

Feb. 11, 1941.

V. LOMBARDI

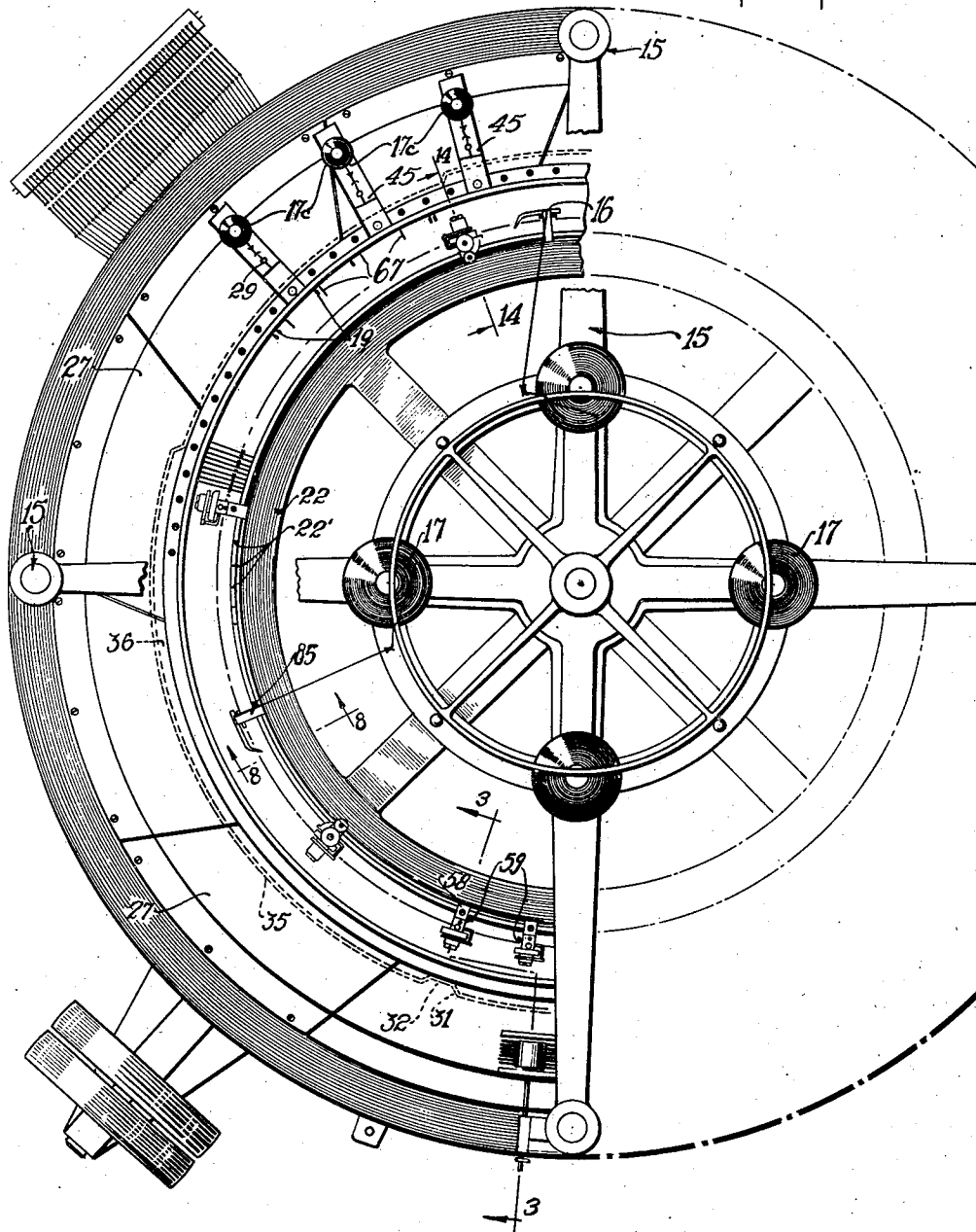
2,231,672

KNITTING MACHINE

Filed Sept. 17, 1938

27 Sheets-Sheet 1

Fig. 1.



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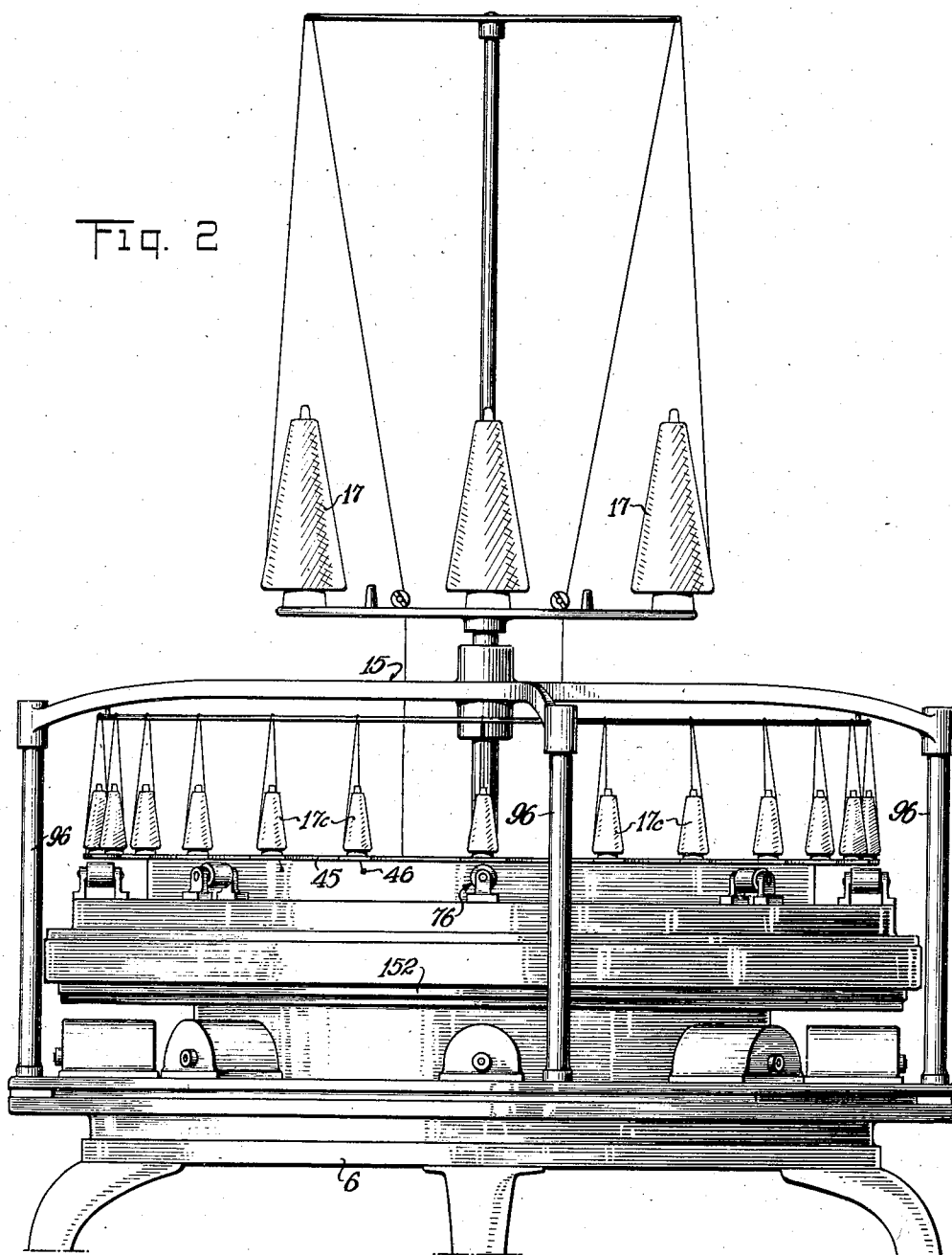
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Fig. 2



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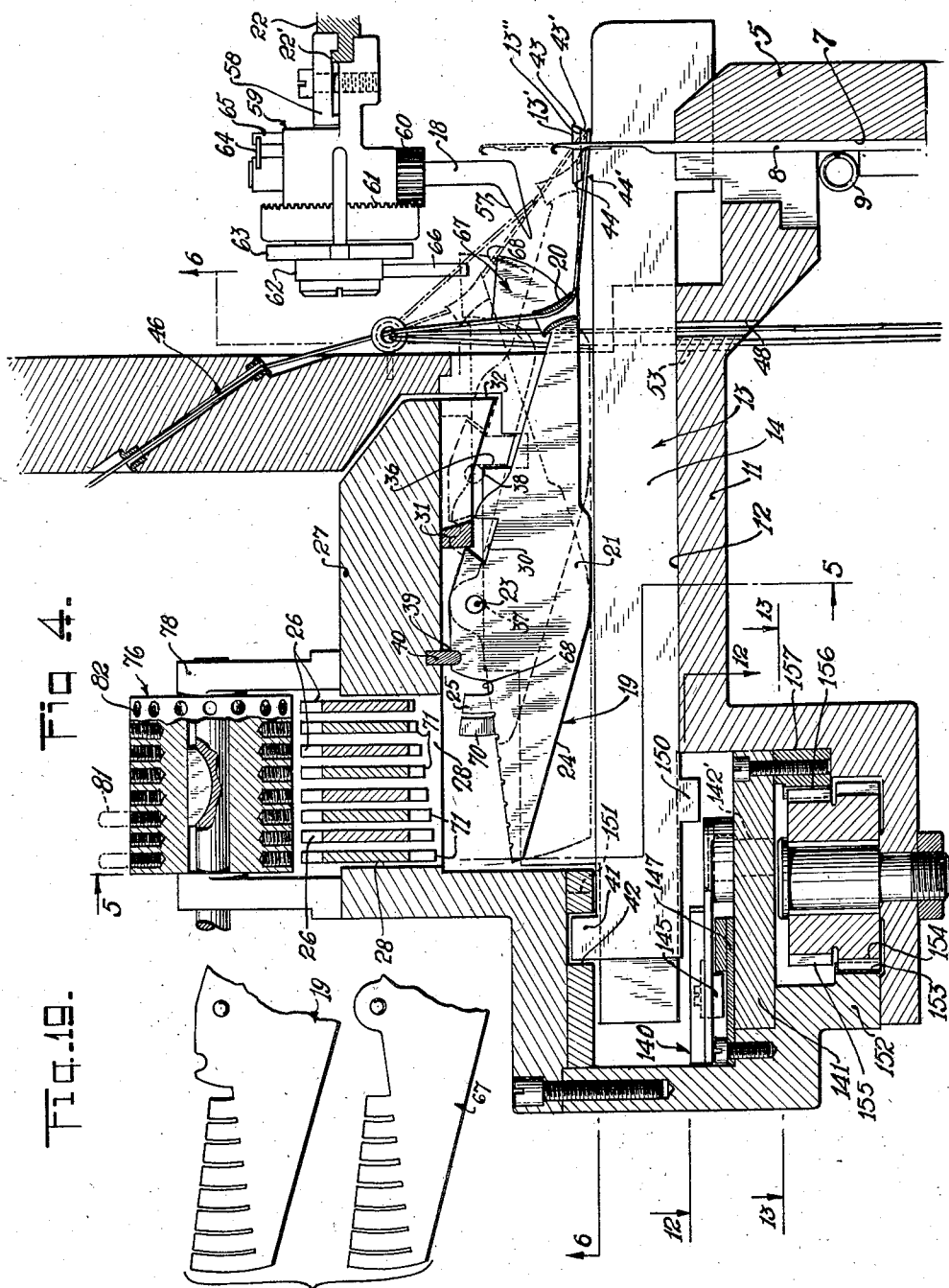
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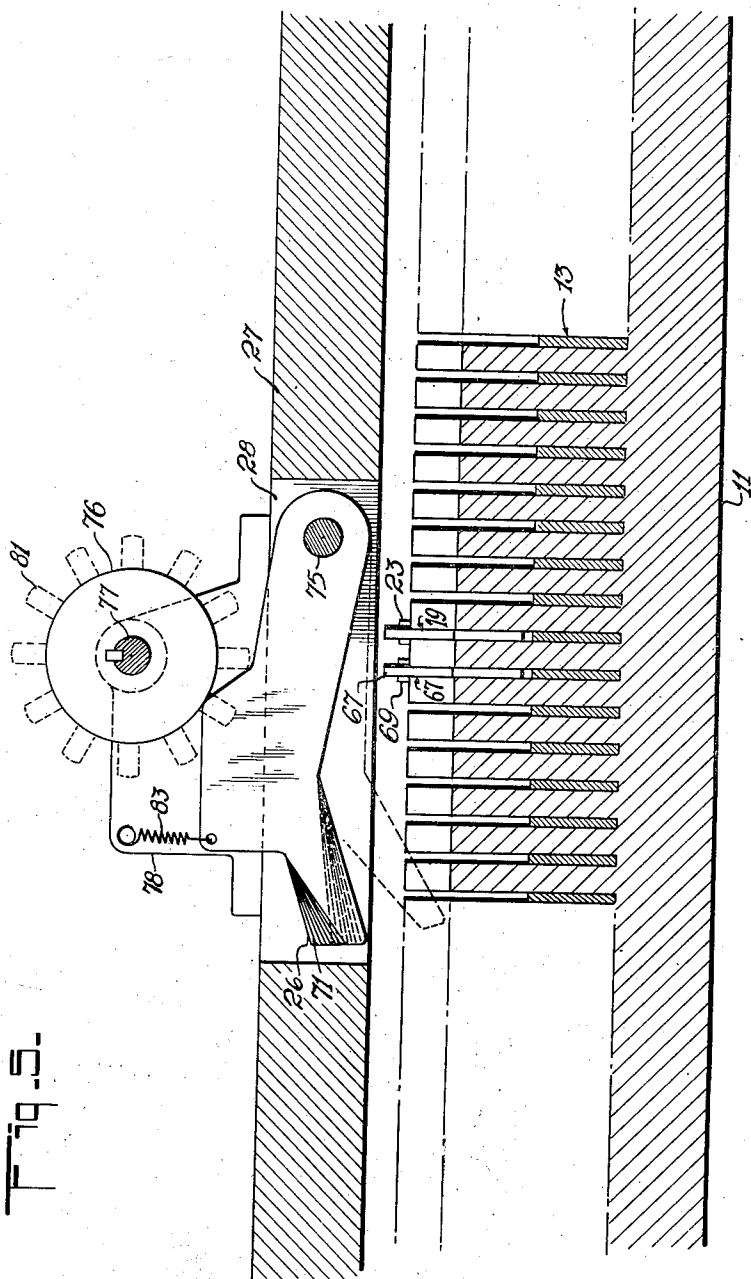
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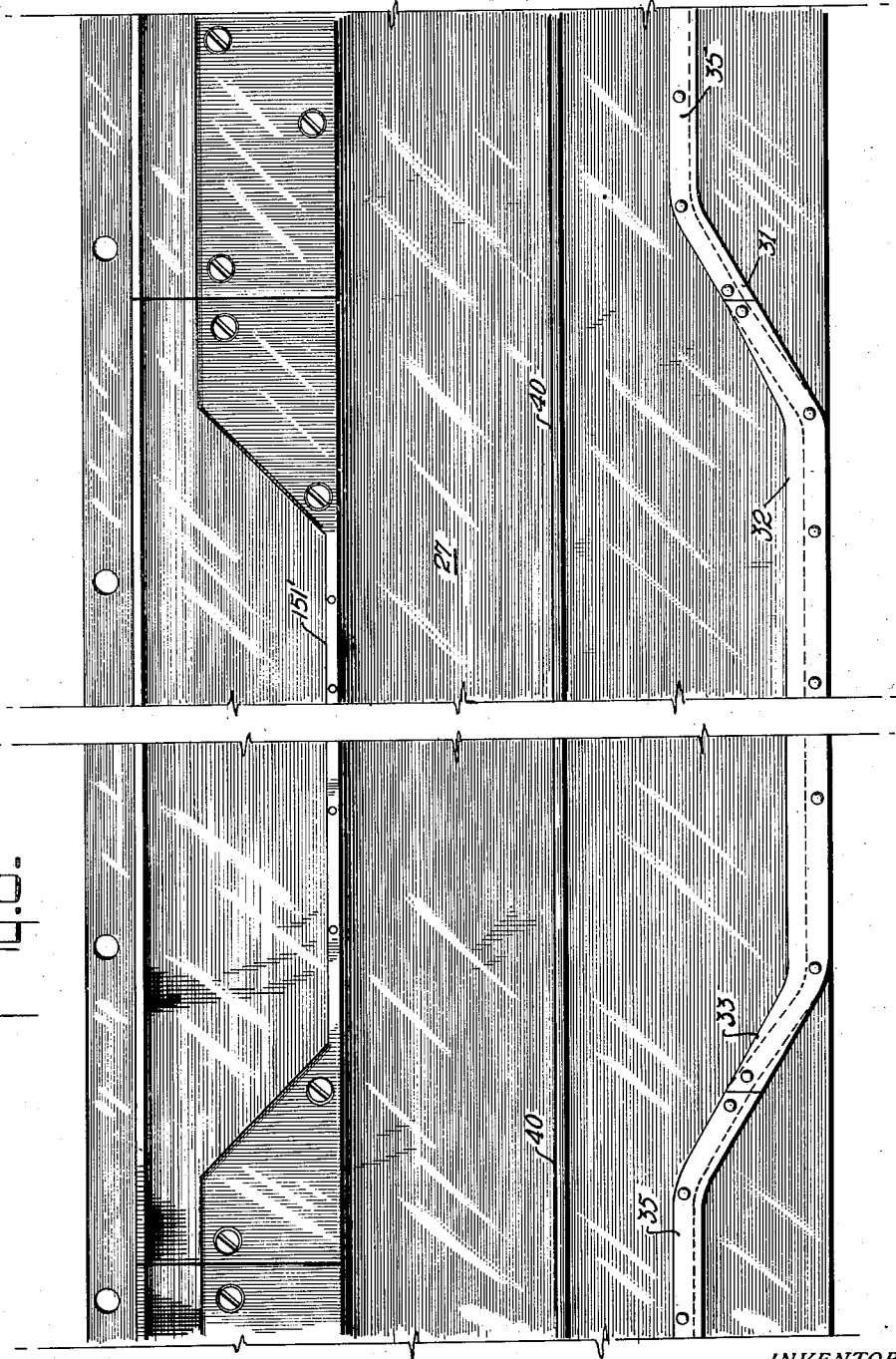
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Fig. 6.



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Fig. 7

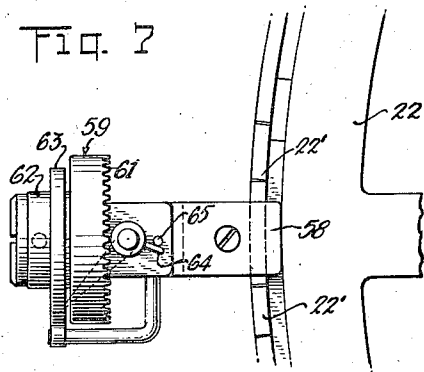


Fig. 6a

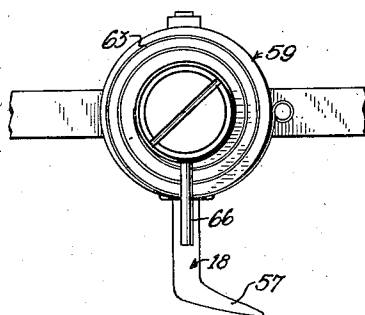


Fig. 8

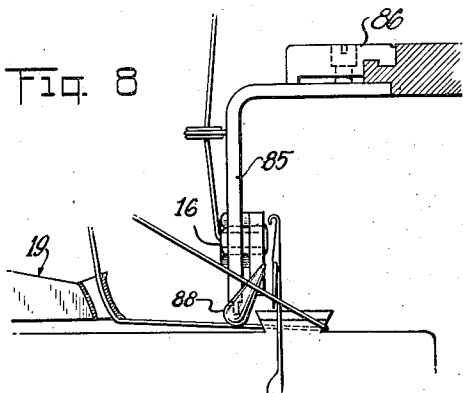


Fig. 9

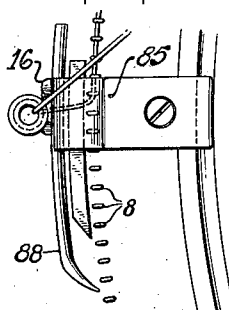


Fig. 15

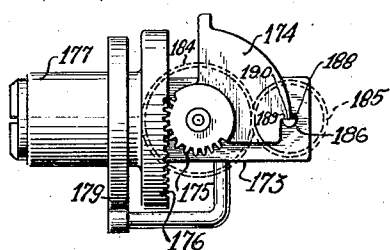
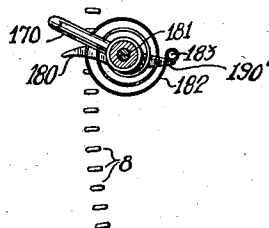


Fig. 15b



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Fig. 11.

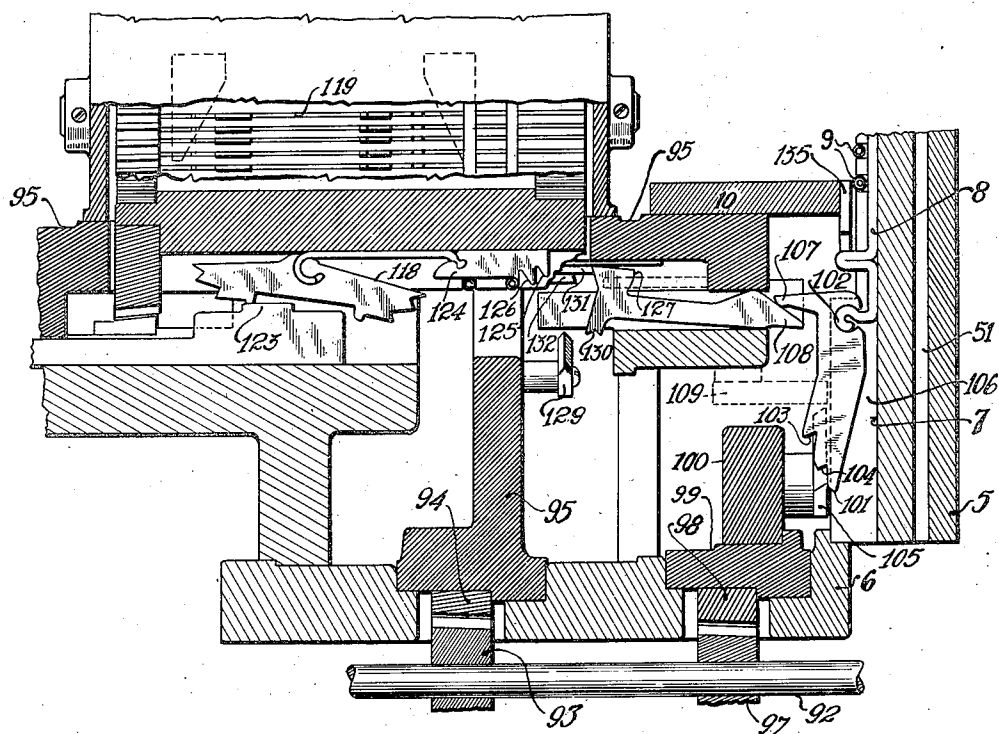
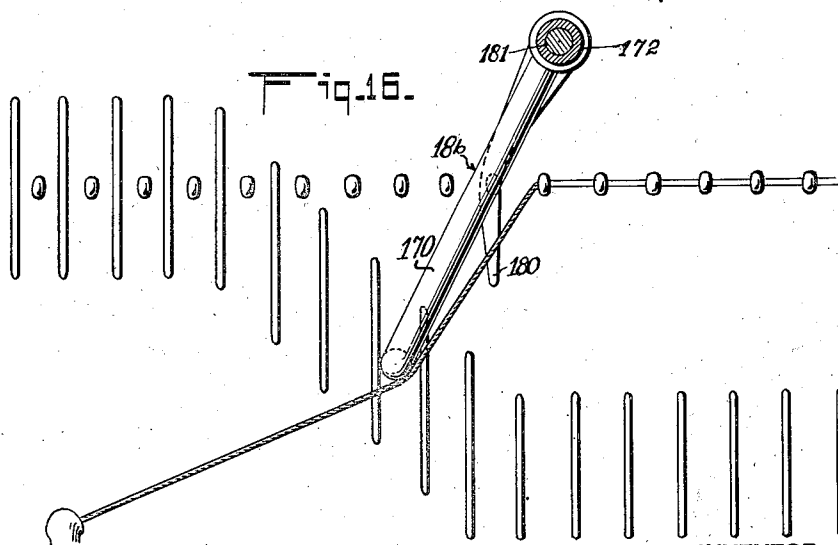


Fig. 16.



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Fig. 12

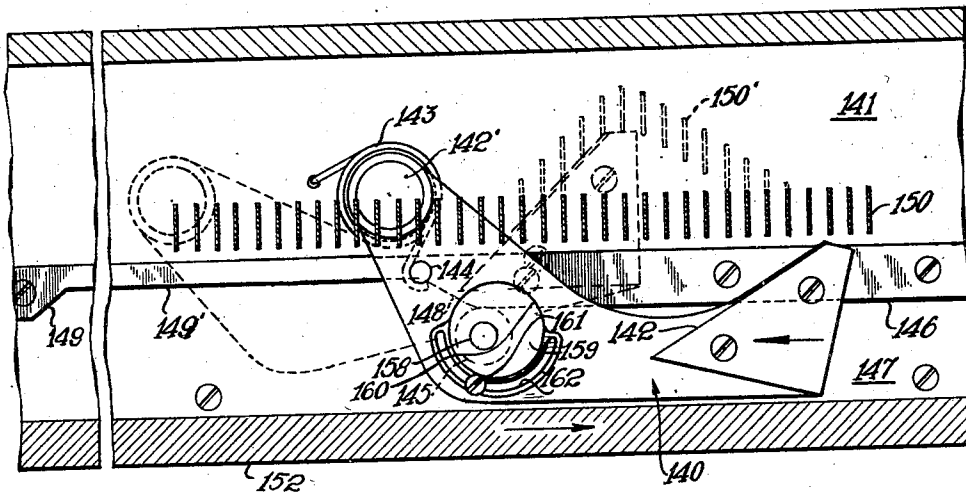


Fig. 37

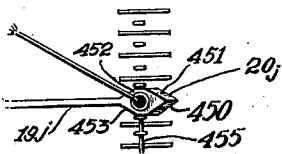


Fig. 13

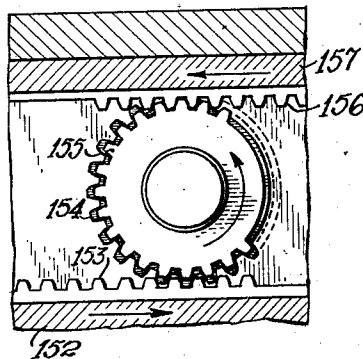


Fig. 40

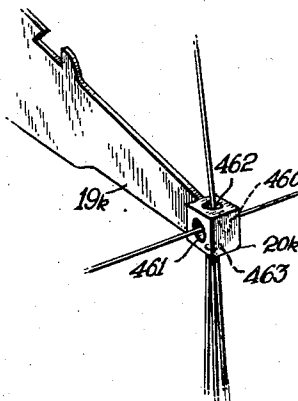


Fig. 38

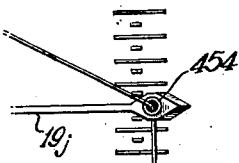


Fig. 34

Fig. 35

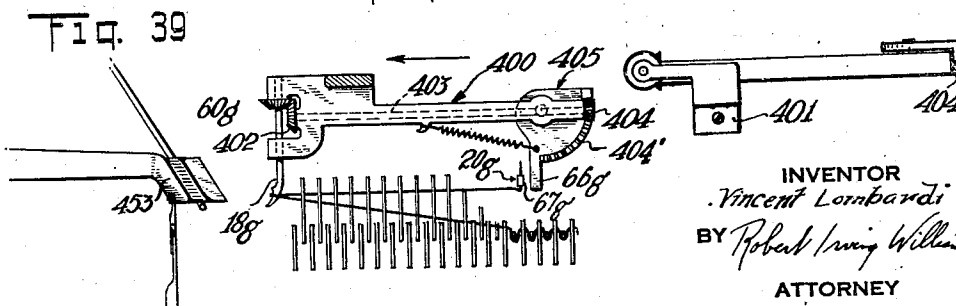


Fig. 39

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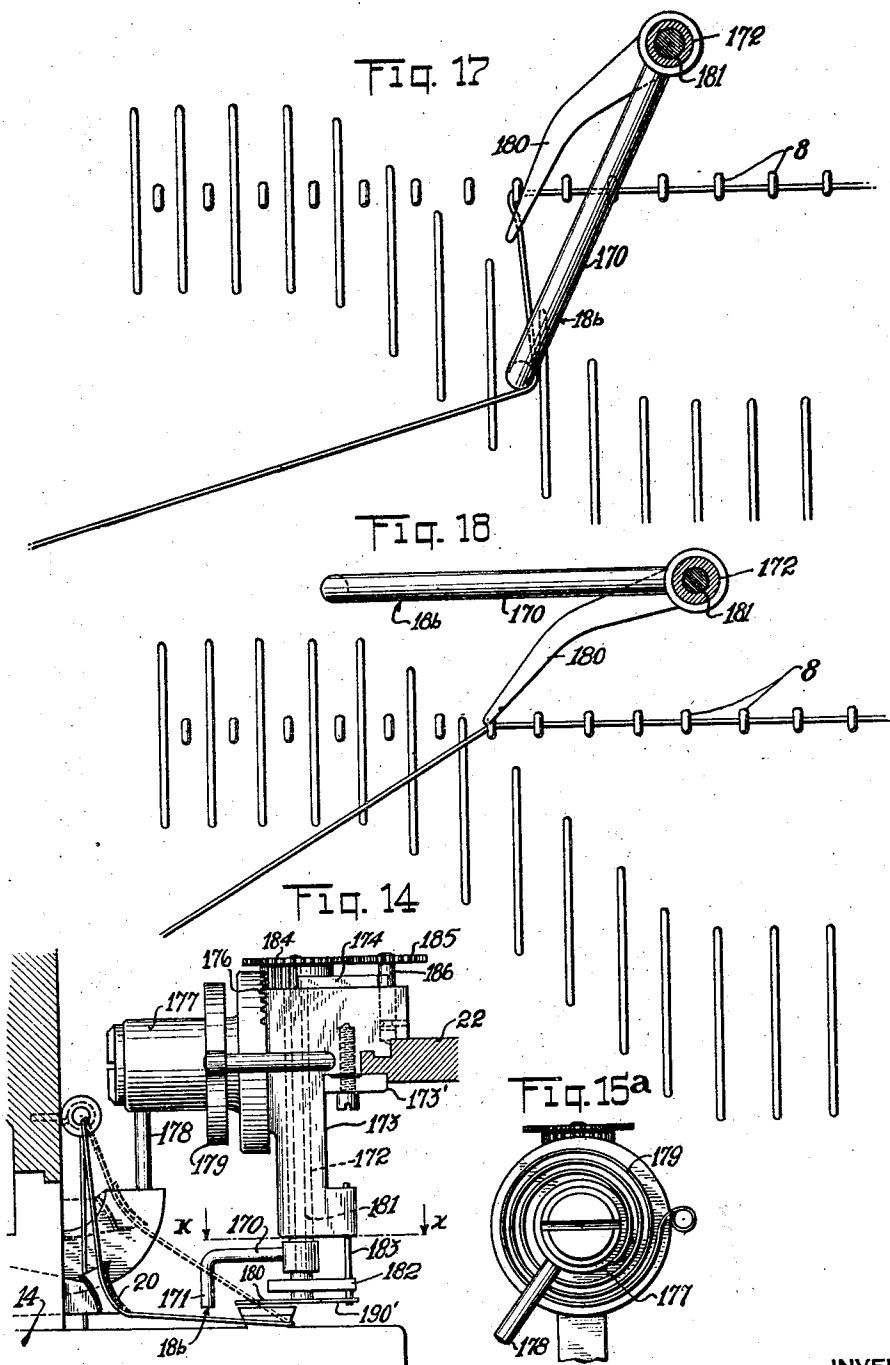
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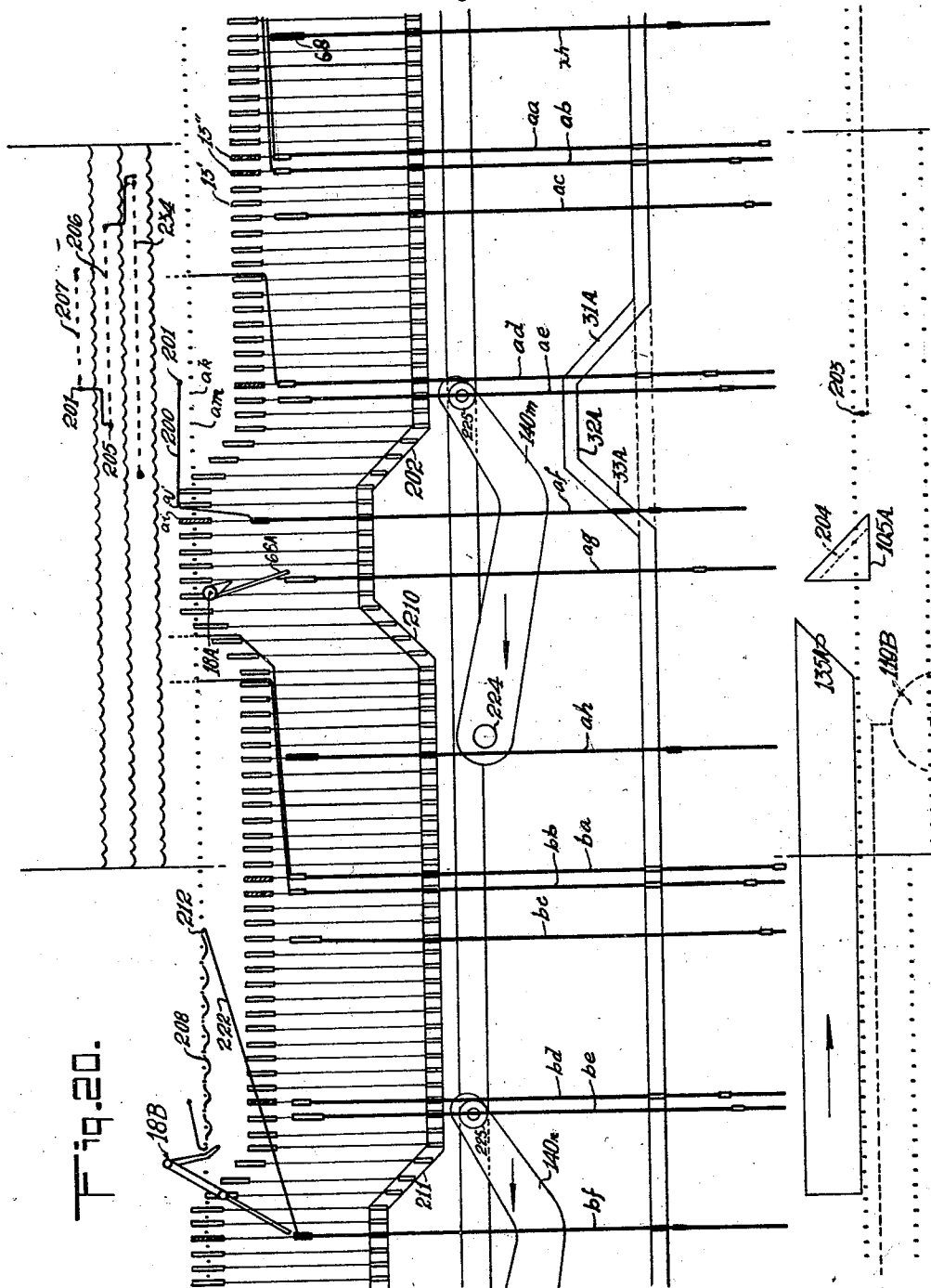


Fig. 20.

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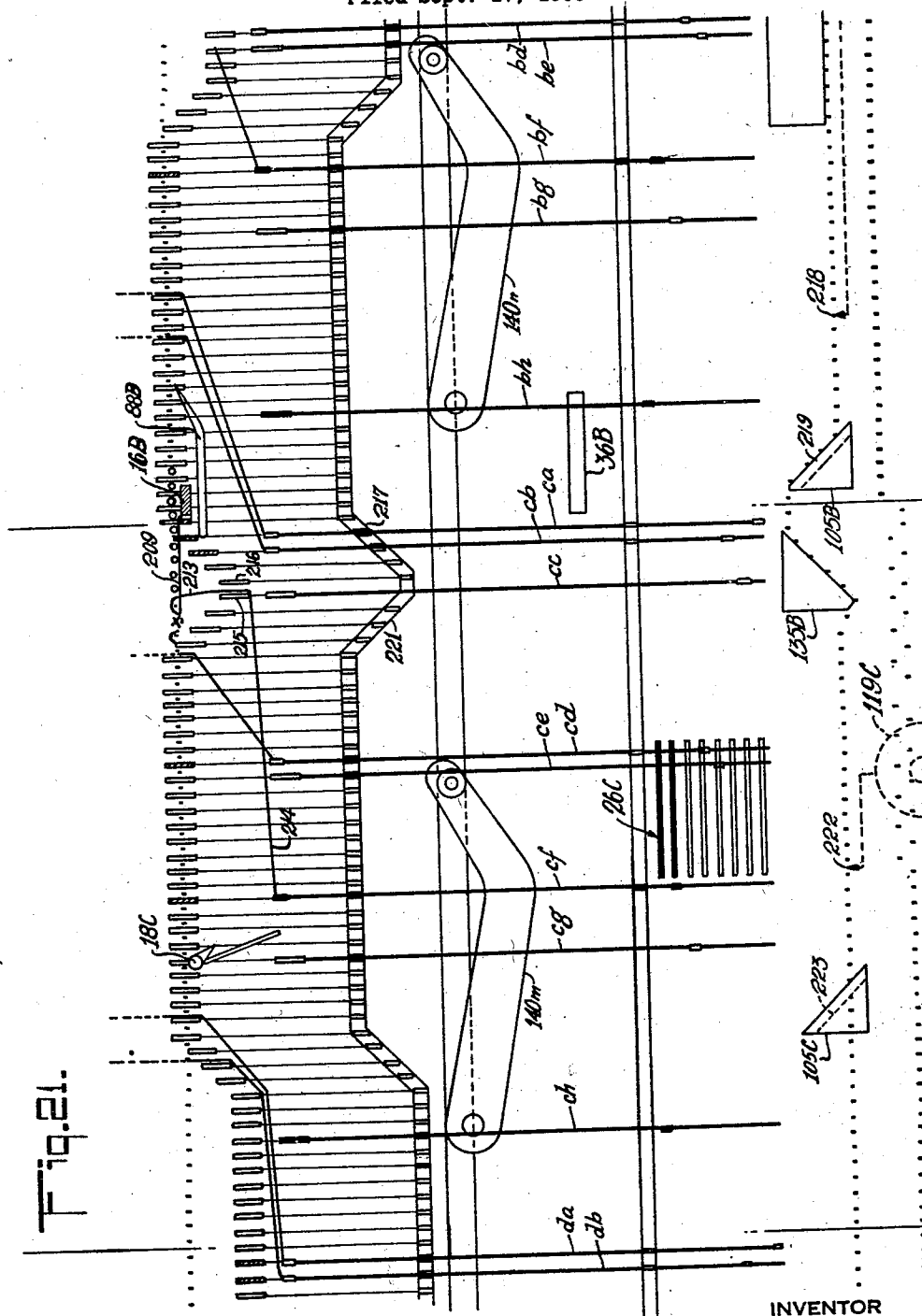


Fig. 21.

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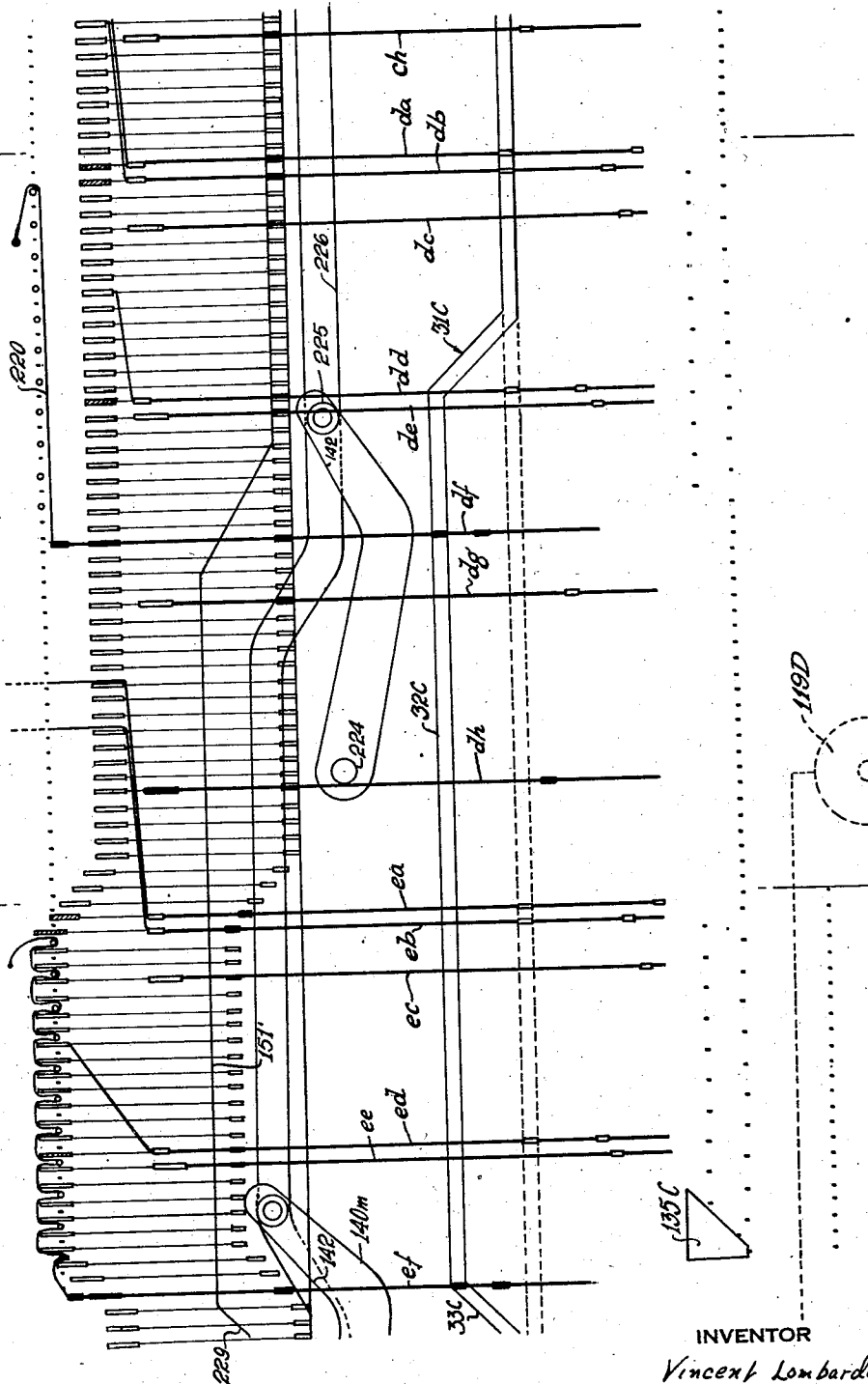
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KNITTING MACHINE

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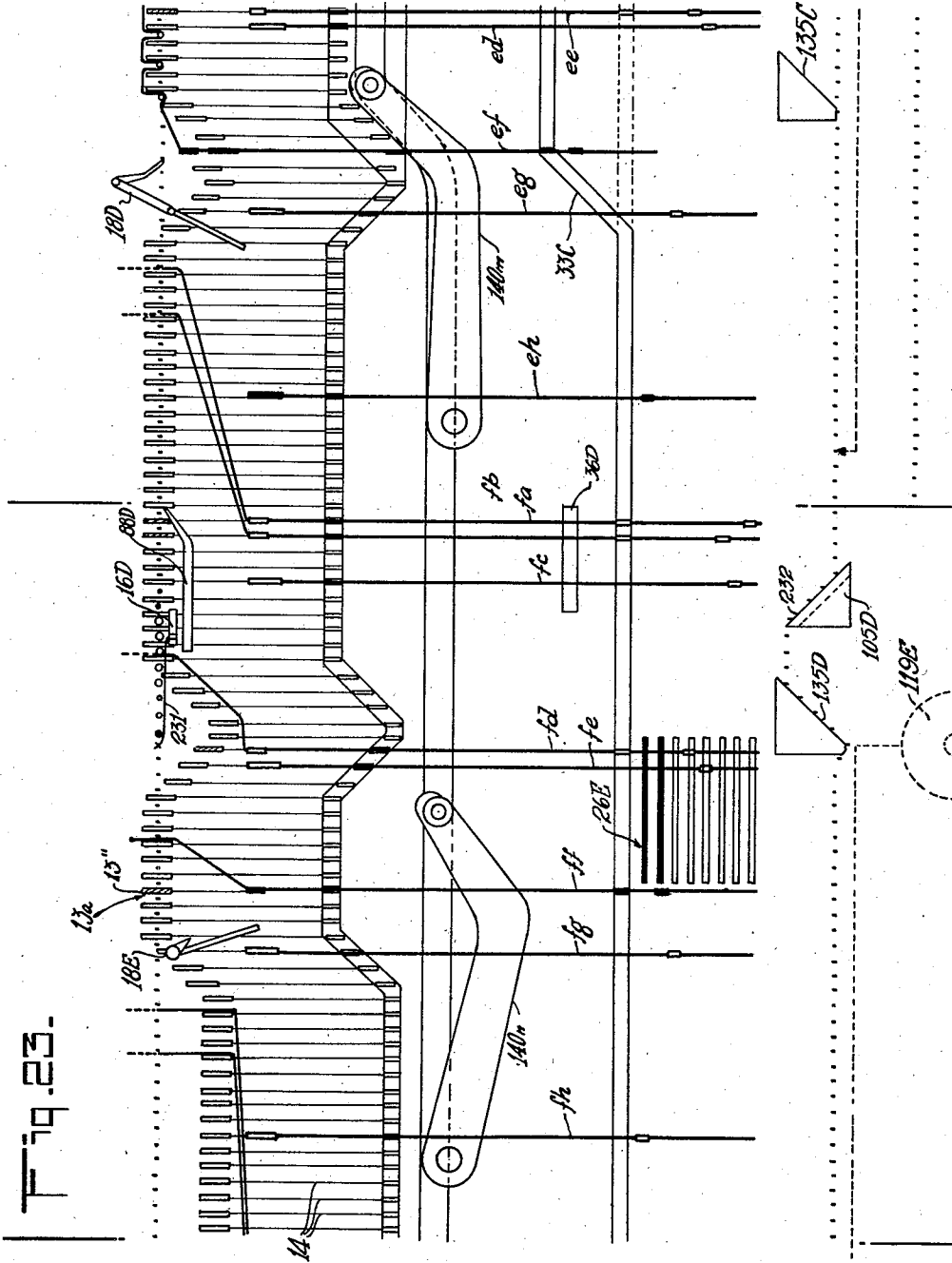
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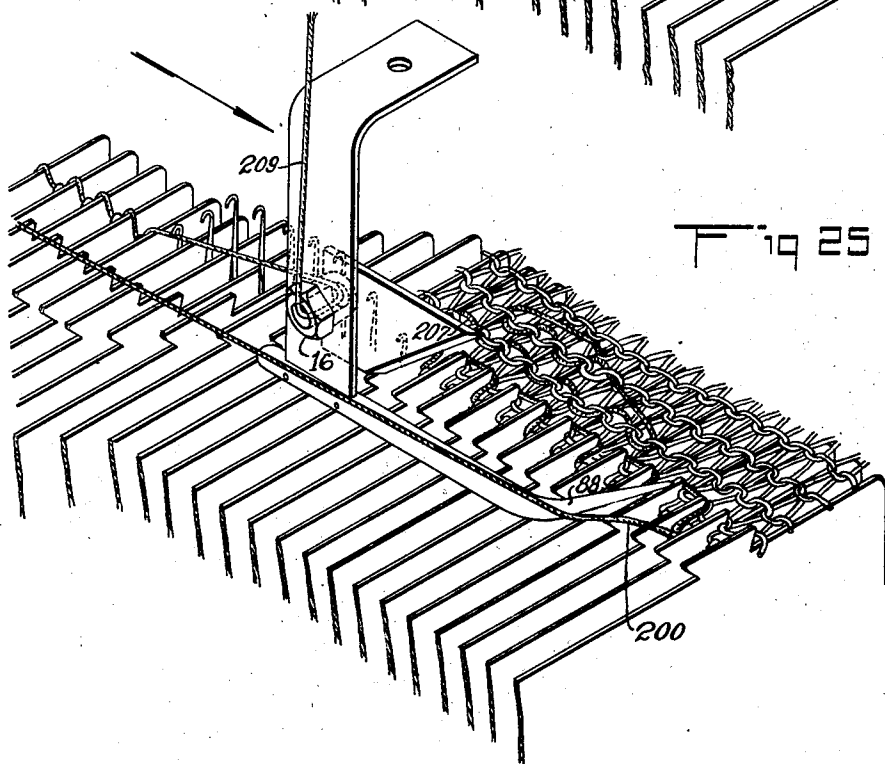
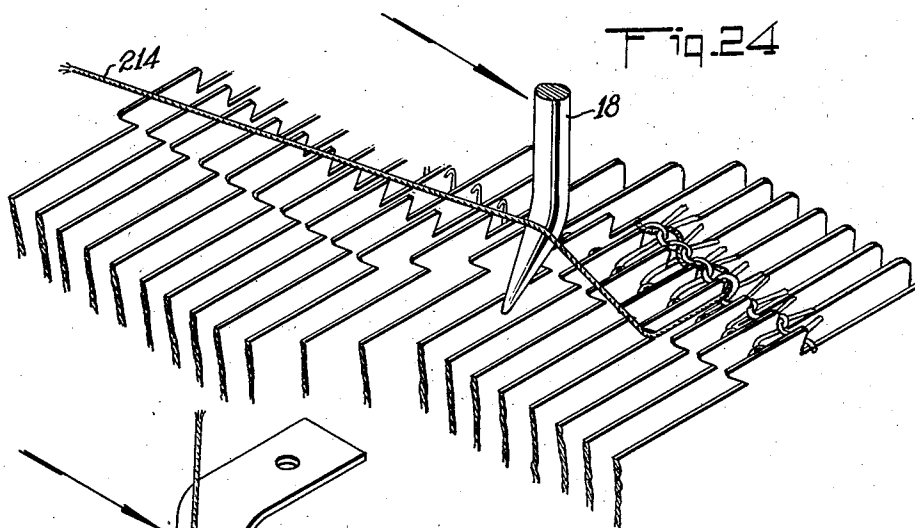
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Fig. 26.

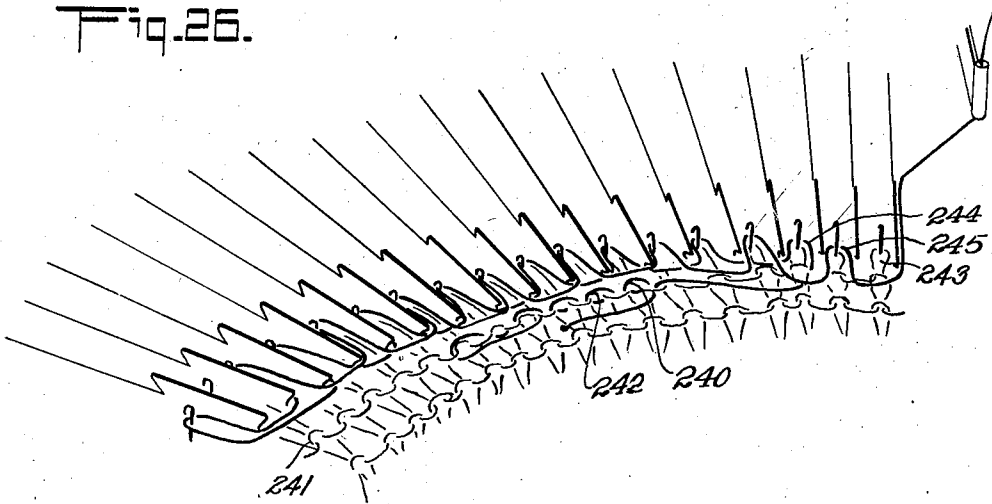
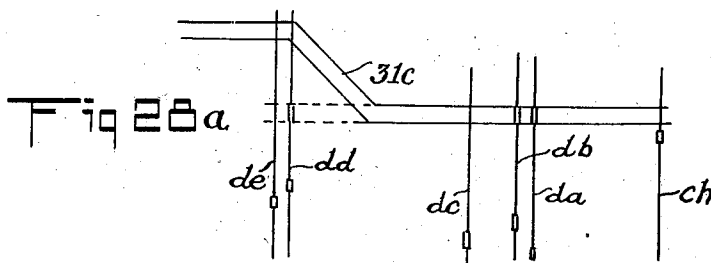
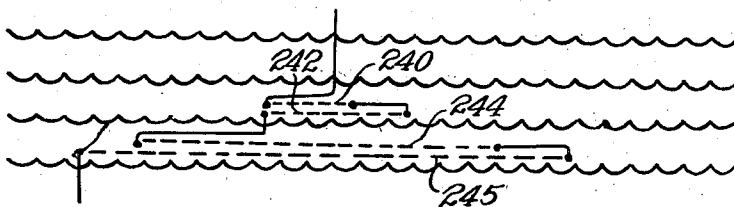


Fig. 27.



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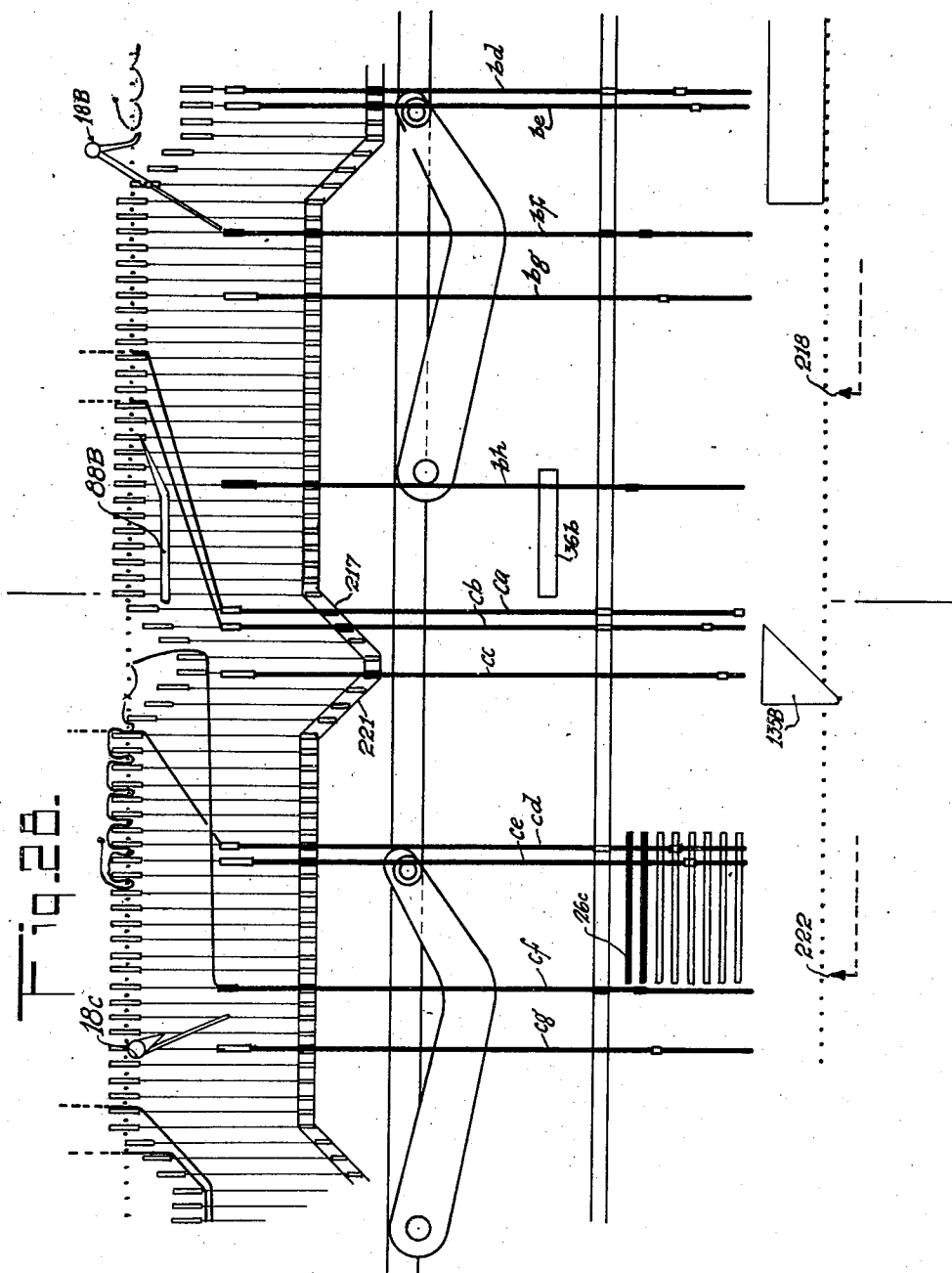
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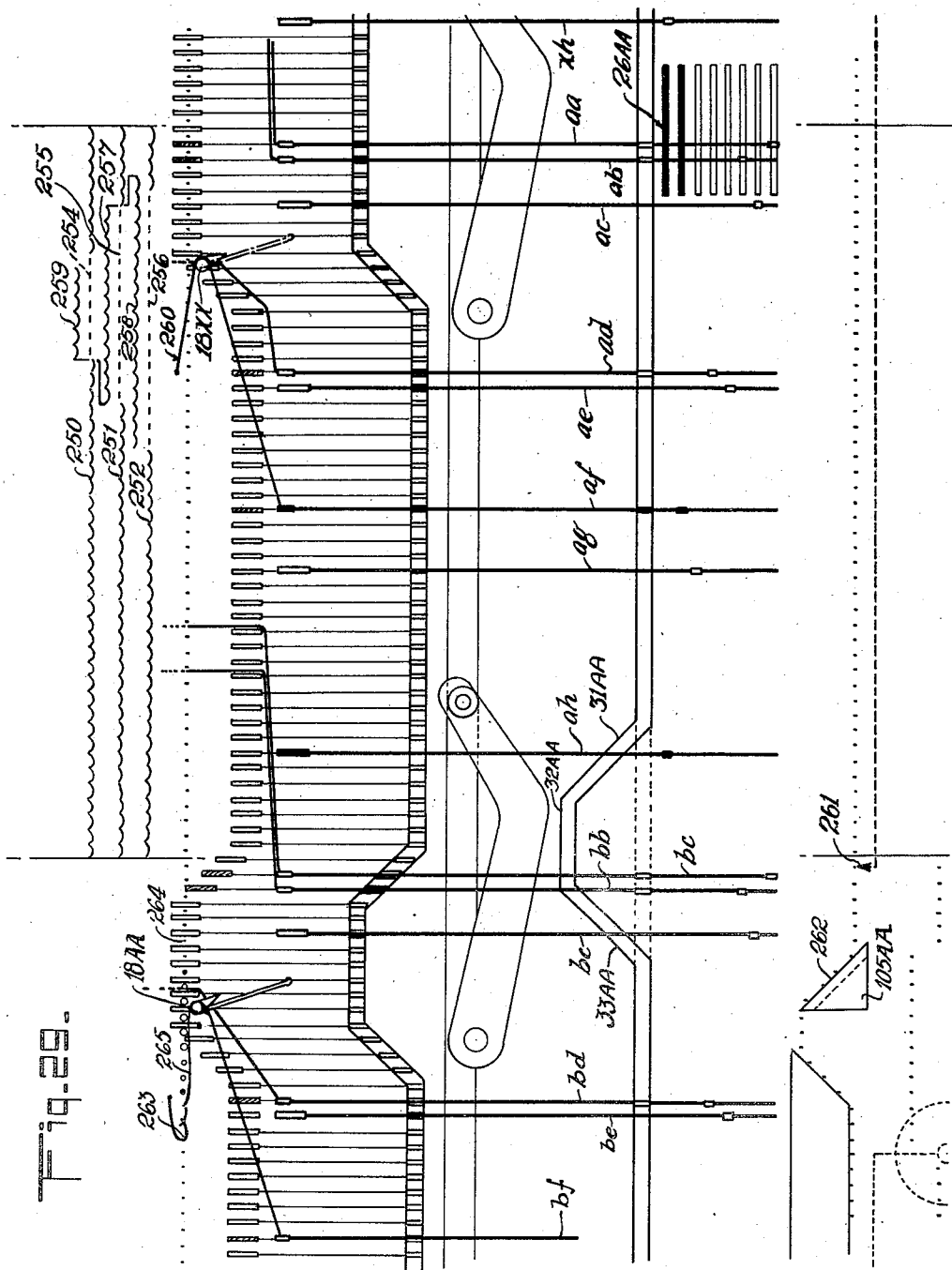
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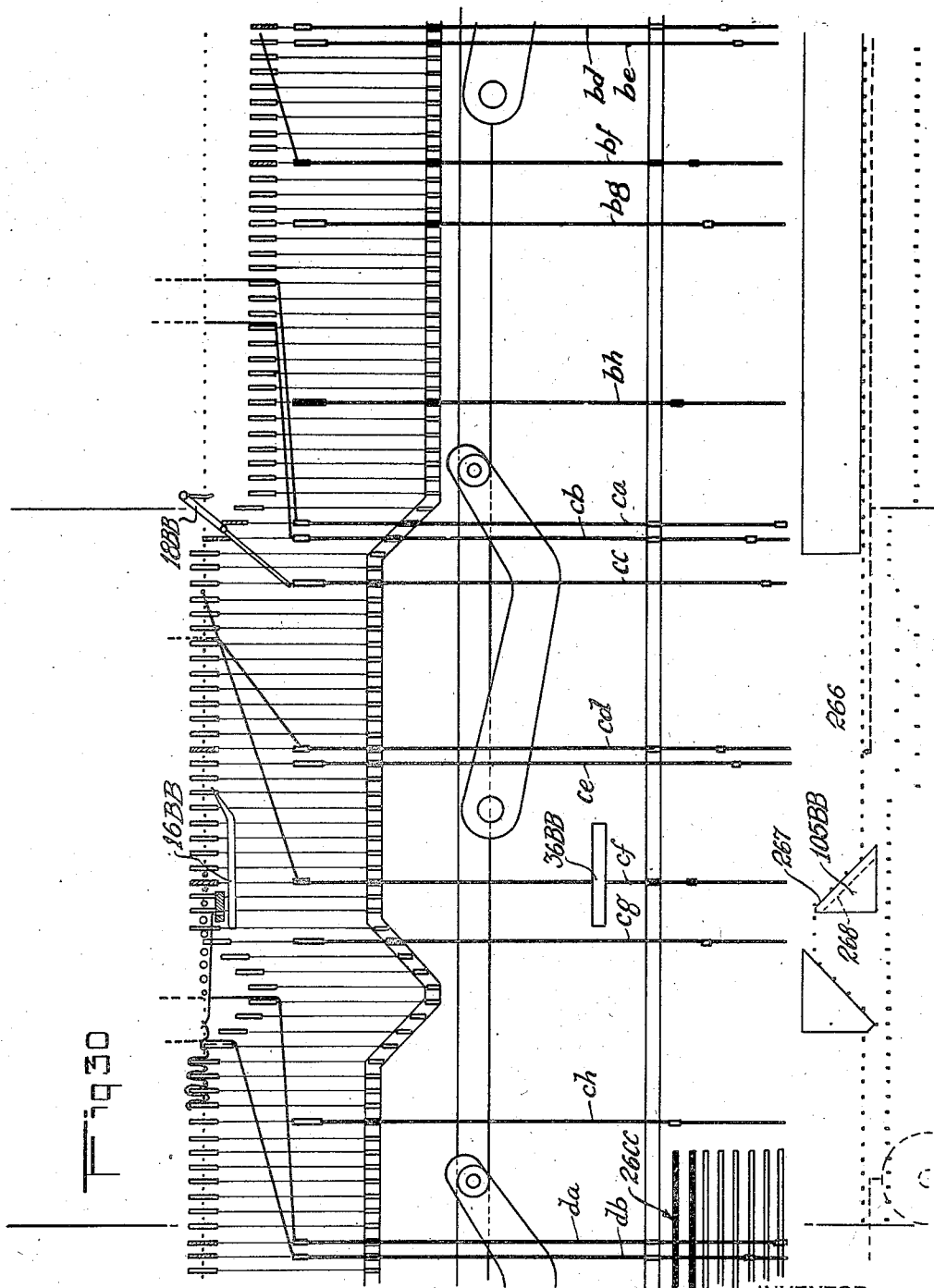
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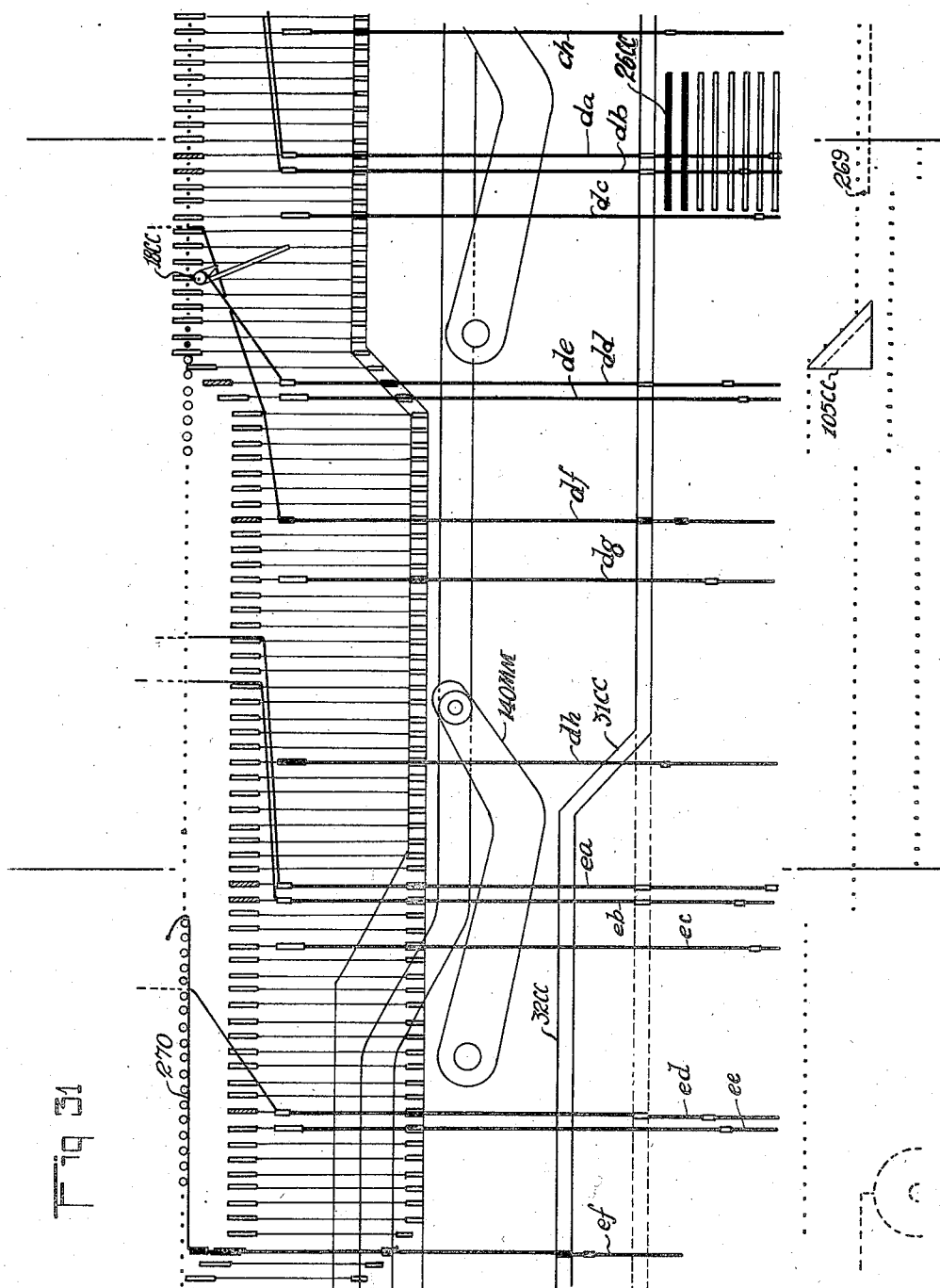
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KNITTING MACHINE

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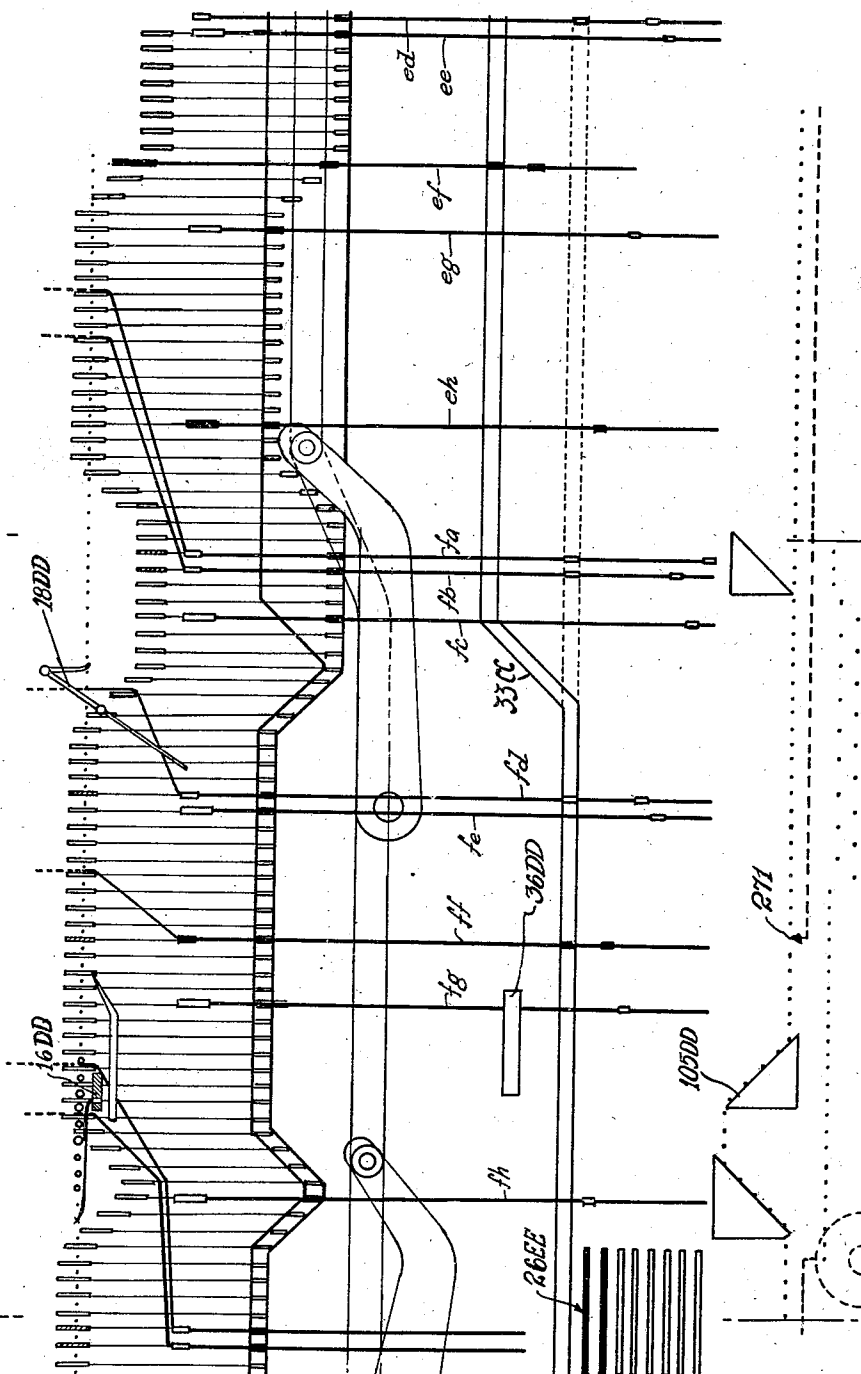
KNITTING MACHINE

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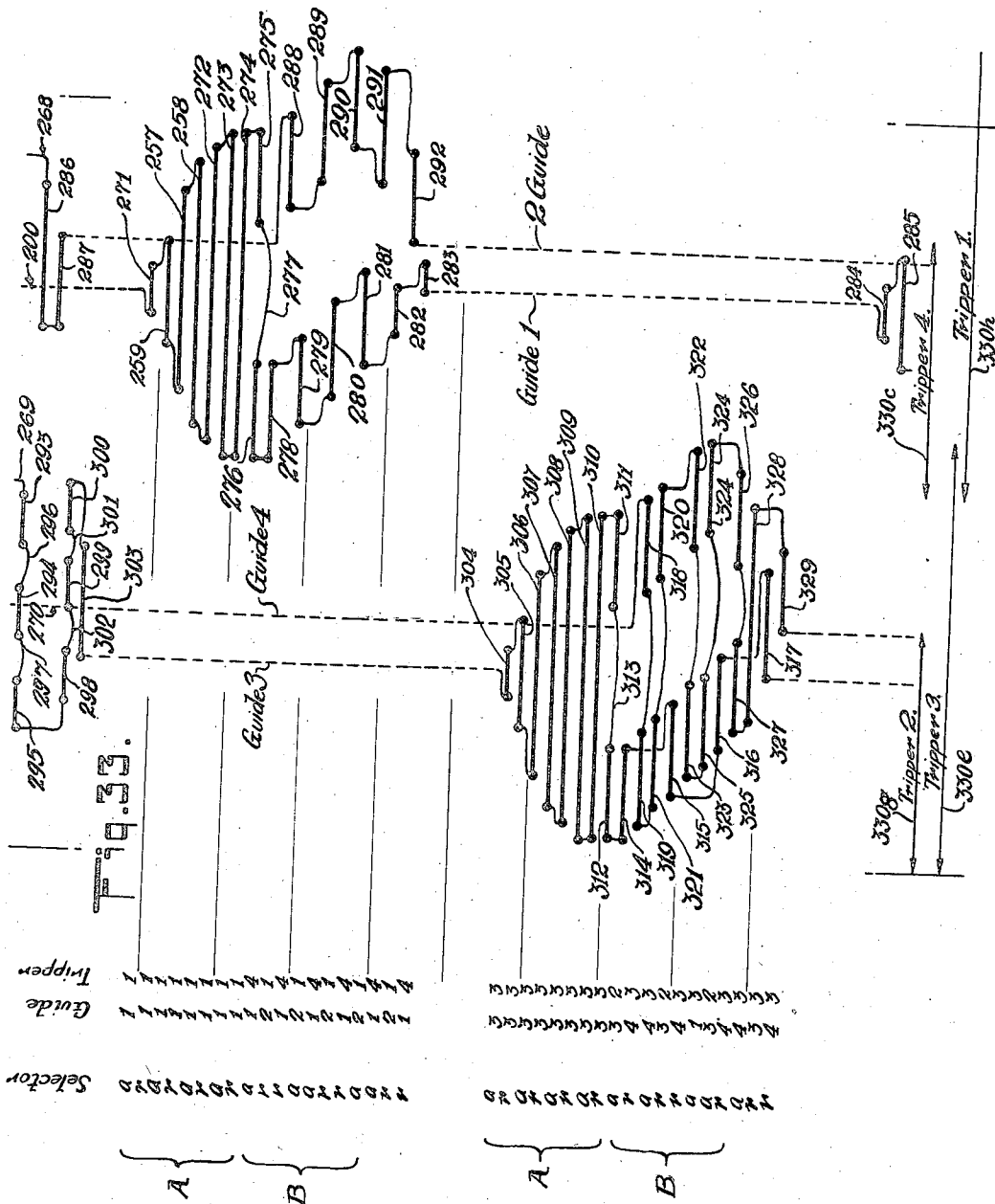
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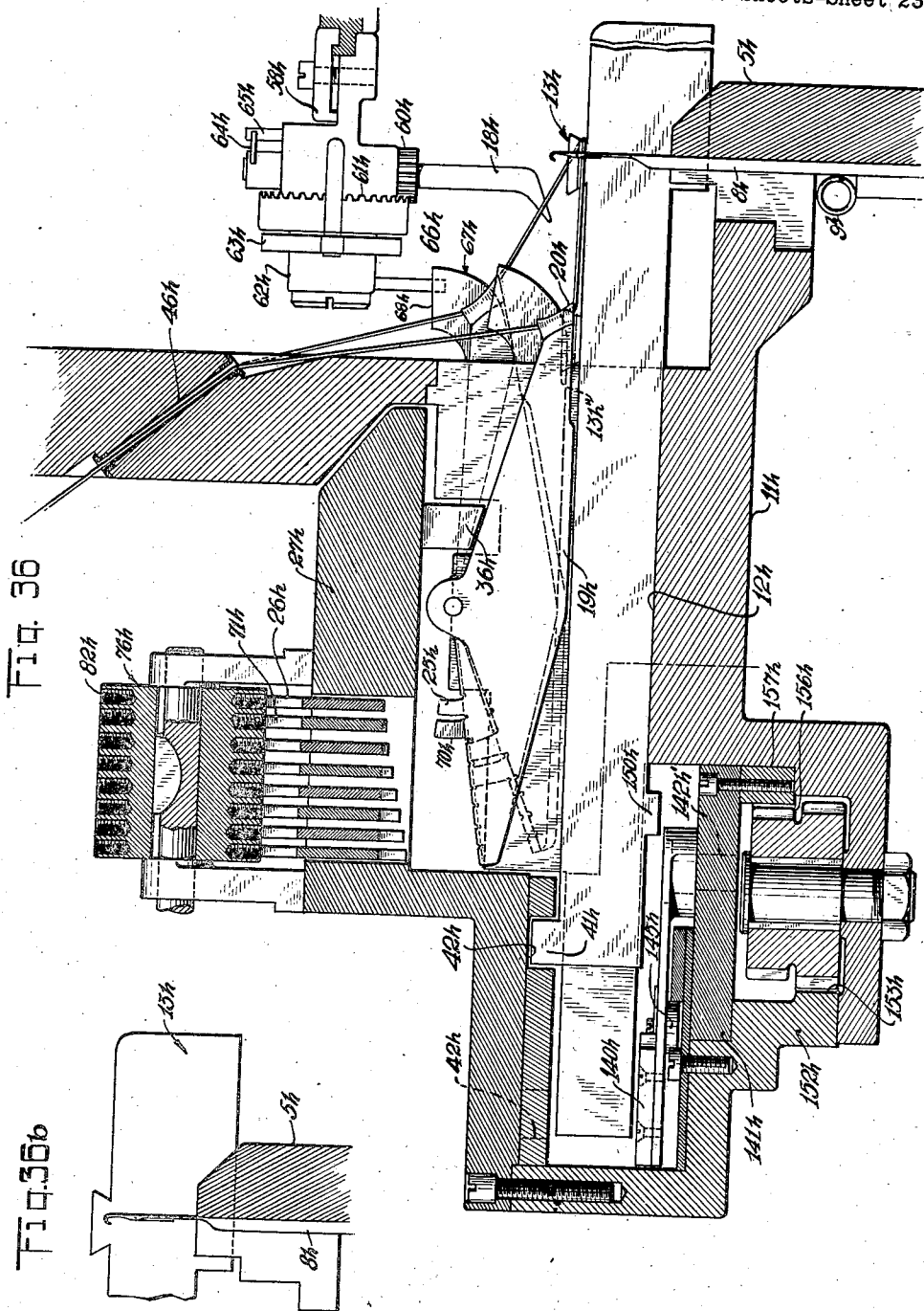
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KNITTING MACHINE

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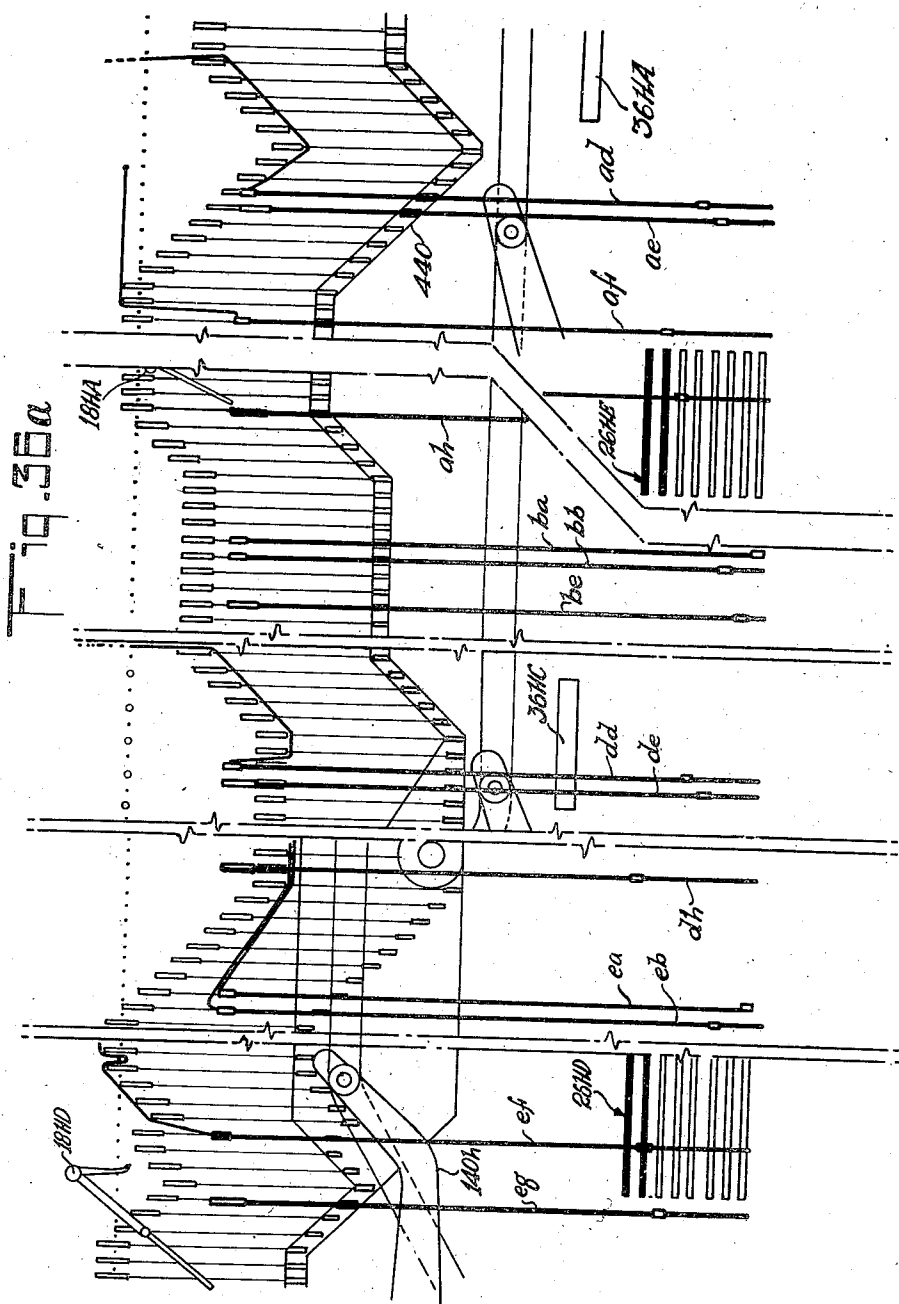
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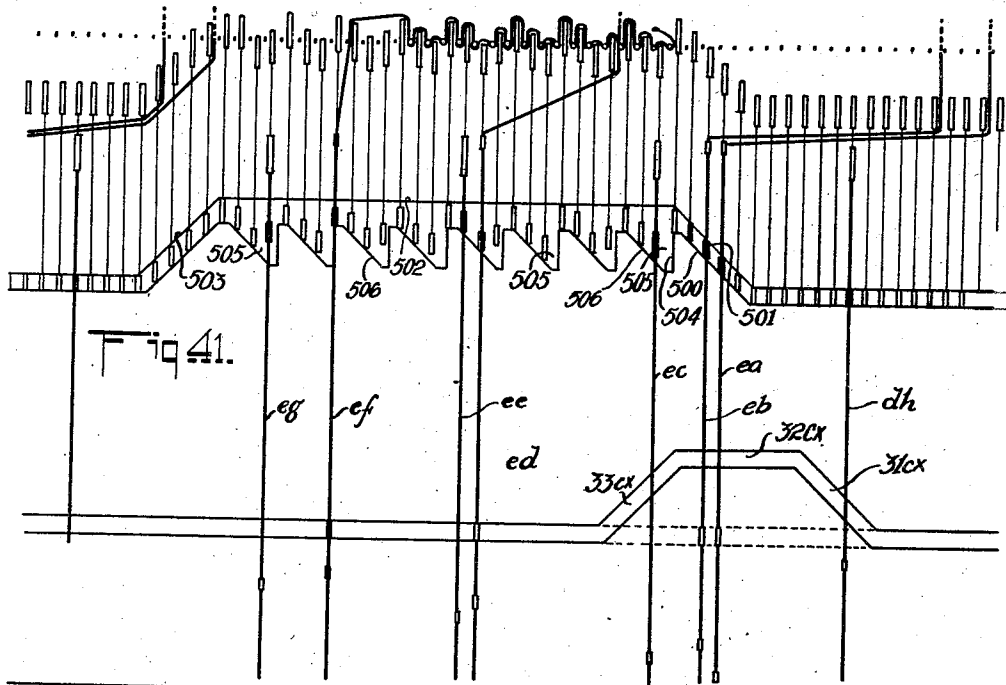


Fig 41.

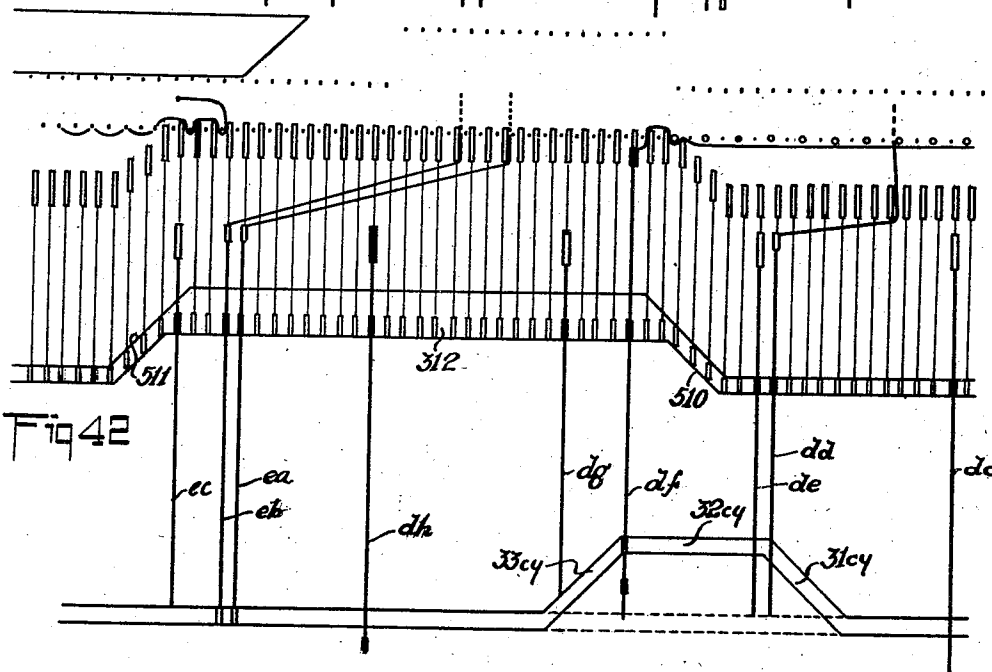


Fig 42

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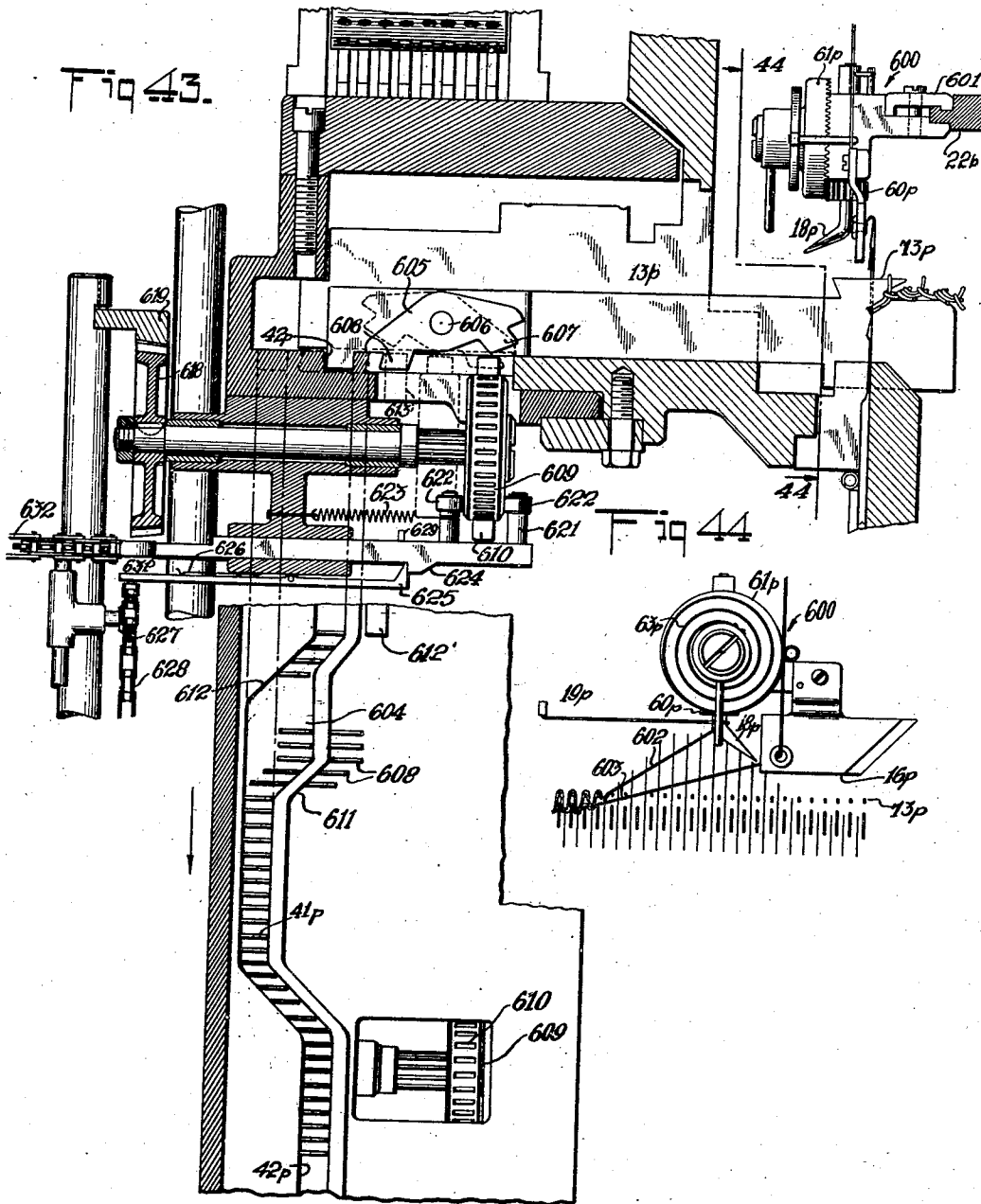
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Fig 43.



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Fig 45.

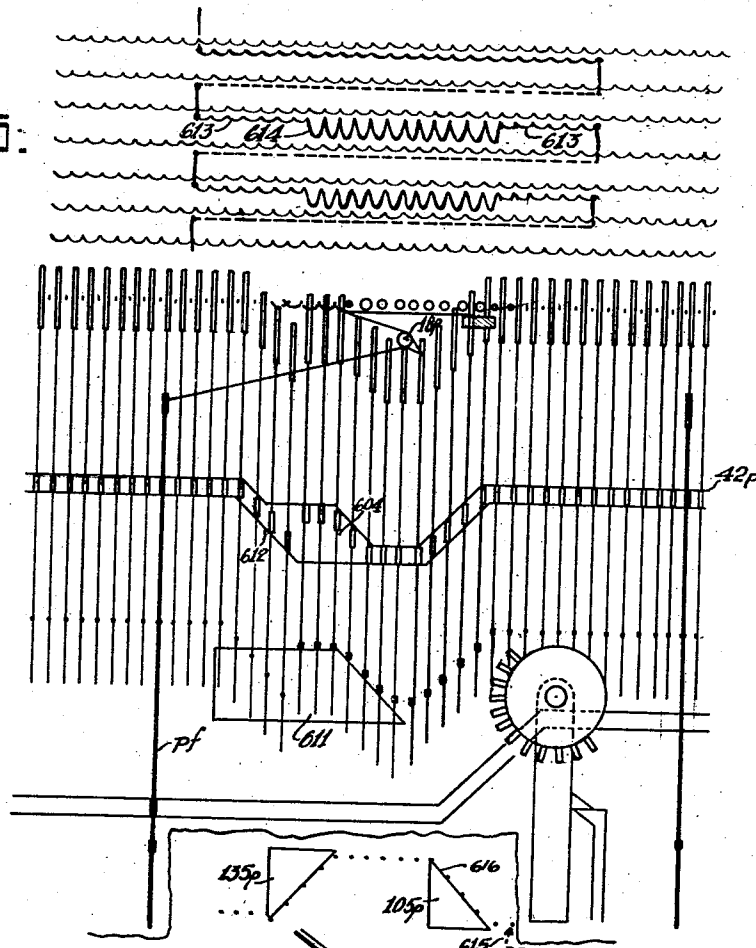
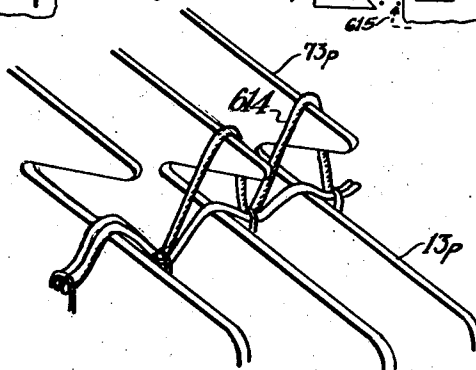


Fig 46.



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UNITED STATES PATENT OFFICE

2,231,672

KNITTING MACHINE

Vincent Lombardi, Garden City, N. Y., assignor
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York, N. Y., a corporation of New York

Application September 17, 1938, Serial No. 230,408

52 Claims. (Cl. 66—135)

This invention relates to knitting machines, and to correlated improvements and discoveries including improvements in knitted fabrics.

An object of the invention is the provision of an improved form of knitting machine adapted to produce a variety of the types of design fabrics and fabrics of a similar character.

A more specific object is the provision of an improved form of circular knitting machine adapted to produce improved types of fabrics wherein auxiliary yarn is present only at one or more portions of the fabric.

Another object is the provision of improved types of knitted fabric having design formations therein.

Other objects of the invention will in part be obvious and will in part appear hereinafter.

The invention accordingly comprises features of construction, combination of elements, and arrangements of parts, and the correlated constructions, all as exemplified in the detailed disclosure hereinafter set forth, the scope of the application thereof being indicated in the claims.

For a fuller understanding of the nature and objects of the invention reference should be had to the following detailed description taken in connection with the accompanying drawings, in which:

Fig. 1 is a top view of one form of construction embodying the invention, certain of the parts being broken away;

Fig. 2 is a reduced-scale elevation of the machine of Fig. 1;

Fig. 3 is an enlarged sectional view taken along the line 3—3 of Fig. 1;

Fig. 4 is an enlarged vertical sectional view of the central portion of Fig. 3;

Fig. 5 is a fragmentary section along the line 5—5 of Fig. 4;

Fig. 6 is a horizontal fragmentary section along the line 6—6 of Fig. 4;

Fig. 6a is a fragmentary showing in elevation of a portion of the mechanism, to illustrate the resetting spring;

Fig. 7 is a fragmentary plan view to show elements of the upper right-hand portion of Fig. 4;

Fig. 8 is a fragmentary section similar to the right-hand side of Fig. 4, taken along the lines 8—8 of Fig. 1;

Fig. 9 is a fragmentary view looking down on the mechanism of Fig. 8;

Fig. 10 is a greatly enlarged view looking inwardly toward a portion of the needle bed;

Fig. 11 is an enlargement of the lower right-hand portion of Fig. 3;

Fig. 12 is a horizontal section along the line 12—12 of Fig. 4;

Fig. 13 is a horizontal section along the line 13—13 of Fig. 4;

Fig. 14 is an enlarged fragmentary sectional view along the line 14—14 of Fig. 1, corresponding to the upper right-hand portion of Fig. 4;

Fig. 15 is a view looking down on the mechanism as in Fig. 14;

Fig. 15a is a fragmentary showing in elevation of a portion thereof, to show the releasing spring;

Fig. 15b is a sectional view along the line x—x of Fig. 14, to show the pawl resetting spring;

Figs. 16—18 are views illustrating the operation of the mechanism shown in Figs. 14—15;

Fig. 19 is a detail view;

Figs. 20—23 are schematic showings of a manner of operation of the machine shown in Figs. 1—19;

Figs. 24 and 25 are somewhat diagrammatic perspective views showing in greater detail certain of these operations;

Fig. 26 is a similar view illustrating a somewhat modified operation and a type of fabric which is formed thereby;

Fig. 27 is a diagrammatic view of this form of fabric;

Fig. 28 is a view similar to a portion of Fig. 21 and illustrating a modified construction and operation for the production of the fabric shown in Figs. 26 and 27;

Fig. 28a is a view similar to the portion of Fig. 22 indicating a modified needle selection utilized in carrying out the operation of Figs. 26—28;

Figs. 29—32 are views similar to views 20 and 23 and illustrating a modified mode of operation;

Fig. 33 illustrates a type of fabric which may be produced by the machine of Figs. 1—19 by the mode of operation illustrated in Figs. 29—32;

Fig. 34 is a view looking toward the needle cylinder showing a modified form of construction;

Fig. 35 is a top view thereof;

Fig. 36 is a view similar to Fig. 4 showing another modified form of construction;

Fig. 36a is a view similar to portions of Figs. 20, 22, and 23;

Fig. 36b is a sectional view of the members shown at the lower right-hand portion of Fig. 36;

Fig. 37 is a fragmentary view looking downwardly on the needle bed and illustrating a modified form of yarn guide and a modified type of operation;

Fig. 38 is a similar view showing the operation at a different stage;

Fig. 39 is a somewhat enlarged detail side view of the yarn guide of Fig. 38;

Fig. 40 is a perspective view of another modified form of yarn guide;

Fig. 41 is a view similar to mutually-contiguous portions of Figs. 31 and 32, illustrating a modified form of construction;

Fig. 42 is a view similar to mutually-contiguous portions of Figs. 22 and 23 showing another modified form of construction;

Fig. 43 is a vertical sectional view of a modified form of machine;

Fig. 44 is a vertical section taken at right angles to Fig. 43 taken along the lines 44-44;

Fig. 45 is a schematic showing, in the manner of the showings of Figs. 20-23 and 29-32, illustrating a portion of an operation of the machine of Figs. 43-44; and

Fig. 46 is a perspective view further illustrating the operation of the machine of Figs. 43-45.

In my co-pending application, Serial No. 114,317, filed December 5, 1936 (now Patent No. 2,130,769), there are disclosed certain types of knitting machines whereby design fabrics embodying stripes, squares, triangles, circles, or other design portions of yarn of one color or character may be economically embodied in a fabric the main portion of which is composed of yarn of another color or character, or whereby strips or pieces of fabric which are wholly or partially unconnected in a course-wise direction may be formed, or whereby various other novel types of fabric may be produced. By the use of certain of the general principles involved in such machines, design fabrics, fabrics with heavy portions, fabrics with elastic portions, and fabrics of a wide variety of other types may be formed in a simple and effective manner and without employment of undue quantity of design or other yarn whose use at only portions of a fabric or a machine is desired, this being of particular importance in situations wherein relatively expensive design yarn, an elastic yarn, or other such yarn is utilized. The mechanisms particularly exemplified in such application are however capable of improvement in various respects and for certain purposes, and it is to the accomplishment of certain such improvements that the present application is directed. For example, in the machine particularly exemplified in said application, the auxiliary yarns are fed from bobbins supported internally of the rotating parts of the machine, and the auxiliary-yarn guide, when inactive, holds the yarn inside the cylinder. This is undesirable in a number of instances as, for example, when the rear of the fabric is to be used as the exposed portion of a garment. Walewise-spaced designs which are formed by an individual auxiliary yarn are consequently connected by floats of this yarn, and if these floats appear on the side of the fabric which is to be used, the floats besides interfering with the fulling operation, undesirably affect the appearance; or, if the floats are cut off, a proper cutting off of the floats at the design side is difficult, and the cut ends are still on the design side of the fabric rather than the opposite side. Also the provision of means to maintain a sufficient number of bobbins internally of the machine is often a matter of very considerable difficulty, and there are definite limitations in the number of bobbins which may be employed.

Among the features of the present invention is

the provision of a machine wherein the auxiliary yarn is fed from the outside of the needle bed, with resultant simplicity of construction, adaptability of operation, possibility of provision of fabrics which are particularly adapted for use with design portions at the side of the fabric which is normally considered as the rear of the fabric, and the possibility of utilizing a very large number of auxiliary yarns for making of a large number of variations of design characteristics in single fabric. Another feature of the present invention is the provision of greater selectivity of operation, and of means for achieving greater certainty in operation and variety of result. The invention also embodies a wide variety of correlated features and improvements which will be exemplified hereinafter.

While the invention in certain of its more specific aspects is directed to the provision of improved types of circular knitting machines and is exemplified in connection with a circular knitting machine having a stationary needle cylinder, the invention in various of its broader aspects may be embodied in circular knitting machines of any well known type, including cylinder machines, dial machines, and cylinder-and-dial machines, and also, in certain instances, on flat knitting machines; and may also be embodied in machines wherein the needle bed is rotatable or otherwise movable and certain of the other parts stationary, or wherein the needle bed is stationary and wherein certain of the other parts revolve about or otherwise move along the bed. In either case, the bed and said other parts will be mounted for relative movement in a direction in which the series of needles extends—i. e., in a cylinder machine either the said other parts will revolve so as to move circularly on an axis corresponding to the center line of the cylinder, or the cylinder will rotate past such other parts; or on a dial machine said other parts will either move in a circle about a line extending perpendicularly thru the center of the dial or the dial will rotate past such other parts; or if in a flat or other machine, either the said other parts or the needle bed will reciprocate in such direction that the needles will move past said other parts or said other parts will move past the needles. It is to be noted, however that tho the relative movement may in any case be said to be in the direction in which the series of needles extends, it need not in all cases continue for the full length of the bed.

The invention, moreover, while exemplified in connection with a latch-needle machine, is in many of its aspects, equally applicable to a spring-needle machine, or to a machine having other types of needles.

In the drawings, rotating parts are cross-hatched with the lines running from the lower left to the upper right, and the stationary parts are cross-hatched with the lines running from the upper left to the lower right. In certain figures parts are omitted or broken away in order to provide a clearer view of the parts beyond them.

The embodiment of the invention particularly exemplified in Figs. 1 thru 19, comprises a needle bed which, in the present instance, is in the form of a stationary cylinder 5 supported by suitable supporting means 6. The cylinder 5 is formed about its periphery with a series of vertical slots 7 in which needles 8, which in the present instance are of the latch type, are mounted for sliding movement. An annular spring 9 serves to hold the needles in the slots. Vertical sliding

movement is imparted to the needles by various cams and selective means certain of which are hereinafter described, but which may be of various well-known or suitable types. These, as exemplified, are carried on a cam ring 10, and parts moving therewith. These are mounted for rotation on an axis corresponding to the axial line running thru the center of the cylinder. Supported from the cylinder 5 is the usual sinker bed 11 having slots 12 thereon. Sinkers are disposed in some or all of these slots—all, in the present instance. The majority of these sinkers, indicated at 13, have high humps 13' hereinafter to be described, and others of the sinkers indicated at 13a have lower humps 13'' hereinafter to be described. Some or all of the sinkers—all, in the present instance—have shank portions 14 which are of insufficient extent to fill the full depth of the slots.

As exemplified, the present embodiment of the invention includes a rotary framework 15 rotating with the cam-ring 10 and including a portion extending centrally above the needle cylinder. This framework carries a plurality of main-yarn feeds 16, to which yarn extends from the bobbins 17 mounted on the rotary member 15. The rotary member 15 also carries a plurality of auxiliary-yarn feeds or "travelers" 18. These travelers are not formed as yarn guides, but serve various purposes, among which are intercepting yarn which extends across the path of movement thereof and feeding such yarn into position to be received by selectively advanced ones of a limited number of needles, means being provided for releasing the intercepted yarn when a traveler has moved thru an arc of suitable extent. In order to position yarn to be intercepted by the travelers, there are provided, at certain fixed points with respect to the cylinder, yarn guide members 19 for auxiliary yarn. Each of these yarn-guide members in the present instance comprise a yarn-guiding end 20 and a body portion 21. As above set forth, the shanks 14 of the sinkers are so formed that they do not fill the slots 12, but leave an empty space in the upper portion of the slots. In the present instance, the body portion 21 of each yarn guide is so formed that it will frictionally fit into the space thus provided. In this manner, an exceedingly compact and readily operated arrangement is provided.

As will be seen, the rotary framework 15 carries a ring 22 having a large number of mounting surfaces 22' on which there may be clamped either a unit carrying a main-yarn feed, or a unit carrying a traveler, a unit carrying both a traveler and a main-yarn feed, or other suitable unit, as may be desired. In this manner a wide variety of design formations and other operations is made possible.

As will be seen, the external disposition of the yarn guides relative to the needle-bed 5 serves to permit a yarn to normally extend outwardly from the needles to the yarn guides. The travelers 18 move in a space between the line of the needles and the outer position of the yarn guides. A yarn guide may, in certain instances, be so arranged that a traveler will always intercept a yarn carried thereby; but, in the present instance, the selectivity is greatly increased by causing the yarn guide to have two vertical positions; one, a position in which it will hold the yarn below the path of a traveler; and the other, a position in which it will hold it in the path of the traveler. In order to provide for this action, the body portion of each of the exemplified yarn

guides is so formed that it may be rocked. In the present instance each yarn guide is held slightly above the sinker so as to assure that movement of the sinker or of the yarn guide will not affect the other of these elements. The exemplified means to this end comprises nubs 23 which may be pressed out to one side of the upper central portions of the body portions 21 of the yarn-guide members 19 so as to provide a support for the yarn-guide members on top of the ridges between the slots of the sinker bed, and which provide pivot points for the yarn-guide members. The outer end 24 of each yarn-guide member 19 is provided with one or more teeth 25 (one as exemplified) which are adapted to extend into the path of movement of certain of a plurality of depressing cams 26, rotating with the sinker cam ring 27, and each movable into an opening 28 therein to a position above the sinker slots. A plurality of sets of selector cams 26 and of openings 28 are provided. Each cam 26 is adapted to bear upon a tooth at a particular position on a portion 24, of a yarn-guide member 19, and the portions 24 carry teeth in various positions so that any given one of the cams 26 will only actuate those yarn guides which have a tooth in a particular position. The action of a cam 26 on a portion 24 of a yarn-guide member serves to raise the yarn-guiding end 20 thereof to a position wherein an approaching traveler will intercept the yarn extending from the needles to the yarn guide, and will feed the yarn into position to be received by the needles (provided they are raised) until release of the yarn occurs; yarn tensioning means, one form of which is exemplified at 29, being provided to hold the yarn taut and to take up slack when the yarn is released.

As will be seen, the normal position of the yarn guide is such as to hold the yarn at a point outwardly of the needles, and, accordingly, whenever the yarn-guide is not raised to position an auxiliary yarn to be caught by a traveler, or whenever the needles are not advanced to take a yarn from a traveler, the yarn will extend outwardly from the fabric to the yarn guide, so that in any row or rows (of loops in the fabric) wherein the auxiliary yarn is not received by the needles it will lie on the front of the fabric. This is highly desirable in the numerous instances wherein the rear of the fabric is utilized as the face portion of a garment to be produced, since in many instances this arrangement will avoid the necessity of cutting off a portion of a yarn which extends more or less vertically between two design portions of a fabric, and the appearance of which is undesirable at the face portion of the garment. Another advantage is in the provision of single-strand generally-vertical design portions on the front of the fabric. In particularly small machines where the mounting of the bobbins on the yarn guides inside the cylinder or inside an extension thereof is impracticable, it is also important that the yarn guides be disposed outside the line of the cylinder. Moreover, in the ordinary knitting of certain design formations, needles which are differently spaced from the position of the yarn guide in the knitting of successive courses are often raised to receive the auxiliary yarn. Accordingly, it is important that means be provided for assuring that yarn be fed to the needle which is nearer the yarn guide than the last needle which receives the auxiliary yarn prior to the passage of the yarn guide. This, may be accomplished in accordance with the invention, by holding the yarn behind such needle

while it is raised. It is also desirable in many instances that the "return" portion of the auxiliary yarn, i. e., the portion of the yarn which extends to the yarn guide from a remote needle by which it is held, as after being fed by the traveler, be knitted or otherwise be caught into the fabric, and a desirable manner of assuring this is to project the yarn against the face of needles which are raised after the passage of the travelers. It is also desirable in certain instances that the auxiliary yarn be carried beyond the needles before they are raised so that it may pass to the back of one or more needles, as for example when the needles are receiving another yarn on the front thereof.

With this and other ends in view, the yarn-guide members 19 are arranged to be projected inwardly (toward the center of the needle cylinder) either to carry yarn to a point at the rear of the line of the needles itself, or to carry yarn inwardly to a sufficient extent that it will be caught by the sinkers and moved by them to a point rearwardly of the line of the needles.

As will be seen, the machine is adapted for the insertion of a yarn guide in any of a variety of sinker slots; and, inasmuch as it is often desirable to have a number of yarn guides in place, and to embody yarn from one yarn guide at one stage of the operation and from other yarn guides at other stages,—as for example, when a pattern of yarn of one color is to be knitted in one portion of the fabric, and a pattern of yarn of another color is to be knitted in another portion of the fabric; or when yarn is to be received by a generally left-hand portion of a group of needles at one point and to be received by a generally right-hand portion of the needles of the group at another point without drawing out an undue amount of yarn at either time, or for other purposes; it is desirable that the operation of the yarn guides be selective. With the foregoing and other ends in view the yarn guides are formed, at a point forwardly of their nubs 23, with notches 30 adapted to fit about an advancing cam 31 when the yarn guide portion 20 thereof is raised, and to be engaged and thrust inward thereby, and likewise to be engaged when in an inward position by a guide portion 32 at the end of which there is provided a retracting cam portion 33; the notches and cams and guide portion being so formed that the cams and guide portion will not engage notches of any yarn guide member the yarn-guiding end 20 of which is in a lower outward position, since when a yarn-guide member is inactive, there is no need to raise it. The raising itself can be, as in the present instance, utilized to effectuate the selection of the yarn guide for such inward and subsequent retractive movements as may be desired. The selecting cams serve to rock a selected yarn guiding member from the position shown in full lines in Fig. 4 to the position shown in dot-and-dash lines in Fig. 4 in which position it is engaged by the cam 31 which moves it first inwardly and then along a downward and inward course to the position shown in dotted lines in Fig. 4 in which position it will so dispose its yarn that the yarn will be engaged by inwardly moving sinkers and thrust thereby against raised needles, or to the rear of retracted needles as may be desired. It is to be observed that the retracting cam 33 withdraws the yarn-guiding member to the position that it was in when its notch was first engaged by the cam 31. Accordingly, any desired number of inward and outward movements of the yarn guide

may occur between the time when it is selected and the time when it is in position for interception of its yarn by a traveler. Desirably the outward and rearward end of the retracting cam 33 merges into a guide portion 35 which, if two inward movements of the yarn-guiding member 19 are desired before the selection is broken, may merge into a succeeding advancing cam 31. As will be seen in Fig. 1, a number of advancing cams 31, with their associated guide portions 32 10 and retracting cams 33, are provided about the machine, to cause inward and outward movement of selected yarn guide members at desired points. In order to restore the yarn-guiding ends of the yarn-guide members to their lower position and to break the selection, there are provided, at suitable points about the machine, depressing cams 36. In order to further assure against slippage of the yarn-guide member, when in either its outer or inner position, the ridges 20 between the slots of the sinker bed are provided with slight depressions 37 and 38, respectively, so that when a yarn-guide member is in an outer position, the nub 23 will rest in a depression 37, and when it is in an inner position, the nub 23 will rest in a depression 38. In order to positively guard against movement of unselected yarn-guide members, each yarn-guide member is provided, at a point outwardly of the nub 23, with a notch 39 adapted to engage a continuous holding annulus 40 whenever the yarn-guide member is in its unselected position, with its yarn-guiding end 20 disposed downwardly and outwardly. When the yarn-guiding member is rocked, this notch will move clear of the annulus so that the yarn-guiding member may be moved inwardly by a cam 31. In this manner assurance is had that neither the movement of the sinkers, the pull of the yarn, nor any other cause will displace an unselected yarn guide from a desired position. The cams and guide portions 31—35 serve to prevent the displacement of a selected yarn guide. These actions are positive, and entirely independent of the frictional engagement of the yarn-guiding member with the sides of the sinker slot. 45

The sinker movement is effectuated by means of butts 41 extending upwardly from the outer ends of the sinkers into a sinker cam groove 42 carried by the sinker cam ring. The sinkers are provided at the forward end of their humps 13' or 13'' with forward hook portions 43 or 43', respectively, and at the outer portion of their humps with rearwardly disposed hooks 44 or 44', respectively. The sinkers in whose slots the yarn guides are disposed are formed with lower humps 13'' so as to permit free inward and outward movements of the yarn-guiding ends 20, and of the sinkers with respect to each other. On sinkers in whose slots yarn-guiding members are not disposed, however, there are provided high humps 13' as a precautionary measure so as to assure that yarn will be caught at all times on the forward and rearward hooks thereof when desired.

The yarn-guiding ends 20 are of tubular shape in the present instance and are formed in such manner that the yarn will come out therefrom at a point in close proximity to the sinkers when the yarn guide is inactive so that this yarn will not be caught by travelers or other members and will not have any tendency to ride over a sinker hump, and will similarly be held in a lower position when the yarn guide is inward so as to assure that the forward sinker hooks 43 or 43' will surely receive a yarn extending from the yarn guide.

As will be observed, the exemplified machine is adapted for the utilization of a large number of yarn-guiding members 19. For example, a plurality of yarn guides may be disposed particularly close together in order, for example, to permit yarn of one color or character to be knitted or otherwise caught into the fabric for one or more courses and a yarn of another color or character to be caught into the fabric for one or more later courses in the same stripe, or to permit two yarns to be caught into the fabric together, or other design formations to be provided when the travelers pass at one time or at another. Different yarn guides may also be employed where it is desired to pick up yarn at different points during different types of operation of the machine. Also, there may be employed a single yarn guide for the delivery of a plurality of yarns, as exemplified in Fig. 37. It is accordingly often desired that a very large number of bobbins for supplying yarns to the yarn-guides be provided in as compact a manner as possible. Moreover, there are various conditions wherein the disposition of a large number of bobbins at a particular position is undesirable or impracticable.

With the foregoing considerations in view, the invention contemplates the provision of yarn-supply means including bobbins disposed at one or more specially desired positions and of means for conducting yarn therefrom to the yarn guides. As exemplified in Figs. 3 and 4 such bobbins and means are shown disposed at three such positions, but it is to be understood that the invention in certain of its broader aspects contemplates the provision of bobbins and means at only that one of such points which is practical or convenient in a particular situation. In the present instance bobbins 17c are mounted on brackets 45 carried on the sinker bed and disposed above the sinker cam ring. Yarn from each bobbin is conducted by suitable yarn retarding and conducting members to the yarn tensioning means 29, and thence thru a guide-tube 46 to the yarn-guiding end 20 of a particular yarn-guide member 19. Also as exemplified in Fig. 3, there are provided a row of bobbins 17a on a second group of brackets 47 beneath the sinker bed and carried therefrom. Yarn from each of these bobbins is carried past a suitable retarding member and a yarn-tensioning means 29a to a guide-tube 48, whence it is carried in the manner exemplified in Fig. 3 to a yarn guide. Still other bobbins 17b are carried on a ledge 49 disposed beneath the cylinder and carried from the supporting means 6. The disposition of bobbins at this point where there is often considerable spare room has hitherto been considered impractical since the provision of the various means which rotate with respect to the cylinder have prevented the carrying of the yarn to the yarn guide. In accordance with the present invention, however, the disposition of bobbins at this point is made practical by the arrangement of the cylinder in such manner that yarn is conducted therethru, and, where necessary, by the provision of suitable accompanying means. As exemplified, yarn passes from each bobbin 17b about suitable retarding means to a point at the rear of the needles and of the slots, the cylinder 5 being formed with vertical bores 51, each adapted to conduct yarn from a bobbin 17b to one of a series of corresponding horizontal bores 52 which conduct yarn to a point between two needles, whence it extends over a yarn tensioning means 29b. Thence it enters a tube

53, whence in turn it is conducted, as in the manner hereinafter exemplified, to a yarn guide. While the provision of vertical bores in the cylinder provides a certain and effective yarn-conducting means, yarn may in certain instances be conducted entirely at the rear of the cylinder and thence conducted therethru to a point between two needles. The needles on either side of the bore 52 are exemplified, in the present instance, as being formed with diverging portions 54 and 55 respectively (Fig. 10), which portions are of sufficient vertical extent to permit full needle movement without blocking the opening from the bore 52 or pinching the yarn coming therefrom. As will be observed, the ridges between the cylinder slots are cut away at this point so as to allow free movement of the diverging portions. It is to be observed, however, that, except in instances where a particularly thick yarn is used or where the needles are particularly closely spaced, this feature may often be omitted. Since the yarn-tensioning means 29b are provided outwardly of the cylinder, the take-up of slack in yarn coming from the bobbins 17b will occur at a point near the yarn-guide, so that yarn within the bores in the cylinder will not be subjected to back-and-forth movement. Yarn from the bobbins 17a and 17b will be carried upwardly thru the sinker bed to their respective yarn guides in the manner indicated at 56 in Fig. 3, a ridge between sinker slots being cut away at such a point. The yarn-retarding means employed in each instance comprises, as exemplified, two cymbal-like elements disposed back-to-back and centrally connected by a supporting post, such elements being disposed in proximity to the bobbins and serving to prevent yarn from being drawn therefrom. In addition, there are provided suitable sheaves or eyelets where desirable to cause the yarn to extend in the proper direction to the spring-supported eyelet or sheave of a yarn-tensioning member or to a guide-tube as the case may be.

In many instances, only a set of bobbins at a single level, such as those on the brackets 45, may be employed.

In my said copending application, Serial No. 114,317 there are disclosed trip means formed integrally with certain of the sinkers. The use of such means, while satisfactory from many standpoints, imposes certain limitations upon the operation, since independent control of the sinkers and trippers is impossible. The present invention, therefore, in certain of its aspects provides trip means carried by the sinker bed but mounted independently of the sinkers and having no radial movement with respect to the sinker bed. As exemplified, such means likewise includes means which are selectively controlled and which will serve to trip the travelers in a particularly effective manner.

As will be seen, each of the travelers 18 is formed with a hook-like portion 57 adapted to move under yarn suitably positioned by the yarn guide, and to draw out this yarn past the needles until the traveler is operated to permit the caught yarn to slip off of its hook, or until the yarn is otherwise removed from the traveler. In the present instance the travelers form parts of units 59, each of which is secured by a clamp 58 on a surface 22' of the ring 22 of the rotary framework 15. Each traveler is mounted in its unit for rotation on a vertical axis, and carries a pinion 60 which meshes with a gear 61. The gear 61 carried on a hub 62, which is mounted in the unit 59

for rotation on a horizontal axis, and is normally held against such rotation by a spring 63 which acts to hold the traveler with its hook in yarn-catching position by pressing a rod 64 on the traveler against an eccentrically-mounted adjustable stop 65. The hub 62 carries a dependent arm 66 which when moved rearwardly will turn the gear 61 against the pressure of the spring 63 sufficiently to swing the hook 57 of the traveler rearwardly and permit any yarn which has been drawn off thereby to slip off the traveler. In order to swing the arm 66 rearwardly after the traveler has drawn out the yarn thru an arc of desired extent in any particular instance, there are provided, as above indicated, selective tripping means comprising, in the present instance, trip members 67 which are frictionally disposed in the upper portions of certain of the sinker slots and are of generally similar character to the yarn-guide members 19, comprising an inner tripping end 68 adapted to be swung into tripping position by the rocking of the trip member on a nub 69 when a tooth 70 at its outer end is depressed. Each of the trip members, as exemplified, is formed with a tooth in one of four positions so that the trip member may be operated by one of four cams 71 which, in the present instance, are interspersed with the cams 26. In advance of the passage of any set of cams, the trip members are all swung by the cam 36 so that their ends 68 are in a lower position wherein they will not contact an arm 66. While, in the present instance, individual selector cams 26 and 71 are shown for the yarn guides and trippers, respectively, and, in the showings, each yarn guide is shown as being operated only by one cam 26, and each tripper as being operated by only one cam 71; it is to be understood that the invention in its broader aspects, contemplates the provision on each yarn guide and tripper element, as originally formed, of a number of teeth corresponding to the number of cams (eight, in the present instance), and the breaking off of any desired teeth for any particular operation, so that each yarn guide or tripper element may have one or more teeth as desired, and each yarn guide or tripper element may be operated by any of the set of cams as the cams 26—71, when desirable for the formation of a particular pattern, it being noted that in certain instances it will be desired to operate both a yarn guide and a tripper from the same selector cam.

As will be seen from the Fig. 5, each of the cams 26 and 71 of a set of control cams are pivotally mounted on a rod 75 carried by the sinker cam ring 27. Directly above each set of cams is a pattern drum 76 which is affixed to the shaft 77, journaled in a bearing 78 which is carried by the sinker cam ring 27. The shaft carries a wheel 79 arranged to be rotated by step-by-step movements thru the medium of suitable pattern means such, for instance, as a pattern chain 80. The drum 76 has thereon a plurality of pattern bands corresponding to the upper number of cams 26 and 71 each band being divided into portions at certain of which there are disposed nubs 81 removably fitting into holes 82 in the drum and at other of which these nubs are omitted; these nubs being arranged so that when one of them is in position at the lower-rearward part of the drum it will hold its cam 26 or 71 as the case may be in a lowered position. When, on the other hand, no nub is pressing upon a particular depressing cam 26 or 71, this will be held upwardly by the action of a spring 83, one of which pulls upwardly

an end of each cam-member which extends rearwardly of the pivot point 75. Accordingly, a cam will not be effective unless a nub on the drum is juxtaposed therewith. Thus the action of the depressing cams is made selective so that even tho a particular yarn guide or trip member has a tooth adapted to be contacted by a depressing cam when the latter is in its lowered position, it will not be operated unless the pattern drum has a nub in the lower rearward portion of the pattern band which corresponds to the particular depressing cam.

Fig. 19 shows the rear ends of a yarn guiding element and a tripper element with their teeth before any teeth are broken off.

Each of the main-yarn feeds 16 are detachably connected with the ring 22, being carried from a unit 85 which is secured by means of a clamp 86 on a surface 22' of the ring 22, so as to permit main-yarn feeds and travelers to be removed, replaced, or interchanged, as desired, and to permit any desired arrangement or operation. Each unit 85 carries, in addition to the main-yarn feed 16, in the present instance, a yarn deflector member 88 the purpose of which will be discussed below.

The cam ring 10 is driven from a suitable source of power, not shown, thru the medium of a shaft 92 carrying a pinion 93 meshing with an annular gear 94 carried by a mounting member 95, which drives a rotatable supporting member which carries the cam ring 10 and other parts including posts 96 from which the rotary framework 15 is carried. A pinion 97 on the shaft 92 meshes with an annular gear 98 carried on ring 99 which carries a supplemental cam ring 100.

As will be apparent, a wide variety of types of needle manipulating means may be employed in conjunction with machines embodying the invention. The particular needle-actuating means exemplified in Figs. 3 and 11 is that of Figs. 42-53 of my Patent No. 2,025,463 issued December 24, 1935. This mechanism is of a highly selective type, being adapted for positioning any desired needle of a group of needles in any of three positions at any one time in response to the formations in or on a pattern band. In the form exemplified there is provided in each of the needle slots a selective element 101 which is swingingly mounted on the end-portion 102 of the needles. These selective elements are each provided with a pair of shoulders 103 and 104 so disposed that either or neither of the shoulders may be disposed in the path of advancing cam 105. If the lower portion of the element 101 is entirely within the lower portion 106 of the needle slots 7, the selective element and the needle, having been retracted by a stitch cam such as hereafter designated, will remain (unless otherwise raised) in a lower position such that the needle will not receive yarn from a main yarn feed or from a traveler. If the selective element is swung partially out of the slot, the cam 105 will engage the upper shoulder 103 and partially advance the selective element and the needle to a position where it will receive yarn but will not cast. If the selective element is swung further out of the slot (to the position shown in Fig. 3), the cam 105 will engage the lower shoulder 104 and will fully advance the selective element and the needle. In order to determine which of the positions any given selective element 101 will be in at a given time each selective element is provided with an outwardly extending lug 107 under which a sliding wedge-member 108 is adapted to 75

move. If the member 108 moves only a limited distance under the lug 107, the member 108 will swing the selective element out of the slot only a sufficient distance so that the shoulder 103 will be engaged by the cam 105; whereas, if the member 108 moves a further distance under the lug 107, the selective element 101 will be swung outwardly a sufficient distance for the cam 105 to engage the shoulder 104. A cam 109 serves to press the lower ends of all the selective elements within the slot at a time when sliders are withdrawn from under the lugs 107. The particular pattern-control means for operating the sliding-members 108 as exemplified is similar to that disclosed in my said Patent No. 2,025,463, and comprises a roller 110 carrying a pattern web 111 and formed with hollows 112 into which the ends 113 of pickers 114 may be received. The pattern web 111, at each of the points which will be aligned with the hollows 112 during its movement over the roller, is either solid, or is formed with a small hole 115 to admit only the small lower end 116 of the picker, or is formed with a large hollow 117 to admit the larger portion 117'. One row of hollows and selectively disposed holes is provided for each of a series of pickers, each picker corresponding to one selective member 118 on a pattern drum 119, as disclosed in my said Patent No. 2,025,463. The drum 119 is mounted for independent rotation on the mounting member 95. Associated with each picker is a transmitter member 120, a resilient rod 121, and a slider 122 the inward end of which is formed with an upward projection 123 for setting the selective members 118 in accordance with the position of the slider, these elements being constructed and operated as disclosed in my said Patent No. 2,025,463, cams carried by the mounting member 95 being utilized to restore the selective members 118, as disclosed in my last-mentioned patent. Each selective member carries an actuator 124 formed with a pair of downward protuberances 125 and 126 so arranged that if the actuator is in a rearward position, as shown in Fig. 3, it will not contact a protuberance 127 on the end of the member 108, whereas if it is in a forward position its most downward protuberance 126 will contact the protuberance 127 and press the member 108 fully downwardly, or if the selective member 118 is in an intermediate position the intermediate protuberance 125 will contact the protuberance 127 and press it part-way down. A cam 129 acting on butts 130 of the members 108 serves to align the members 108 for setting, and cams 131 and 132, passing after the passage of the pattern-drum, serve to push individual members 108 all the way forward, part-way forward, or not at all, depending in each case on whether the protuberance 127 thereon is in an uppermost position, or has been pushed part-way down by a downward protuberance 125, or all the way down by a downward protuberance 126. For a detailed description of the construction and operation of this mechanism reference may be had to my said Patent 2,025,463.

In the present instance a drum 119 will be provided in advance of every point wherein needle selection is desired; and cams 131-132 being provided intermediate the drum and each advancing cam 105. The position of these cams 105 will depend upon the actual operations to be performed; certain arrangements thereof being shown in Figs. 20-23 and 29-32. In general, it may be said that one such cam will operate in advance of the passage of each main-yarn feed

16, of each main traveler (except, as will be apparent, where the main-yarn feed and a traveler are designed to be effective in a single knitting wave, or where other special conditions apply), and in advance of each point where a return portion of an auxiliary yarn is to be laid against the needles. Stitch cams 135 are provided for retracting advanced needles at suitable positions.

It is important in many instances, and particularly when auxiliary yarn in its return extent is to be received by a considerable number of needles, or when it is to be knitted by several needles, that means be provided for assuring that sufficient yarn is drawn out from the yarn guide. The means to this end particularly exemplified comprises members 140 carried on an annulus 141 which is mounted to rotate in the opposite direction to the cam ring 10 and the other rotating parts. Each member 140 has a cam surface 142 adapted when projected against the outer ends of the sinkers to urge them inwardly when the sinker cam groove so permits. Each member 140 is pivoted at 142' and is provided with a spring 143 acting against a nub 144. On each member 140 there is carried a roller 145, and inward movement of the roller 145, and consequently of the member 140, is prevented during the major portion of the revolution, by means of surfaces 146 on an annular element 147 carried by the sinker cam ring 27. The annular element 147 is formed at desired points with receding surfaces 148 and 149 along which the roller is adapted to ride toward and away from the outer ends of the sinkers. The surfaces 148 and 149 are joined by an arcuate surface 149'. As the roller moves inwardly, the cam portion 142 will press against nubs 150 on the sinkers, and will tend to move the sinkers inwardly as indicated at 150' in Fig. 12. At points in line with the surfaces 148, 149', and 149, the member 151, which form the inner side of the sinker cam groove, is cut away to a line 151' to permit the inward movement of the nubs 41 on the sinkers under the influence of the cams 142.

In order to drive the annulus 141, there is provided on the sinker cam ring 27 an annulus 152 having an annular gear 153 meshing with one or more pinions 154 rotatably mounted at affixed points on the sinker bed. Each pinion 154 has thereon a pinion 155 of different circumferences arranged to mesh with an annular gear 156 on an element 157 to which the annulus 141 is attached, the gear arrangement, in the present instance, being such that the member 157 will make the same number of revolutions in any given time as the annulus 152, but will revolve in the opposite direction.

In order that the amount of inward movement of the sinkers by the cam surfaces 142 may be adjusted so as to provide just the right amount of yarn for the particular operation to be performed. The stud 158 of each roller is carried in an eccentric mounting 159 fitting in an eccentrically-disposed circular depression 160 in the member 140. The member 159 is held in position by means of a screw 161 fitting in an arcuate slot 162.

It is to be noted in this connection that in instances where the needle cylinder rotates and the needle cams and associated parts are stationary, if cams equivalent to the "oppositely-rotating" cams 140 are used, they will rotate in a similar direction to the needle cylinder, but faster, as for example twice as fast.

In formation of designs of varying width,

there are instances where it is desirable to draw yarn out to different extents depending upon the point where the edge of the design occurs in a given course, and to release the yarn at or near that point. The provision of trippers and selective means to this end is a matter of considerable difficulty in many instances, and, with this in view, there is provided in accordance with the present invention traveler means trippable by the yarn itself. The means to this end particularly exemplified (see Figs. 14-18) comprises a traveler 185 consisting of a bent rod 170, the lower end 171 of which is adapted to intercept yarn suitably positioned by a raised yarn guide. The rod 170 extends to a hollow shaft 172 rotatably mounted in a unit 173 which is secured on a surface 22' of the ring 22 by a clamp 173' and which carries at its upper end a fan-shaped member 174 carrying an arcuate gear 175 at one side thereof. The gear 175 meshes with an arcuate gear 176 on a member 177 which carries an arm 178 adapted to be swung between a position in which it will clear the trippers and a position in which it can be intercepted by an active tripper. On the member 177 is a spring 179 which normally urges the member 177 in a direction which will swing the arm 178 into position to be intercepted by the tripper, and which will rotate the gearing to swing the rod 170 rearwardly so as to release a yarn.

In order to swing the rod 170 rearwardly to release the yarn, there is provided a trigger 180 carried on a post 181 rotatably mounted interiorly of the hollow shaft 172. The trigger is normally urged into an outward position wherein it is radial of the machine and in which it will intercept the yarn, as indicated in Fig. 16, by a light spring 182 which is carried on an arm 183. At its upper end, the post 181 carries a light gear 184 meshing with a similar gear 185 fixedly secured to a post 186 which is rotatably mounted in a portion of the unit 173. In the portion of its length juxtaposed to the fan-shaped member 174, the post 186 (as shown in Fig. 15) is formed with a recess 188 terminating in a flat surface 190 against half of which a shoulder 189 on the fan-shaped member 174 is pressed due to the action of the spring 179. It is to be noted that the shoulder extends inwardly (to the right of Fig. 15) only to the center line of the post 186 so that when the post 186 rotates 90° in a counterclockwise direction (Fig. 15) the fan-shaped member 174 will be free to rotate in a clockwise direction (Fig. 15) due to the provisions of the recess 188. When even a fairly slight pressure is exerted against the trigger 180, the post 186 will be rotated so as to swing the surface 190 away from the shoulder 189. Upon release of this shoulder, the spring 179 will swing the traveler 170 rearwardly so as to release yarn engaged thereby. This same movement will move the arm 178 into a position where it can be contacted by a raised inward end of a tripper, and when it contacts such a tripper it will be swung backwardly, which in turn will rotate the fan-shaped member to the position where the post 186 can be rotated by the spring 182 to move the surface 190 against the shoulder 189. To insure that the surface 190 will stop in the proper relation to the shoulder 189, a stop finger 190' forming part of the trigger 180 is made to contact with the lower portion of arm 183, and when the surfaces 190 and 189 are in engagement, they will hold the parts in position until the trigger 180 is again moved. As will be seen from Figs. 16, 17, and 18,

a traveler 185 intercepts yarn from a yarn guide 19 and draws it out, in this instance for positioning the same upon the sinker humps. As the traveler accomplishes its purpose, the trigger 180 comes in contact with the yarn. It is thereupon swung rearwardly by the portion of the yarn extending from the needle or from the fabric to the traveler. As this rearward swinging motion is completed, the fan-shaped member is released and the traveler is swung rearwardly by the spring 179 to release the yarn. It is to be noted that although the traveler draws the yarn forwardly, the portion of the yarn with which the trigger is in contact is adjacent to the needle, and is held back thereby, so that the rod 170 moves forwardly much faster than the yarn or the portion of the trigger engaged thereby.

While the exemplified machine is adapted for catching auxiliary yarn into a fabric in a wide variety of manners, including the catching of a single yarn in a single wale in various rows and also the formation of stripes or design portions of only two or three wales in extent; machines of this character are particularly well adapted for the formation of design portions extending across a large number of wales—it being possible to cause the auxiliary yarn to be fed to be received by needles along one-eighth or more of the circumference of the machine in certain instances. In a machine such as exemplified having a cylinder twenty-two inches in diameter with thirteen needles to the inch, yarn may be very easily fed to sixty needles (or, with twenty-six needles to the inch, to one hundred and twenty), and in some cases to a considerably larger number. In the provision of such design portions of the auxiliary yarn will, in many instances, extend back and forth thruout the stripes or other portions wherein it appears. In such instances, it is ordinarily desirable that the auxiliary yarn be caught into the fabric both in its forward and in its rearward, or return, extents. The yarn may be knit in its forward extent and merely caught in the fabric in its rearward extent, or vice-versa, or may be knit in both its forward and return extents, or merely caught into the fabric if the main yarn or another yarn is knitted in the design portions—in both its forward and return extents, or may be embodied in other ways. As disclosed herein the return portion of the auxiliary yarn may be laid against suitable ones of the needles, this operation occurring after the retraction of the needles, which have received the forward portion of the auxiliary yarn and after the needles have again been selectively raised. As will be understood this selective raising of the needles may involve raising some or all of the needles to fully advanced position for receiving yarn for knitting or by raising selected ones of the needles, such as alternate needles, alternate pairs of needles, or otherwise spaced needles or groups of needles to a partially advanced position for catching the yarn into the fabric without knitting, or the needles may be otherwise selectively raised. One problem in knitting or otherwise catching return portions of auxiliary yarn is that occasionally the yarn will extend in such a manner from the forward end of the design portion to the yarn guide that when the needles are raised the yarn may go on the back of one or more needles in cases where it is desirable that the yarn be laid against the front of these needles, or that the yarn may otherwise become undesirably entangled in the needles.

With the foregoing considerations in view, there is provided in accordance with the invention, as will be seen, means for holding the return portion of the yarn out of the way while the needles are raising or at other desired times.

It will be apparent that where in one portion of the fabric walewise thereof it is desirable to form wide patterns, or continuous patterns which extend about the entire fabric, and where in another portion of the fabric it is desirable to form only narrow patterns extending vertical of the fabric; this can be accomplished with particular facility on a machine such as that exemplified, and without drawing out more than a small portion of yarn from the yarn guide at the portion of the fabric where narrow patterns are being formed, by inserting yarn guides and trippers at points such that a yarn guide will be near one edge of the narrow pattern and a tripper will operate near the other edge, and, where the position of the pattern makes it desirable, by providing a yarn guide at a point other than the yarn guides utilized in forming the wide patterns. Where necessary or desirable, this may be supplemented by additionally lengthening the outermost portion of some or all of the yarn guides and trippers to permit additional teeth at spaces operated in by additional cams 26 and 71. By the provision of the exemplified or other types of varying selection, moreover, yarn guides and trippers may be operated at any of a wide variety of desired points and for any of a wide variety of desired purposes, as will readily be apparent. If desired, however, uniformly-acting means may be employed in certain instances. For example, where variability in the point at which yarn is tripped from a traveler, the selecting means for the trippers may be replaced by a cam groove, or the like.

In Figs. 20-23, there is illustrated schematically one form of operation of mechanism of the character shown in Figs. 1 thru 19 for the production of designs at one side of a jersey background (that side which is commonly considered the rear of a jersey fabric) by laying in the advance and return portions of an auxiliary yarn at successive courses in design portions. In this arrangement, the needle selection will be such that yarn from the main yarn feeds will be knitted at all points in their rotation, and auxiliary yarn from selected yarn guides will be received at selected portions by spaced needles or groups of needles which have been partially advanced to a position in which the previously formed jersey loops will not clear the latches. The operation is shown at a stage in the formation of designs of a character such as indicated at the upper right-hand corner of Fig. 20. Figs. 20-23 illustrate six successive sectors on the machine, the yarn-guide and tripper arrangement at each of these sectors being similar to that in each of the other of these sectors. In each sector, in the exemplified arrangement, an exactly similar design is being formed, so that the operation of the moving parts in any sector will be exactly repeated at a succeeding sector, and a consideration of the operation from sector to sector in connection with the showing of the rotatable parts will give a full understanding of the operation in any one sector. The positions of the yarn guides, etc., are indicated by double small letters; the first letter indicating the sector and the last letter the position in the sector. It is to be noted that those yarn-guide means and trippers which have their inward portions raised are shown black, whereas those which

have their inward portions in a lower outward position are shown white; and also that teeth on yarn guides and trippers which are selected in the particular operation shown are shown black, whereas unselected teeth are shown white. Also cams 26 and 71 depressed for selection of guides and trippers are shown in black; those not so depressed are shown in white. It is to be noted that needles which are in their normal lower position are indicated by light dots, that needles which are just above their normal position are indicated by heavy dots, that needles which are in partially advanced, "tucking" position—i. e., needles which are in position to receive the yarn but not to cast—are indicated by small circles, that needles which are in fully advanced position are indicated by large circles, and that needles which are in loop-tightening position are indicated by an "x"; the line of the needle butts being indicated near the bottom of the sheet. The settings by the drums for operating particular jacks and needles is indicated by three lines of dots at the very bottom of the sheets, the lower line indicating no selection, the middle line indicating selection for receiving the yarn without casting, and the upper line indicating selection for the full advancement of the needles.

Of the various yarns which can be utilized in forming the designs, only one is being utilized in each sector in the arrangement shown in Figs. 20-23, the others being at this stage of the operation carried in the form of vertical floats on the front of the fabric being formed. The inactive yarn guides are shown at *aa*, *ab*, and *ad*, *ba*, *bb*, and *bd*; etc. Yarn guides which are active during the operations exemplified are shown at *af*, *bf*, etc. Inactive trippers are shown at *ac*, *ae*, and *ag*; *bc*, *be*, and *bg*, etc. Trippers which are active during the operations exemplified are shown at *ah*, *bh*, etc. As will be understood, the positioning of the teeth of the active yarn guides and active trippers will be such that the cams 26 and 71 under control of the particular setting of the drum 76 at this stage will engage such teeth to swing the elements in question so that their inner ends will be in an upward position at desired intervals, whereas the inactive yarn guides and trippers will not have teeth in position to be so operated.

At the right-hand portion of Fig. 20 yarn 200 extends from a point 201 which is at the end of a return coursewise conformation of this yarn which has been previously laid in; a course of jersey knitting from a main-yarn feed having occurred subsequent to the laying in of its return portion. From the point 201, the yarn 200 extends inside the inner hooks 43 of sinkers at *ai*, and *aj* to the yarn guide *af*. The sinkers have received the yarn due to the inward movement of the yarn guide *af* by the cam groove 31a, the sinkers having been moved inwardly by the sinker cam portion 202 while the yarn guide was held inward by the connecting portion 32A. The yarn guide is shown toward the end of its outward movement under the influence of the retracting portion 33A. The completion of this movement will so dispose the yarn guide at *af* that a traveler will intercept yarn held thereby. At this stage, while the sinkers still hold the yarn 200 in an inward position at the rear of the line of needles, needles are selectively raised to partially advanced or "tucking" position by a cam 105A, the selective mechanism having previously been operative at point 203 to set the jacks 101 of selected needles (alternate needles in the present in-

stance) of a group of needles in position so that their upper shoulders 103 will be engaged by the cam 105A and to set the jacks of the remaining needles in position such that neither shoulder 5 will be engaged by the cam 105A. For the sake of simplicity of illustration, the cam 105A is shown with a dotted line 204 which indicates the course of advance movement of the jacks which have their upper shoulder 103 engaged by the cam 105A. The selective mechanism will, of course, set the jacks of needles at each side of the selected group of needles in position so that neither shoulder will be engaged by the cam 105A. In the present instance, the design which in the previous coursewise conformation terminated at point 201 will be expanded to a point 205 at this stage, the number of needles which are raised to receive the advance portion for incorporating into the fabric in coursewise conformation 206 being greater than the number of needles which were raised to incorporate the return yarn for the formation of the previous coursewise conformation 207. By thrusting the yarn behind additional needles at *ak* and *am* due to the inward movement of the yarn guide at *af* and of sinkers by the cam 202 and by the raising of the needles at *am* and *ak* while the sinkers hold the yarn back of them, the widening of the pattern is effectuated. While the sinkers are still in inward position and after the inner portion of the yarn guide at *af*, has been returned to its upward, outward position by the cam 33A, a traveler 18A passes; intercepting the yarn 200 and laying it along the outside of the needles for reception thereby. A stitch cam 135A is provided to retract the advanced needles so that the advance portion of the yarn 200 drawn out by the traveler 18A will lie in the hooks of the needles and over the forward portion of the sinkers. The traveler 18A will draw out yarn until its arm 66A contacts the tripping portion 68 of a tripper as at *xh*, which, if the machine had no additional sectors than those shown in Figs. 20-23, would be the tripper *fh* shown at the left-hand end of Fig. 23. The tripping portion of the tripper will have been raised by a cam 71 of the set of cams 26 and 71 which are similarly disposed with respect to the sinker cam groove to the set of selector cams at 26E shown at the left-hand end of the Fig. 23. The yarn 200 will thereupon lie as does the yarn 208 coming from the yarn guide *bf*, and the consideration of the operation will be taken up in connection with the zone wherein the latter yarn appears. The next yarn to be incorporated into the fabric will be main yarn 209 from a main-yarn feed 16B. As the needles are advanced and retracted for the reception of this yarn 209, the free portion of yarn 208, if it continued to lie on top of the humps of the sinkers, or if it were caught by the inner hooks of the sinkers, would tend to be received by certain of the needles. In order to prevent this, means are provided, in accordance with the invention, for catching the free portion of yarn 208 under the outer hooks of the sinkers. In the present instance, the sinkers will have been drawn outwardly by the portion 210 of the sinker cam groove, and prior to the passage of the main-yarn feed will be moved inwardly again by the action of the portion 211 of the sinker cam groove. Moving with the sinker cam groove and disposed at a point in line with a part of the cam portion 211 there is provided a traveler 18B. This traveler is of the character illustrated in Figs. 14 and 15. It will catch yarn 208 from the yarn guide *bf* and tend to draw it

out, but, instead of being tripped by a tripper, will be tripped by the yarn itself as it reaches a particular position during the drawing-out operation, as particularly exemplified in Figs. 16-18, being restored, after it has released the yarn, by the tripper *ah*, which has been raised by the same group of selective cams which selected the yarn-guide *af*.

As will be seen, the traveler 18B draws the yarn to a position such that upon the release of the traveler the yarn will be placed over the sinker humps between the inner and outer hooks of the sinkers to the left of the needle 212. A yarn deflector 88B, as it operates in advance of the main-yarn feed, serves to push yarn, as from the guide *cf*, off the sinker humps so that the portion 213 of a yarn, as shown at 214, will lie between the humps of sinkers, as at 215 and 216. As the sinkers are drawn out by the portion 217 of the sinker cam groove, the rearward hook of the sinker 215 will draw the yarn outwardly so that it will be entirely out of the way of the main-yarn feed 16B, and the yarn 209 therefrom. It is to be noted that once a yarn has been situated under the outer, or rear, hooks of the sinkers, it will stay in this position until its yarn guide is raised, so that whenever it is desired to terminate a design nothing further needs to be done, but the portion of the yarn, as at 213, will continue to extend radially between sinker humps, as at 215 and 216, and, no matter how many courses are knit, will lie on the front of the fabric until its yarn guide is again rendered active. In the present instance, however, the return portion of each active auxiliary yarn is to be laid against the needles for incorporation into the fabric (without knitting) after only one course of the main yarn 209 has been knit following the feeding of the advance yarn to the needles.

The knitting of the main yarn occurs due to the advancement of all the needles by the selective means and the cam 105B, the latter acting pursuant to a selection at 218 in accordance with the setting of the drum 119B, to perform a function similar to that of a cam having a surface illustrated diagrammatically at 219, and to the retraction of the needles by a stitch cam 135B. By this full advancement and retraction of the needles, the main yarn 209 is knit and the advance portion of the auxiliary yarn which has been held by alternate needles is caught into the fabric without knitting. A restoring cam 36B passes at about the same time as the cam 105B, as indicated.

The operation for causing suitable needles to receive the return portion of an auxiliary yarn is exemplified in connection with the yarn 214 and, later with the yarn 220 coming from the yarn-guide *df*. Before this operation can be performed, it is necessary to remove the yarn from the outer hooks of the sinkers so that it can be laid against the needles, and to this end there is provided a traveler 18C. The yarn guide *cf* will have been selectively raised by a cam of the set 28C and, the sinkers having been thrust forward by a portion 221 of their cam groove, the yarn will lie between the sinker 215 and the raised yarn guide in position to be intercepted by the traveler 18C. The traveler will be tripped by the tripper at *bh* which is positioned by a suitable selecting cam. The yarn, when released by the traveler, will then lie very much in the position of the portion 222 of the yarn 208. Thereupon the yarn guide *cf* will be thrust forwardly and downwardly by the cam 31C, and held forwardly and

downwardly, in the position shown at *df*, by the guiding portion 32C while the sinkers are moved forward by an "oppositely-rotating" member 140m. The forward and downward movement of the yarn guide will serve to put the yarn in the position in which the yarn 220 is shown—in front of the inward hooks of the sinkers—and the inward movement of the sinkers will thrust the yarn against raised needles. Alternate needles having been partially raised, by the needle selecting means at 222 controlled by drum 119C, and by the cam 105C acting like a cam having a surface at 223, the yarn 220 will lie in front of these needles and be pushed inwardly against them by the sinkers. It is to be observed that the cam 105C advances the needles while the yarn is still held by the traveler 18C so that by the partial elevation of a needle at *fn* (and a suitable number of alternate needles to the left of it) at this stage, the design may be widened to the right so that the course 206 will extend further to the right than the course 207, as well as further to the left than course 207. It is to be further observed that in the present instance the needles which are partially advanced by the cam 105C include all the needles partially advanced by the cam 105A, as well as others. In the schematic showing "oppositely-rotating" sinker cams 140 are each shown as if pivoted at a point 224 and carrying a member 225 guided by a cam groove 226, the cam groove being so formed and the members 140 so spaced, that a cam surface 142 on alternate ones 140m of the members 140 will act to project inwardly the sinkers to the right of yarn guides such as those at *af*, *bf*, etc. and that intermediate ones, as exemplified at 140n, will act to move inwardly sinkers to the right of yarn guides such as *aa*, *ba*, etc. It is to be observed that it is not contemplated, in the particularly exemplified arrangement, that a yarn from any particular yarn guide will be drawn out more than a few needles beyond the half-way point between one yarn guide, such as *bf*, and the next similarly-positioned yarn guide, such as *af*. For example, the tripper *ah* will trip a traveler 18A drawing yarn from a yarn guide *bf* at a point considerably more than a quarter of the distance from the yarn guide *af* to the yarn guide *bf*. After the yarn 220 has been received by the inner hooks of the sinkers, the cam 33C acts to restore the yarn guide *df* to its outer elevated position. After the passage of the retracting cam 135C, a cam portion 229 draws out the sinkers, whereupon there passes a traveler 18D which is similar to the traveler 18B and which moves substantially in line with the end of a portion 229 of the sinker cam groove, which again moves the sinkers inwardly, the traveler 18D assuring that the yarn from the yarn guide *ef* will not be received by the inner hooks of the sinkers, but will lie above the sinker humps.

After the operation of the traveler 18D, there passes a main-yarn feed 16D, this being preceded by a yarn deflector 88D. The needles are fully advanced for reception of a yarn 231 from the yarn guide 16D by a cam 105D acting like a cam having a surface 232 responsive to the setting of a selective means 233. The needles are retracted by a stitch cam 135D, after which a set of yarn-guide-and-tripper-selecting cams 26E pass. Following this there is a traveler 18E similar to the traveler 18C and acting to clear yarn for a succeeding operation of the sinkers by a cam groove such as at 202 and of a traveler such as at 18A. It is to be noted that the return extent

234 of the yarn 200, and similar yarns, is cast from the needles when they are retracted by the stitch cam 135B. A restoring cam 36D passes at about the same time as the cam 105B, as indicated.

In Fig. 24, there is depicted in particular detail an operation wherein a clearing traveler, such as the traveler shown at 18C is acting to remove a yarn such as 214 from in back of the outer hooks of the sinkers and is laying this yarn above the sinker humps.

In Fig. 25 there is depicted in particular detail an operation wherein a yarn deflector 88 is acting to carry a yarn from the humps of the sinkers to the outside of the sinkers so that the yarn will lie beyond the outer hooks of the sinkers.

As will be observed from Fig. 6, the sinker cam groove is formed in the usual manner by a series of plates which may be removed and replaced. Accordingly, by suitable disassembling the machine, the cam groove may be adapted for the omission of main-yarn feeds or travelers, and for positioning these various members in any of a variety of desired relationships to each other. One type of fabric contemplated by the invention and adapted to be produced by machines embodying the invention is one wherein both advance and return portions of an auxiliary yarn are laid into the same course of knitted main yarn. A fabric of this character is shown in the process of formation in Fig. 26, and is illustrated diagrammatically in Fig. 27; claims to fabrics of this type being included in my copending application, Serial No. 280,705, filed June 23, 1939. As will be seen from these figures, an advance extent 240 of auxiliary yarn is laid into a course 241 of knitted yarn, and a return extent 242 of the auxiliary yarn is laid into the same course 241, the advance extent of the yarn being laid in front of different needles than the return extent of the yarn in the present instance. Similarly, in a succeeding course 243 of the knitted main yarn, an advance extent 244 and a return extent 245 of the auxiliary yarn is laid in. It is to be noted that the extent 240 corresponds generally to an advance extent which would appear in the course above the return extent 207 in Fig. 20, the return extent 242 corresponds generally to the extent 207 in Fig. 20 (except that it is caught on different needles), the advance extent 244 corresponds generally to the extent 206 of Fig. 20, and the return extent 245 corresponds generally to the extent 234 in Fig. 20 (except that it is caught on different needles). From the course 240, the auxiliary yarn extends at the front of the fabric across one or more courses, such as the course 246 of knitted yarn shown. A fabric of this type may be produced on a machine such as exemplified in Figs. 1-23, wherein the traveler 18B, the main-yarn feed 16B, yarn-deflector 88B, sinker cams 217 and 221, needle cams 105B and 135B, with their accompanying selective means, etc., are omitted, and the machine suitably consolidated and rearranged in a manner that will be readily apparent; the needle selection being modified as indicated above. For example, the needle selection shown at the right-hand side of Fig. 22 may be modified to conform with the needle selection indicated in Fig. 28a. Likewise it may be produced on the machine such as exemplified in Figs. 20-23 by omitting the main-yarn feed 16B and the needle-raising cam 105B, but leaving the yarn deflector 88B in place, and by partially advancing, as by a cam 105C and its ac-

companying selector means, for the reception of the return extent, different needles from those partially advanced for the reception of the advance extent of the yarn. There is exemplified schematically in Figs. 28 and 28a portions of the mechanism shown in Figs. 21 and 22 which has been so modified, the parts having similar reference numerals to those in Fig. 21. In Fig. 28a the needle selection carried out by the cam 105C is exemplified, it being noted that the needles partially raised are those intermediate the needles shown as partially raised in the right-hand side of Fig. 22, and that the needles shown in the right-hand side of Fig. 22 as partially raised being in retracted position in Fig. 28a. As will be apparent, the machine of Figs. 20-23 may be employed as shown therein, provided the yarn feed 16B carries no yarn, and the setting of the drum 119B is such that no rockers 102 will be in position to be engaged by the cam 105B, and that the setting carried out by the cam 105C is modified to perform the operation exemplified in Fig. 28a.

As will be appreciated, a wide variety of other operations may be performed by mechanism of the character exemplified in Figs. 1 thru 19. In Figs. 29-32, there is exemplified a type of operation for the formation of a fabric such as exemplified in the upper right-hand corner of Fig. 29 and wherein main yarn is knitted as at 250, 251, and 252, except at the portions of the fabric where the design appears, and at such portions it is laid into the fabric as illustrated schematically at 254, 255, and 256. In the design portion of the fabric, the auxiliary-yarn is knitted in both its forward and return extents as shown at 257 and 258, a previous return extent 259 also being shown. In these figures the various parts are similar to the various parts illustrated in Figs. 20-23, the same yarn guides and trippers being active and inactive. The needle selection will, of course, be different, and as indicated in the figures and referred to herein-after. The parts are indicated by similar reference numerals to those utilized in Figs. 20-23 with the exception that those parts which combine a number and letter in Figs. 20-23 have the letter doubled in Figs. 29-32. As will be seen, the traveler 18XX (similar to the traveler 18E) is shown drawing out the yarn 260 from the yarn guide af. The selection of the selecting means effective at 261 is such that the cam 105AA operates as a cam having an active surface 262 such that the needles from the needle 263 thru needle 264 are fully advanced for the reception of an auxiliary yarn as at 265, which is drawn out by a traveler 18AA. Needles to the left of needle 263 and to the right of needle 264 will remain in their lower position, in which they will not receive any yarn. The auxiliary yarn is placed at the rear of the forward sinker hooks 43 and 43' by a clearing traveler 18BB, after which a main-yarn feed 16BB passes. In response to the selection of a selecting means effective at 266, cam 105BB, acting as if it has an effective surface at 267, fully advances all the needles during the passage of the yarn feed 16BB, with the exception of the needles which were fully advanced by the cam 105AA. Of these needles, it will partially advance alternate ones, acting on them as if it were a cam with an effective surface 268. The auxiliary yarn from the active yarn guides is cleared from the outer sinker hooks by a traveler 18CC, whereupon needles for incorporating the extent 268 of the auxiliary yarn 260

(and similar extents in design portions at other sectors of the machine) are fully raised by a cam 105CC acting pursuant to the selection at 269. Auxiliary yarn such as the yarn 270 from the yarn guide ef is laid against the raised needles and is pushed back of individual needles by an "oppositely-rotating" sinker cam 140XX, it being observed that this cam begins its action on the sinkers at the right of the group of raised needles, and continues to the left, so that yarn at the left of each individual needle beyond which it is pushed is still entirely free to be drawn out from the yarn guide ef. Yarn is cleared from the inner hooks of the sinkers by a traveler 18DD, after which a main-yarn feed 16DD passes, needles for reception of yarn from this feed being selectively raised pursuant to the operation of a selection means 271 and a cam 105DD, which act similarly to the selective means acting at 266 and the cam 105BB, except that the number of needles not fully advanced by the cam 105DD is larger and corresponds to the number of needles fully advanced by the cam 105CC. Alternate ones of the needles not fully advanced by the cam 105DD are partially advanced thereby.

In Fig. 33 there is exemplified a portion of a form of fabric which may be produced by the machine exemplified in Figs. 1-19. Certain of the operations in the formation of this fabric are exemplified in Figs. 29-32. In this showing yarn 200 from the yarn guide af, yarn 268 from the yarn guide ad, yarn 269 from yarn guide bb, and yarn 270 from yarn guide ba are all shown as incorporated in various portions of the fabric. The yarn 200 floats in the front of the fabric over eight courses and is then knitted in successive courses to provide extents 271, 259, 257, 258, 272, 273, and 274. In a succeeding course, it is knitted to provide two portions 275 and 276 separated by a float. It is knitted in a succeeding course to provide an extent 278 beneath the extent 276 and then in alternate courses to provide extents 279, 280, 281, 282, and 283, being floated at the front of the fabric past the intervening courses of main yarn. It is floated over a number of courses from the extent 283 to an extent 284, which is an advance extent, and in the next course a return extent 285 is provided. The number of wales in each extent will be seen by checking the extent with the numbers in the middle of the figure. The yarn 268 is knitted in extents 286, 287, 288, 289, 290, 291, and 292 at the points indicated. The yarn 269 is knitted to provide portions 293, 294, and 295 in the first course of the part of the fabric shown, these portions being connected by floats 296 and 297, the entire extent being a return extent of this yarn. Three courses later an advance extent, comprising portions 298, 299, and 300 connected by horizontal floats 301 and 302, is knitted, and in a succeeding course a return extent 303 is knitted. This yarn is then floated in front of the fabric in a number of courses and is then knitted to provide extents 304-310, and an extent comprising portions 311 and 312 and a horizontal float 313, and extents 314, 315, 316, and 317, all as indicated. The yarn 270 is floated over a considerable number of courses and it is then knitted to provide portions 318, 320, 322, 324, and 326 at one side of the design and portions 319, 321, 323, 325, and 327 at the other side of the design, and two extents 328 and 329, all as indicated.

At the bottom of Fig. 33, the extent of drawing-out of the various yarns due to the tripper

position in operation is indicated, the extent of drawing out permitted by a tripper such as *ag*, *bg*, etc. being indicated by line 330*g*, the extent of drawing out permitted by the trippers *ae*, *be*, etc. being indicated by the line 330*e*, the extent of drawing out by the trippers *ac*, *bc*, etc. being indicated by the line 330*c*, and the extent of drawing out permitted by the trippers *xh*, *ah*, *bh*, etc., being indicated by the line 330*h*. In this manner selective tripping for narrow or wide stripings of yarn from the yarn guides *af* and *ad* may be selectively controlled by the trippers operating the right-hand ends of the lines 330*c* and 330*b*, respectively, and narrow or wide striping by the yarn guides *ba* and *bb* may be controlled by trippers acting beyond the right-hand ends of the lines 330*g* and 330*e*, respectively.

The chart at the left-hand side of Fig. 33 indicates operations of various trippers and yarn guides for putting in the advance and return yarn. It is to be noted that the tripper lines at the bottom of the sheet are labeled "Tripper 1," "Tripper 2," "Tripper 3," and "Tripper 4," respectively, and that the yarn from the various guides are labeled "Guide 1," "Guide 2," "Guide 3," and "Guide 4," respectively. In the column at the left marked "Guide" the guide raised for any particular course is indicated, and in the column at the left marked "Tripper" the tripper operated in the formation of any particular course is indicated. In the column at the left marked "Selector," the selection of the selector cams 26 and 71 as at 26AA, 26CC and 26EE in Figs. 29-32 is indicated. The letter "a" indicating the selection of the set of cams 26AA and 26EE and the letter "r" indicating the selection of the selector cams 26CC. It is to be noted that whereas, in the courses bracketed "B," a restoring cam 26BB (Fig. 30) is required, as well as a restoring cam 36DD (Fig. 32) the restoring operation of the restoring cam 36BB is not essential in all cases for the formation of courses such as bracketed at "A".

There are various instances in which it is desirable that the tripper and yarn guide be combined in a single element. This reduces to one-half in certain instances the number of elements that need to be inserted in the machine, as for example when it is desired to make numerous narrow patterns. It also serves when certain types of mechanism are employed to desirably reduce the number of points at which element-movement or element-selection occurs, or to assure that tripping will unfailingly result whenever a yarn is received by a traveler. With this and other ends in view, an arrangement for combining a yarn guide and tripper portions on a single element may be provided in accordance with the invention. One form of such construction is exemplified in Figs. 34 and 35 wherein a single unit 400 removably mounted on a surface 22' of the ring 22 by means of a clamp 401, is provided with a yarn-guiding portion 20*g* and with a tripping portion 67*g*. A traveler 18*g* catches yarn from the yarn guide on its hook in a manner similar to the traveler 18. Instead of a gear 60, the traveler carries a bevelled gear 60*g* meshing with a bevelled gear 402 mounted on a rod 403, having at its end a pinion 404 meshing with an arcuate gear 404' carried on a swinging gear member 405 from which a tripper arm 60*g* depends. Since the rod 403 extends rearwardly from the traveler, the tripper arm 60*g* will not contact the trip portion 67*g* of the combined

yarn-guiding and tripper unit 400 until the traveler has drawn out an amount of yarn sufficient for reception by a desired number of needles. Such an arrangement is particularly adaptable in situations where it is desirable to operate the yarn guide and tripper from a single segment of a pattern control portion such for example as a pattern drum, as where a large number of yarn guides need to be operated with varying mutual selectivity, or where a pattern control member with a small number of segments is to be employed. Arrangements such as exemplified have, as will be appreciated, a wide variety of uses. For instance, by placing the geared swinging member ahead of the traveler, a yarn guide in advance of the traveler may be utilized to trip the traveler to release the yarn which is drawn out from a yarn guide from which it caught yarn at an early stage of its movement.

While in the form of machine exemplified in Figs. 1-32 the auxiliary yarn is carried to or beyond the line of the needles by a combined action involving inward movement of a yarn guide and inward movement of the sinkers, the invention in certain of its aspects contemplates the performance of operations of this character either by the sinkers alone or by a yarn guide alone.

In Fig. 36 there is exemplified a form of construction which is generally similar to that of Figs. 1-19, but in which the yarn guides do not move inwardly. In this showing, members similar to corresponding members in Fig. 4 are designed by similar reference numerals distinguished by the addition of the subscript *h*. It will be observed that the yarn-guiding members 19*h* are formed without a notch such as 30, and that the cam portion 31 and accompanying members are omitted. The cams 26*h* and 71*h* are the same as the cams 26 and 71 and are adapted to act similarly on the teeth of the yarn guides and trippers. Restoring cams 36*h* are provided, however, at all points where a yarn guiding end 20*h* of a yarn guide is to be lowered either for the purpose of restoring where a new selection is desirable, or for the purpose served in the construction of Figs. 1-19 by the cam 31. Accordingly, a set of selector cams (26*h* and 71*h*) will be provided at each point where a yarn guide or tripper is to be raised, since there is no cam serving the purpose of the cam 33. In Fig. 36a there are shown portions of the operation of a form of machine of the type exemplified in Fig. 36, corresponding to portions of the operation shown in Figs. 20, 22, and 23, the yarn guides and trippers being indicated by similar reference numerals, and the moving parts being designated by similar reference numerals, except that they include an "h" or an "H". As will be seen, a restoring cam 36HA serves the purpose of the cam portion 31A in lowering the inward ends of the yarn guides, and a selector means 26HB (composed of cams 26*h* and 71*h*) serves the purpose of the cam portion 33A for raising selected guiding ends for the reception of yarn by the traveler 18HA. Similarly, a restoring cam 36HC serves the purpose of the cam portion 31C, and a selector means 26HD serves the purpose of the cam portion 33C, in these respects. The inward ends of the sinkers (Fig. 36b) are longer than those of the sinkers 13; and the sinker cam groove 42*h* is arranged, as will be seen, to draw the sinkers back further at points where auxiliary yarn is to be carried inwardly thereby (but not, in the pres-

ent instance, at other points, and, in no case, at points of main-yarn feeding) than does the cam groove 42 (Figs. 20-23) so that the outer sinker hooks will be drawn outwardly to the position indicated by dotted lines (Fig. 36) wherein they will receive and move inwardly yarn from a yarn guide in its lower position. As will be seen, the outward position of the sinker hump 13h' is such that it extends underneath the yarn-guiding end 20h. As shown at the left-hand side of Fig. 36, the distance between the pivot 142h' of the "oppositely-rotating" cams 140h and the member 152h is greater than the distance between the pivot 142' and the member 152 so that the cams 140h will have a greater effective action on the butts 150h, and one that is equal to the action of the sinker cam groove 42h at the point 440 (Fig. 36a).

In Figs. 37-39 there is shown a yarn guide 19j having a yarn guiding end 20j of such character that it may pass behind the needles even when the needles are raised. As will be seen the end 20j is formed with converging surfaces 450 and 451 of such character that the yarn guide may move inwardly between the needles, and with receding surfaces 452 and 453 of such character that the yarn guide may move outwardly between the needles. The yarn guiding end 20j being relatively thin, as compared with the distance between the needles, being just thick enough for the provision of a yarn guiding bore 454, it can be readily moved to carry the yarn behind the line of the needles so that sinker action is not required. In Fig. 37 the yarn guide 19j is shown in position for laying a yarn 455 against previously-raised needles for reception thereby. In Fig. 38 the yarn guide 19j is shown in position for laying the yarn 456 beyond needles which are about to be raised. The machine of Figs. 1-19 can be readily modified in a manner apparent to those skilled in the art to permit the yarn guide to be operated to carry yarn back of the needles, as for example by continuing a cam such as 32 inwardly from its inward end in Figs. 1-19 to move the yarn guide inwardly the desired amount. Various readily apparent simplifications may be made in certain portions of the construction of Figs. 1-19 as so modified.

In Fig. 40 there is exemplified a form of yarn guiding end 20k of a yarn-guide member 19k. This has openings 460, 461, and 462, each adapted to receive yarn from a separate bobbin, and each connected by a suitable bore to a single opening 463 thru which yarn is drawn to be received by the needles or the sinker hooks.

As above indicated, the "oppositely-rotating" cams as exemplified at 140 provide a particularly effective arrangement for operating sinkers in connection with the inclusion of relatively long return extents of the auxiliary yarn, being especially desirable when the same is to be knitted. It will be appreciated, however, that, when relatively short extents of such yarn are to be included, or when such yarn is to be received only by a few spaced needles, ordinary sinker cams rotating with the needle cam ring (such as the cam ring 10) may be employed. Moreover, in certain instances any of a number of various types of specially constructed cams operating in the same direction as the rotating parts of the machine (or being stationary if the needle cylinder is stationary) may be employed.

In Fig. 41 there is shown one form of sinker cam which may be employed in certain instances wherein the "oppositely-rotating" cams are dis-

pensed with. This figure is similar to the portion of Figs. 30 and 31 containing the trippers *eg* and *dh* and the yarn guides and trippers therebetween. In this form of construction the sinker cam groove is so formed that, instead of being widened between the line 151' and the outer side of the sinker cam to permit movement of the sinkers inwardly by "oppositely-rotating" cams, no "oppositely-rotating" cams are used but the sinker cam groove is formed with an inwardly extending portion between a cam surface 500 and a complementary surface 501. The friction of the sinkers in their slots in this instance is less than in the case of Figs. 1-19. The surface 501 terminates in a surface 502 which is parallel to the needle bed which extends to the retracting cam portion 503. At the end of the cam portion 500, the outer line of the cam groove recedes rapidly as at 504 to provide a recess 505 after which there is another inward cam surface 506. The surfaces 501 and 500, in this instance extend in far enough to move the sinkers in further than the distance to which they are moved in Figs. 20-23 and 29-32, with the particular adjustment of the members 140 there shown (altho, of course, the members 140 may be adjusted to move the sinkers in farther). Recesses 505 and inward cam portions 506 thereafter succeed one another so as to provide a "saw-tooth" form of construction whereby the sinkers are successively thrust inwardly and allowed to be pushed outwardly by the tension of the yarn, this inward and outward action of the cam portions 506 and the recesses serving to work the yarn between the needles in such a manner that it will be drawn outwardly from the yarn guide *ef* without substantial binding. In this instance the yarn-guide guide portion 32CX connecting the yarn-guide cams 31CX and 33CX is shown shorter than the yarn-guide guide portion 32CC, altho it can be of different extent than that shown, if desired.

In instances wherein the return portion of an auxiliary yarn is to be received by the needles without knitting, the "oppositely-rotating" cams may be omitted in many instances, even tho a considerable extent of the return portion of auxiliary yarn is to be incorporated. A simple form of arrangement for this purpose is exemplified in Fig. 42, which corresponds to the portion of Fig. 22, including the trippers *ec* and *dc* and the intervening yarn guides and trippers. In this construction the sinker cam groove, instead of being formed with a widened portion between the line 151' and the outer side of the sinker cam groove, is formed as a narrow groove thruout; an inwardly-camming portion 510 and an outwardly-camming portion 511 of the usual type being provided. It is to be noted that the cam portion 510 does not extend as far as the cam portion shown in the other figures, being adapted only to bring the forward humps of the sinkers slightly beyond the needles in the manner indicated. A cam portion of similar inward extent may also be utilized at 202 (Fig. 20) if desired. In the present instance, the cam portions 510 and 511 are connected by a groove portion 512. In this exemplification, the yarn-guide camming and guiding portions 31CY, 32CY, and 33CY are disposed similarly to the corresponding portions 31CX, 32CX, and 33CX.

In Figs. 43-46 there is illustrated a form of machine generally similar to the form of machine exemplified in Figs. 1-23 as modified in Fig. 42, and further modified and arranged as set forth

below and in a manner which will be apparent to those skilled in the art. This form of machine, comprises a main yarn feed 16p and a traveler 18p, mounted on a single unit 600, which is detachably secured to a rotating ring 22b by means of a clamp 601 similar to clamp 58. Various elements not specifically referred to and which correspond to elements similar to those of Figs. 1-19 are indicated by similar reference numerals distinguished by the subscript *p*. There is thus provided a combined main-yarn feed and traveler as a single unit, which is adapted to feed a main yarn about the entire machine and to feed an auxiliary yarn along with it at one or more particular parts of the machine for incorporation in a fabric as plated yarn, or as a special formation, such for example as that known as "Terry cloth," at certain portions of the fabric. As will be observed the traveler 18p and the main-yarn guide 16p are so arranged that the auxiliary yarn 602 from the traveler will be delivered somewhat above the main yarn 603 from the main-yarn feed. This arrangement is adapted for the formation of plated fabrics and of Terry cloth, and the machine as exemplified is particularly adapted for the formation of Terry cloth. The sinker cam groove 42p is formed with a widened portion at 604 and suitable selectively-control means are provided for projecting desired sinkers to a point where their humps 73p will lie between the needles as the yarn is fed, with the inward hooks of these sinkers extending under the auxiliary yarn 602 to above the main yarn 603, as exemplified in Figs. 44 and 46. The sinkers 13p carry at their outer ends rockers 605 each pivoted to the sinker at 606 and each carrying a pair of cam-engaging portions 607 and 608. In order to select sinkers there is provided a selector wheel 609 having removable inserts 610 selectively disposed about its periphery, each insert 610 being adapted to engage the portion 607 of a rocker and to swing it from the position shown in dotted lines in Fig. 43 to the position shown in full lines in Fig. 43. When so swung, the rocker will have its portion 608 in the path of a cam 611 aligned with the widened portion 604 of the sinker cam groove and adapted to move selecting sinkers inwardly to the position in which their inward hooks will lie between the auxiliary yarn and the main yarn. Sinkers not selected will remain outward and will be moved inwardly, after the retraction of the needles by a cam 135P, by a cam portion 612. A cam 612' adapted to engage the portions 608 of the rockers and to restore them to the dotted line position is provided.

The auxiliary yarn is shown plated at 613, and formed in long loops at 614 for the formation of a Terry cloth design. The needles are selectively raised pursuant to the selective action at 615 by a cam 105P, which corresponds to the cam 105B of Figs. 20-23 and which has an operative surface 616, whereby needles when selected are moved to fully advanced position. The main-yarn feed 16p and the traveler 18p correspond to the main-yarn feed and traveler 16B and 18A, respectively, of Figs. 20-23, the selection carried out by a cam such as 105A being omitted. The auxiliary yarn intercepted by the traveler 18p in Fig. 45 is drawn from a yarn guide *pf*, and the traveler 18p is tripped by a tripper *ph*. The return portion of the auxiliary yarn is caught into the fabric without knitting as was the case in Figs. 20-23.

The pattern wheel 609 is slideably splined on a shaft 617 carrying a gear 618 meshing with a

stationary annular gear 619. In order to move the wheel 609 out of action when its effect is not desired, there is provided a sliding bar 620 carrying posts 621 on which are mounted rollers 622 which embrace the wheel. A spring 623 tends to draw the bar 620 and the rollers 622 toward the left in Fig. 43. The bar 620 carries a tooth 624, and a pawl 625 normally prevents movement of the bar 620 to the left, a spring 626 serving to maintain the pawl in position. The pawl is periodically moved out of position by one of a series of selectively disposed nubs 627 on a pattern chain 628. Movement of the bar 620 to the left is limited by a stop 629, and return of the bar 620 to the position shown is controlled by a plunger 630, operated by selectively spaced nubs 631 on a pattern chain 632. References to a direction by the term "lateral" and the like, when used herein with respect to the needle bed are intended to refer to a direction generally corresponding to the direction of needle movement.

Since certain changes may be made in the above construction and different embodiments of the invention could be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the following claims are intended to cover all of the generic and specific features of the invention herein described, and all statements of the scope of the invention which as a matter of language might be said to fall therebetween.

I claim:

1. A circular knitting machine comprising a needle cylinder, a series of needles thereon, means to feed yarn to said series of needles, a yarn-guiding member exteriorly mounted for sliding movement in a direction generally transverse to said bed and adapted to supply other yarn, means to cause said other yarn to be received only by needles of a limited group of said needles, said yarn-feeding means and said bed being mounted for relative movement, means including said yarn-guiding member to cause said other yarn to extend outwardly from said series of needles at all times when said first-mentioned yarn-feeding means and said group of needles are in passing relationship.

2. In a knitting machine, in combination, a needle bed, a series of needles thereon, primary-yarn feeding means, said yarn-feeding means and said bed being mounted for relative movement, mounting means disposed in a given relationship to said bed, a yarn guide carried by said mounting means, auxiliary-yarn feeding means disposed in a given relationship to the first-mentioned yarn-feeding means and adapted to feed yarn from said yarn guide to certain of said needles, said auxiliary yarn-feeding means and said yarn guide being relatively movable pursuant to said relative movement and being in passing relationship from time to time during the operation of the machine, and means to cause said yarn guide to be disposed exteriorly of said row of needles at least when the first-mentioned yarn-feeding means and when said auxiliary yarn-feeding means are in passing relationship with said yarn guide.

3. In a knitting machine, in combination, a needle cylinder, a row of needles on the outer side of said cylinder, yarn-feeding means, said yarn-feeding means and said cylinder being mounted

for relative rotation, mounting means disposed in a given relationship to said cylinder such that the mounting means and cylinder have no relative rotative movement, a yarn-guide carried on said mounting means at a point outwardly of said cylinder, and means disposed in a given relationship to the aforesaid yarn-feeding means to feed to certain of said needles yarn from said yarn guide.

4. In a knitting machine, in combination, a needle cylinder, a row of needles on the outer side of said cylinder, yarn-feeding means, said yarn-feeding means and said cylinder being mounted for relative rotation, mounting means disposed in a given relationship to said cylinder such that the mounting means and cylinder have no relative rotative movement, a yarn-guide carried on said mounting means at a point outwardly of said cylinder and movable inwardly toward said row of needles, and means to selectively operate said yarn guide.

5. In a knitting machine, in combination, a needle bed, a yarn guide, means to advance and retract said yarn guide in a direction transversely of the bed and means operative in advance of the aforesaid means to selectively move said yarn guide in a direction lateral of said bed.

6. In a knitting machine, in combination, a needle cylinder, a series of needles on said cylinder, a yarn guide disposed generally outside of said cylinder, needle-manipulating means, said needle-manipulating means and said cylinder being mounted for relative rotative movement, means forming a unit with said cylinder in said relative rotative movement and providing a support for said yarn guide, means to selectively move said yarn guide between raised and lowered position, and means to cause yarn from said yarn guide to be disposed in position for reception by a multiplicity of said needles when said yarn guide is in one of said positions but not when it is in the other of said positions.

7. A knitting machine comprising a sinker bed having slots therein, sinkers in said slots, and an element slidably disposed in one of said slots in addition to the sinker therein and carrying a yarn-guide portion projecting from the end of said slot and constructed and arranged to pay out yarn.

8. A knitting machine comprising a needle bed, a series of needles thereon, a sinker bed, sinkers on said sinker bed, a yarn guide mounted on said sinker bed in addition to said sinkers and movable independently thereof, and means to feed yarn from said yarn guide to certain of said needles.

9. A knitting machine comprising a needle bed, a series of needles on said bed, a yarn guide mounted generally outwardly of said bed, needle selecting means, means including said needle selecting means and said yarn guide to cause yarn from said yarn guide to be received by at least one needle spaced from said yarn guide but not by at least one needle intermediate said spaced needle and said yarn guide, thereafter to cause yarn from said yarn guide to extend to the rear of at least one needle intermediate said yarn guide and said spaced needle and to cause at least one intermediate needle to be positioned in front of said yarn, and subsequently to cause yarn from said yarn guide to be received by at least one needle intermediate said spaced needle and said yarn guide.

10. A knitting machine comprising a needle bed, a series of needles on said bed, a yarn guide

mounted generally outwardly of a given point on said bed, needle selecting means, means including said needle selecting means and said yarn guide to cause yarn from said yarn guide to be received by at least one needle spaced from said yarn guide but not by one or more needles intermediate said spaced needle and said yarn guide, thereafter to cause yarn from said yarn guide to extend at the rear of at least one needle intermediate said spaced needle and said yarn guide and to thereupon advance in front of said yarn at least one needle intermediate said spaced needle and said yarn guide, and subsequently to cause yarn from said yarn guide to be received by at least one needle intermediate said spaced needle and said yarn guide.

11. A knitting machine comprising a needle bed, a series of needles on said bed, a yarn guide disposed generally outwardly of a given point on said bed, means to cause yarn from said yarn guide to extend in one direction and to be received by certain of a group of said needles, means thereafter to advance certain of the needles of said group including at least one needle between the yarn guide and the last needle of which yarn was received, means to cause a further portion of said yarn to be laid against at least certain of the advanced needles while extending in the opposite direction, and means to thereafter retract the advanced needles.

12. In a knitting machine, in combination, a needle bed, a series of needles on said bed, a yarn guide disposed generally outwardly of said bed, means to cause yarn from said yarn guide to extend in one direction and to be received by certain of a group of said needles, means thereafter to advance certain of the needles of said group including at least one needle between said yarn guide and the last needle by which yarn was received, a series of sinkers, and means including said sinkers to cause a further portion of said yarn to be laid against at least certain of the advanced needles while extending in an opposite direction, and means thereafter to retract the advanced needles.

13. In a knitting machine, in combination, a needle bed, a series of needles on said bed, a yarn guide disposed at a given point along said bed, a yarn feed, said yarn feed and said bed having a relative movement in the direction in which said series extends, and said yarn feed being adapted to intercept yarn extending from said yarn guide and to feed it to said needles, and pattern-controlled means to cause yarn to be released from said yarn feed at a selected period in said movement.

14. In a knitting machine, in combination, a needle bed, a series of needles on said bed, a sinker bed, a yarn guide disposed at a given point along said beds, a yarn feed, said yarn feed and said beds having a relative movement in a direction longitudinal of said bed, and said yarn feed having a hook adapted to intercept yarn extending from said yarn guide and to feed it to said needles, and means including means carried by the sinker bed to rotate said yarn feed to permit said yarn to slide off said hook at a desired period in said movement.

15. In a knitting machine, in combination, a needle bed, a series of needles on said bed, a yarn guide disposed at a given point along said bed, a yarn feed, said yarn feed and said bed having a relative movement in the direction in which said series extends, said yarn feed being adapted to intercept yarn extending from said

yarn guide and to feed it to said needles, a sinker bed, sinkers movably mounted on said bed and means carried by said sinker bed in such manner as not to partake of the sinker movement, the last mentioned means being adapted to cause yarn to be released from said yarn feed at a selected period in said relative movement.

16. In a knitting machine, in combination, a sinker bed, slots in said bed, sinkers in said slots each of at least certain of said sinkers having a shank portion narrower than the depth of said slots, yarn-feeding means arranged for the interception of suitably positioned yarn and for the release of intercepted yarn therefrom, and means to control at least one of the positioning and releasing means and comprising an additional element disposed in the unfilled portion of each of at least certain of the slots in which sinkers having narrow shank portions are disposed.

17. In a knitting machine, in combination, a needle bed, a series of needles on said bed, a sinker bed having slots therein, sinkers in said slots, each of at least certain of said sinkers having shank portions narrower than the depth of said slots, yarn-feeding means, and means to determine the yarn-feeding action of said yarn-feeding means, said determining means comprising at least one element disposed in the unfilled portion of at least one of said slots containing sinkers having narrow shanks.

18. In a knitting machine, in combination, a series of needles, a series of sinkers, a sinker cam ring, means to feed yarn into position to be received by said needles, means to determine the commencement and termination of said feeding actions, and means including means carried by said sinker cam ring for controlling the action of said determining means.

19. In a knitting machine, in combination, a needle bed, a series of needles on said bed, a yarn guide disposed at a given point along said bed, yarn-feeding means adapted to intercept yarn extending from said yarn guide and to feed it to certain of said needles, said yarn-feeding means being so arranged that yarn intercepted thereby may be released therefrom, and selectively-operated means to control the release of yarn by said yarn-feeding means.

20. In a knitting machine, in combination, a needle bed, a series of needles on said bed, a yarn guide disposed at a given point along said bed, yarn-feeding means adapted to intercept yarn extending from said yarn guide and to feed it to certain of said needles, said yarn-feeding means being so arranged that yarn intercepted thereby may be released therefrom, means movable into the path of movement of a portion of said yarn-feeding means to cause the release of yarn intercepted thereby, and means to selectively control the movement of said release-causing means.

21. A knitting machine comprising a needle bed, a series of needles on said bed, means to deliver yarn to the needles and to cause it to be received by selected ones of the needles, the last-mentioned means being operative in such manner that at certain periods in the operation of the machine certain yarn will be held by a needle at one point along said bed and will be held by another element at another point spaced along said bed, and said last-mentioned means including means to advance and retract needles, and means to hold said certain yarn away from the

needles during the advancement thereof when said certain yarn is not to be received by said needles.

22. In a knitting machine, in combination, a needle bed, a series of needles on said bed, means to feed primary yarn to said needles, said feeding means and said bed being mounted for relative movement in the direction in which said series extends, means to cause at least certain of said needles to receive yarn from said feeding means, a yarn guide at a given point on said bed, auxiliary feeding means to feed yarn from said yarn guide to some of said needles, means to cause selected ones of said needles to receive yarn from said auxiliary feeding means and operative at least at certain times to cause yarn to be received only by certain of said needles, said certain of said needles being spaced from said yarn guide, and means to prevent yarn from said yarn guide from being received by any of said needles at the time when yarn is being received thereby from the first-mentioned feeding means regardless of which needles have received yarn from said auxiliary feeding means.

23. In a knitting machine, in combination, a needle bed, a series of needles on said bed, means to feed primary yarn to said needles, said feeding means and said bed being mounted for relative movement in the direction in which said series extends, means to cause at least certain of said needles to receive yarn from said feeding means, a yarn guide at a given point on said bed, auxiliary feeding means to feed yarn from said yarn guide to some of said needles, means to cause selected ones of said needles to receive yarn from said auxiliary feeding means and operative at least at certain times to cause yarn to be received only by certain of said needles, said certain of said needles being spaced from said yarn guide, and means to cause the uncaught portion of the auxiliary yarn which extends from said certain of said needles to extend in a direction away from said bed when any needle between said point and said certain of said needles is receiving yarn from the first-mentioned feeding means.

24. In a knitting machine, in combination, a needle bed, a series of needles on said bed, means to feed primary yarn to said needles, said feeding means and said bed being mounted for relative movement in the direction in which said series extends, means to cause at least certain of said needles to receive yarn from said feeding means, a yarn guide at a given point on said bed, auxiliary feeding means to feed yarn from said yarn guide to some of said needles, means to cause selected ones of said needles to receive yarn from said auxiliary feeding means and operative at least at certain times to cause yarn to be received only by certain of said needles, said certain of said needles being spaced from said yarn guide, and means to cause the uncaught portion of the auxiliary yarn which extends from said certain of said needles to extend substantially directly outwardly from the needles when one or more needles intermediate said point and said certain of said needles are receiving yarn from the first-mentioned feeding means.

25. A knitting machine comprising a series of needles, means to feed yarn to said series of needles, means to position other yarn for reception by at least certain of a limited group of said needles, means to advance and retract said needles for the incorporation of the first-mentioned yarn and said other yarn in a fabric, and means to hold said other yarn away from the

needles during the advancement thereof for the reception of the first-mentioned yarn.

26. A circular knitting machine, comprising a needle bed, a series of needles on said bed, actuator means, said bed and said actuator means being arranged for relative rotation in a given direction, means including part of said actuator means to manipulate said needles, yarn-feeding means adapted to cause a portion of a yarn to extend in said direction and to be disposed in position to be received by needles of a group of said needles while the same are selectively manipulated by said manipulating means so as to cause said yarn to be received by at least certain of the needles of said group, and means to cause a further portion of said yarn to be received by at least certain of the needles of said group while extending in the opposite direction and to cause the extent of said yarn from the last needle by which it was received when extending in the first-mentioned direction to the rearward one of the needles by which it is received when extending in said opposite direction to be markedly longer than the distance between said needles.
27. In a knitting machine, in combination, a needle bed, a series of needles on said bed, yarn-guiding means disposed generally outwardly of said bed, a series of sinkers, means to cause a portion of a yarn from said yarn-guiding means to extend in one direction and to be received by at least certain of a group of said needles, means thereafter to cause a portion of yarn to extend in the opposite direction and to lie in front of said sinkers, and means including said sinkers to cause the last-mentioned portion of said yarn to be received by said needles.

28. In a knitting machine, in combination, a series of needles, yarn-guiding means, a plurality of sinkers, means including said sinkers to cause yarn from said yarn-guiding means to be received by said needles, each of said sinkers having a forward hook and a rearward hook, and means to control the disposition of yarn from said yarn-guiding means so that it will lie either in front of the forward hooks or at the rear of the rearward hooks of certain sinkers at different stages in the operation of the machine.

29. A knitting machine comprising a needle bed, a series of needles on said bed, a sinker bed, sinkers on said sinker bed, and sinker-operating means comprising sinker cam means movable only in one direction with respect to said beds and other sinker cam means movable only in the opposite direction.

30. A knitting machine comprising a needle bed, a series of needles on said bed, a plurality of yarn guides, means to feed yarn from selected ones of said yarn guides to suitable ones of said needles, a plurality of tripper elements, means adapted to be operated by selected tripper elements to cause yarn to be released from said feeding means, and pattern-control means to select said yarn guides and said tripper elements.

31. In a knitting machine, in combination, a needle bed, a series of needles on said bed, a yarn guide, yarn feeding means, and needle-actuating mechanism, said bed and said yarn-guide on the one hand and said yarn-feeding means and said needle-actuating mechanism on the other hand being mounted for relative movement, said yarn-feeding means comprising means adapted to intercept yarn extending from said yarn guide and to feed it into position to be received by a group of said needles and also comprising means adapted to thereafter inter-

cept the yarn extending from said yarn guide and to dispose the same in a desired position, said needle-actuating mechanism being adapted to cause desired ones of the needles of said group to receive yarn from the first mentioned intercepting and feeding means, and means including said feeding means and said needle-actuating mechanism to cause said yarn to extend back and forth and to be caught into the fabric on both its forward and return conformations at least at certain portions of the fabric formed on said machine.

32. In a knitting machine, in combination, a needle bed, a series of needles on said bed, a yarn guide disposed at a given point along said bed, a yarn feed, said yarn feed and said bed having relative movement in the direction in which said series extends, and said yarn feed having a hook adapted to intercept yarn extending from said yarn guide and to feed it to said needles, and means to turn said yarn feed to permit said yarn to slide off said hook at a desired period in said movement.

33. A yarn feed for knitting machines comprising a member adapted to move relatively to a yarn guide and having a hook adapted to intercept a yarn extending from the yarn guide, said yarn feed being rotatable to permit the yarn to slide off said hook when a desired length of said yarn has been drawn out.

34. A circular knitting machine comprising a needle bed, needles on said bed, yarn-feeding means, said yarn-feeding means and said bed being mounted for relative rotation, a yarn guide, means forming a unit with said bed in said relative rotation and providing a support for said yarn guide, and means including said yarn-feeding means to cause yarn from said yarn guide and another yarn to be fed together into position to be received by needles on only a portion of said bed and to cause only said other yarn to be fed into position to be received by needles on the remainder of said bed.

35. A circular knitting machine comprising a needle bed, needles on said bed, primary-yarn feeding means, said primary-yarn feeding means and said bed being mounted for relative rotation, needle-manipulating means forming a unit with said primary-yarn feeding means in said relative rotation, a yarn guide, means forming a unit with said needle bed in said relative rotation and providing a support for said yarn guide, auxiliary-yarn feeding means associated with said primary-yarn feeding means and adapted when a yarn from said yarn guide is held thereby to feed the same to the needles at the same time that primary yarn is fed to the needles by the primary-yarn feeding means, means including the needle manipulating means to cause both yarns to knit, and means to cause auxiliary yarn to be received by said auxiliary-yarn feeding means at one or more points during a single relative rotation and to be released from said auxiliary yarn feeding means at one or more successive points in each relative rotation.

36. A circular knitting machine comprising a needle bed, needles on said bed, yarn-feeding means, said yarn-feeding means and said bed being mounted for relative rotation, mounting means forming a unit with said bed in said relative rotation, yarn-guiding means carried by said mounting means, means including said yarn-feeding means and said yarn-guiding means to cause two yarns to be fed together into position to be received by needles on only a portion of

said bed and to cause only one of said yarns to be fed into position to be received by needles on the remainder of said bed, the last mentioned means being arranged to cause the other of said yarns to be fed in plating relation to said one of said yarns.

37. A circular knitting machine comprising a needle bed, needles on said bed, yarn-feeding means, said yarn-feeding means and said bed being mounted for relative rotation, mounting means forming a unit with said bed in said relative rotation, a yarn guide carried by said mounting means, means including said yarn feeding means to cause yarn from said yarn guide and another yarn to be fed together into position to be received by needles on only a portion of said bed and to cause only said other yarn to be fed into position to be received by needles on the remainder of said bed, means to cause knitted loops of the latter of said yarns to be formed, and means to cause longer loops to be formed of the yarn from said yarn guide.

38. In a knitting machine, in combination, a needle cylinder, needles on said cylinder, yarn-feeding means, said cylinder and said yarn-feeding means being relatively rotatively mounted, means to supply yarn to said yarn-feeding means, yarn-guiding means disposed near the upper end of said cylinder, means to cause yarn from said yarn-guiding means to be received by certain of said needles, means to supply yarn to yarn-guiding means from above the same, means to supply yarn to yarn-guiding means from a lower point, the last-mentioned means being arranged to conduct yarn from a point at the rear of said needles to a point in front of said needles and means to supply yarn to yarn-guiding means from a point below and outside of said yarn-guiding means.

39. In a knitting machine, in combination, a needle cylinder, needles thereon, yarn-feeding means, means to supply yarn to said yarn-feeding means from an interior point, means including yarn-guiding means to cause an auxiliary yarn to be received by selected ones of a group of said needles, means to impart reciprocating movement to said yarn-guiding means, and means to supply yarn to said yarn-guiding means from an exterior point; said cylinder and said yarn-guiding means and the last-mentioned yarn-supply means on the one hand, and said yarn-feeding means and said reciprocation-imparting means and the first-mentioned yarn-supply means on the other hand, being mounted for relative movement.

40. In a knitting machine, in combination, a needle cylinder, needles thereon, yarn-feeding means, means to supply yarn to said yarn-feeding means, means including yarn-guiding means to cause an auxiliary yarn to be received by certain ones of said needles, a sinker bed, and means above said sinker bed to supply yarn to said yarn-guiding means; said cylinder and said sinker bed and said yarn-guiding means and the last-mentioned yarn supply means on the one hand, and said yarn-feeding means and the first-mentioned yarn supply means on the other hand being mounted for relative movement.

41. In a knitting machine, in combination, a bed, slots in said bed, elements slidably mounted in said slots, a yarn guide disposed at a given point along said bed, and means comprising an opening in said bed intermediate two adjacent ones of said elements to supply yarn to said yarn guide.

42. In a knitting machine, in combination, a

needle cylinder, a series of independent needles on said cylinder, a yarn guide, and means whereby a yarn to be supplied to said yarn guide may extend between a pair of adjacent needles.

43. In a knitting machine, in combination, a needle bed, slots in said bed, needles slidably mounted in said slots, a yarn guide disposed at a given point along said bed, means to cause the needles to slide a given distance in said slots, said cylinder being formed with a yarn-supply opening including a portion of each of a pair of adjacent ones of said slots and the space therebetween, the shanks of the needles in said pair of slots having outwardly-bent portions which diverge sufficiently to permit a yarn extending thru said opening to move freely toward said yarn guide, the length of said outwardly-bent portions being greater than the extent of sliding movement imparted to said needles.

44. A circular knitting machine comprising a circular needle bed, a series of needles on said bed, means to cause a primary yarn to be received and knit by said needles, means to cause an auxiliary yarn to be received by certain of a group of said needles while the auxiliary yarn extends in one direction and thereafter to be received by certain of a group of said needles while the auxiliary yarn extends in the opposite direction, said groups having at least certain needles in common, and means including the aforesaid means to cause said auxiliary yarn to be incorporated in the fabric without knitting.

45. A circular knitting machine comprising a needle bed, a series of needles on said bed, means to feed primary yarn into position to be received by said needles, means to thereafter dispose an extent of auxiliary yarn in position to be received by a group of said needles, means to thereafter feed primary yarn into position to be received by said needles, and means to thereafter dispose an opposite extent of auxiliary yarn in position to be received by a group of said needles having at least certain needles in common with the first-mentioned group of needles, and means to manipulate said needles to cause desired ones thereof to receive said yarns when in position to be received thereby.

46. A circular knitting machine comprising a bed, a circular series of knitting instrumentalities slidably mounted on said bed, operating means, said operating means and said bed being mounted for relative rotative movement, cam means for said instrumentalities, said cam means forming a part of said operating means, and further cam means, there being relative rotation between each of the three elements consisting of said bed the first mentioned cam means and said further cam means and each of the others of said elements, said further cam means being movable laterally of said instrumentalities so as to be operative thereon only at certain periods of their rotation.

47. In a knitting machine, in combination, a needle bed, a series of independent needles on said bed, a yarn guide mounted generally outwardly of said needle bed and movable between a plurality of positions, means movable in a path disposed outwardly of said needles to draw out yarn from said yarn guide when the same is in one of said positions but not when it is in another thereof, and means to cause the drawn-out yarn to be received by certain ones of said needles.

48. A knitting machine comprising a needle bed, a series of needles on said bed, yarn-guiding

means, means movable along said bed and including a swingable element adapted to intercept yarn extending from said yarn-guiding means and to feed it to certain of said needles, and means to swing said swingable element to permit yarn to slip off the same at a desired point in the movement of the intercepting-and-feeding means.

49. A knitting machine comprising a needle bed, a series of needles on said bed, needle-manipulating means, said needle-manipulating means and said bed being mounted for relative movement in a direction in which said series extends, yarn-guiding means arranged to form a unit with said bed in said relative movement, means forming a unit with said manipulating means in said relative movement and adapted to intercept yarn from said yarn-guiding means to control the delivery thereof to certain of said needles and operable to release said yarn, a second bed arranged to form a unit with said needle bed in said relative movement, elements movably carried by said second bed and adapted when moved in one manner to cause the release of yarn by said intercepting means, and means to selectively control the movement of said movably-carried elements.

50. A circular knitting machine comprising a needle cylinder, needles on said cylinder, an exteriorly disposed support, needle-manipulating means, said needle-manipulating means on the one hand and said cylinder and said support on the other hand being mounted for relative rotative movement, a yarn-guiding element constructed and arranged to pay out a yarn, a yarn-guide operating element mounted for radial sliding movement on said support, means to cause radial movement to be imparted to said operat-

ing element, and means to cause said yarn to be fed to a plurality of said needles pursuant to said radial movement.

51. A circular knitting machine comprising a needle cylinder, needles on said cylinder, an exteriorly-disposed support, main-yarn feeding means, said main-yarn feeding means on the one hand and said cylinder and said support on the other hand being mounted for relative rotative movement, a yarn-guiding element supported from said support and constructed and arranged to pay out an auxiliary yarn, yarn-guide operating means mounted for radial sliding movement on said support, means to impart radial movement to said operating means, and means to cause said auxiliary yarn to be fed to a plurality of said needles pursuant to said radial movement.

52. A circular knitting machine comprising a needle cylinder, needles on said cylinder, an exteriorly-disposed support, needle manipulating means, said needle manipulating means on the one hand and said cylinder and said support on the other hand being mounted for relative rotative movement, means mounted for radial sliding movement on said support and comprising a yarn-guiding portion constructed and arranged to pay out a yarn and an operating portion, selective means operable on said operating portion, means responsive to the operation of said selective means to impart radial sliding movement to said slidable means, and means operative upon the radial movement of said slidable means to feed a yarn from said yarn-guiding portion into position to be received by a plurality of said needles.

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