, means for moving said welt bar toward the needle row and means to unlatch said hooks during said movement of the welt bar to permit the hooks to engage the welt wires.

72. In a full-fashioned knitting machine having a needle row, in combination, a pair of draw-off straps each having a hook at one end for engaging a welt wire, a shaft to which the other ends of said straps are connected, means including said shaft for moving said hooks toward the needle row, means including said shaft for moving said hooks away from the needle row for drawing off fabric, a latch acting substantially immediately after said hooks have been moved toward the needle row to resist said draw-off means, and means acting after a certain amount of fabric has been knitted to release said latch.

73. In a full-fashioned knitting machine in combination, two cooperating mechanisms one of which has a single operating cam and a follower therefor and the other of which has a plurality of cams, a single follower adapted to cooperate with each one of said plurality of cams in turn, said follower for the single cam mechanism adapted to receive a material operative impulse from its cam only at a time at which a given cam of said plural cam mechanism delivers a material operative impulse to said second follower, and means to shift said followers acting to shift said second follower into the plane of each cam of the plural cam mechanism in a given order and to shift said first follower into the plane of its cam each time it shifts said second follower into the plane of one of its cams.

74. In a flat knitting machine, the combination of a needle row, guide rails extending at right angles to the line of the needle row and having grooves for a welt wire in opposed sides thereof, a hook-up bar movable toward and from the needle row along the tops of said rails, draw-off straps having hooks thereon adapted to engage a welt wire whose ends are in said grooves, and means for moving said straps to position said hooks between the needle row and the welt bar and for holding the straps temporarily in this position, the pressure of fabric between said needle row and said welt bar holding a welt wire in such position that the wire may readily be engaged by the hooks when released.

GOTTLOB BITZER.