Sept. 9, 1941. F. E. JONES 2,255,693

PATTERN-PRODUCING CIRCULAR KNITTING MACHINE

Original Filed March 6, 1926 17 Sheets-Sheet 1

Fig. 1.

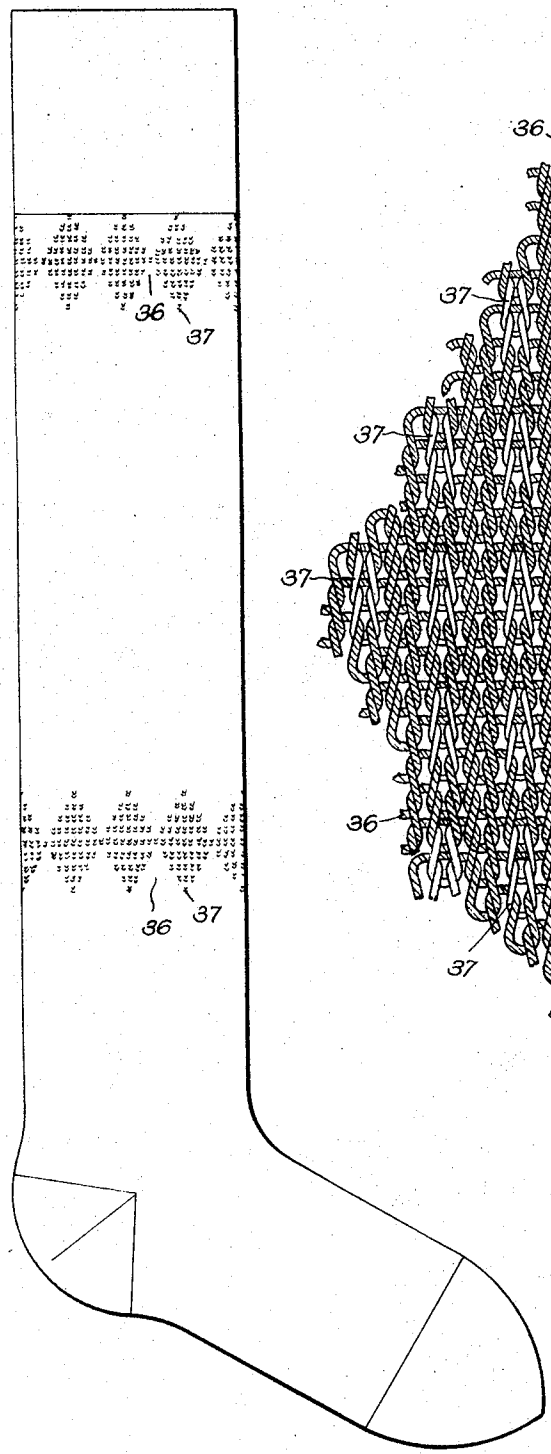
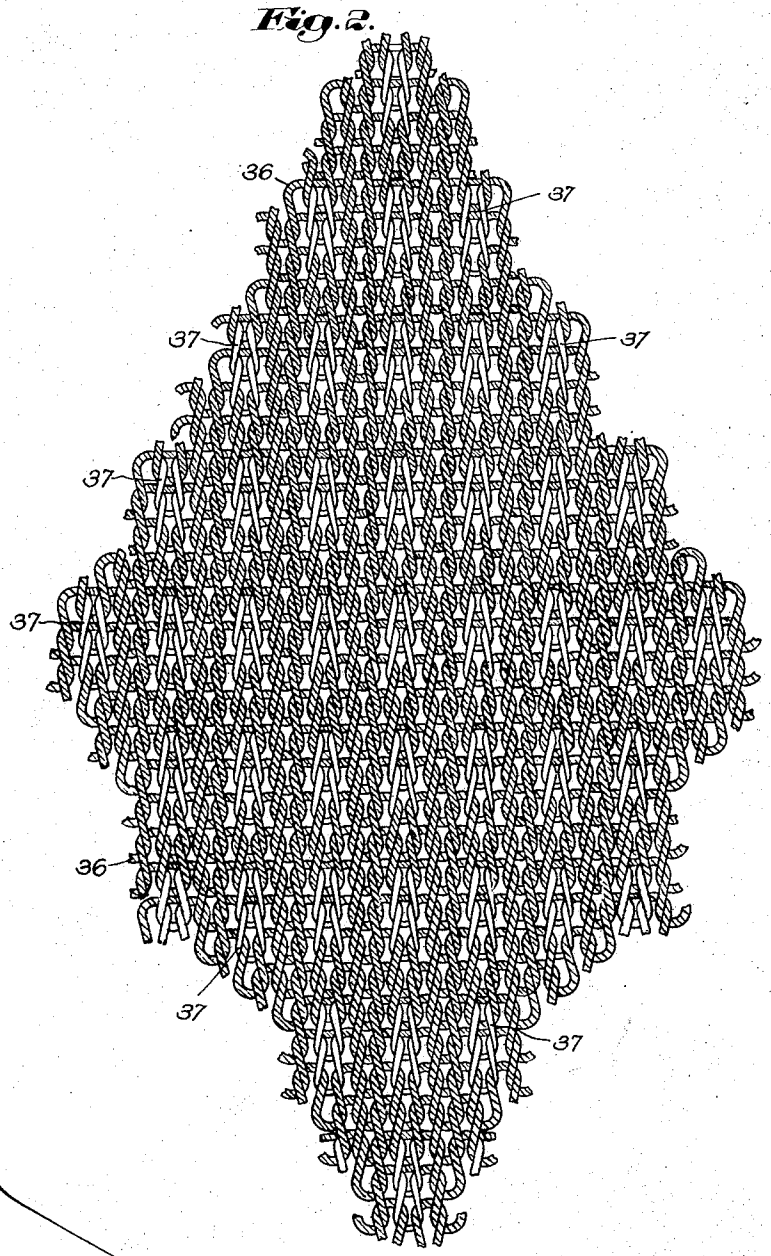


Fig. 2.



Inventor:
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Sept. 9, 1941. F. E. JONES 2,255,693

PATTERN-PRODUCING CIRCULAR KNITTING MACHINE

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Fig. 3.

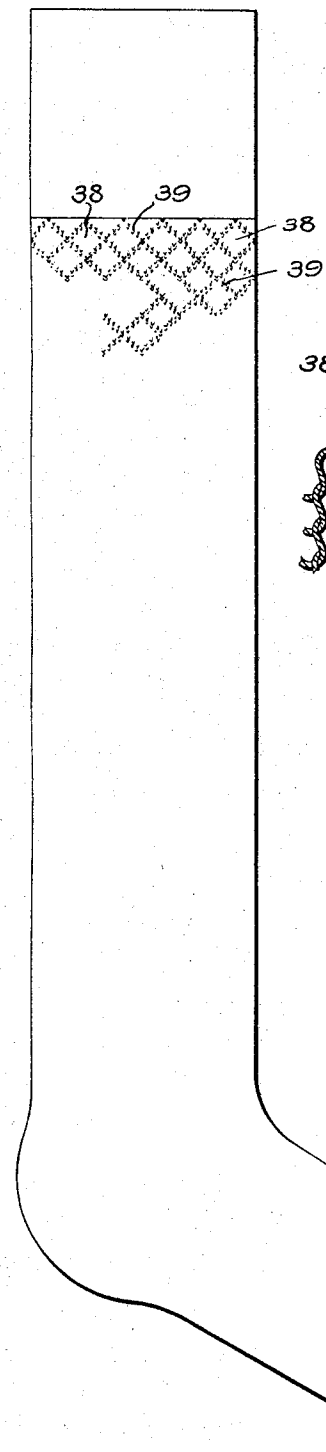
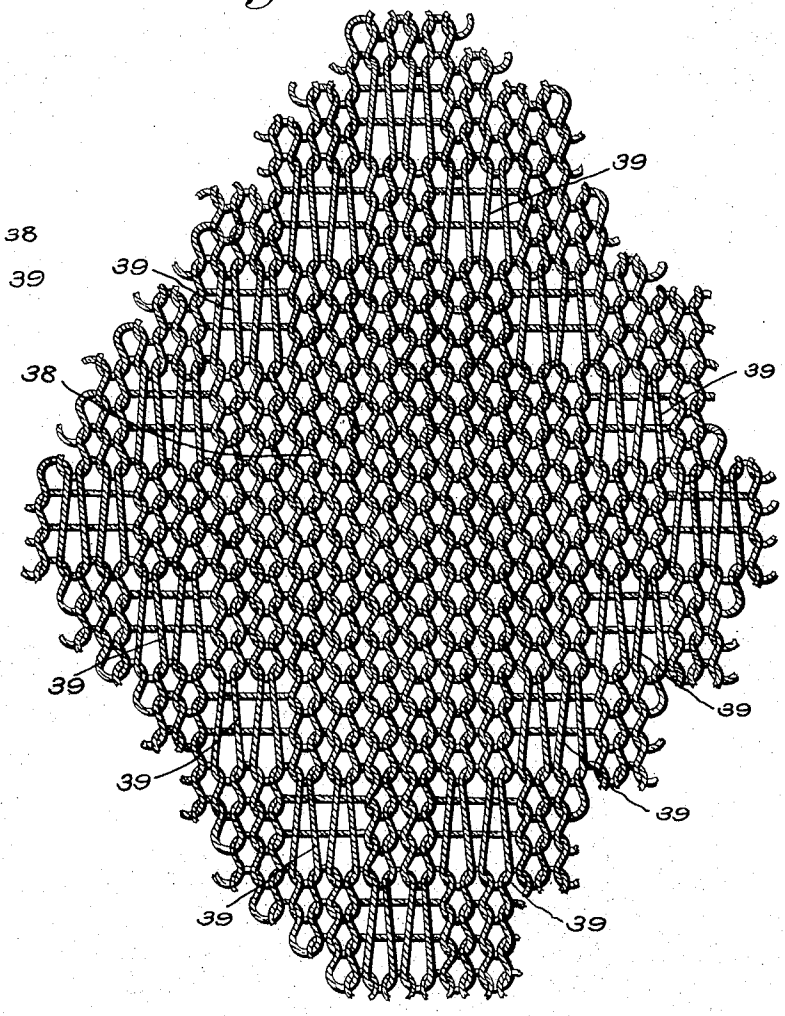


Fig. 4.



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Sept. 9, 1941. F. E. JONES 2,255,693

PATTERN-PRODUCING CIRCULAR KNITTING MACHINE

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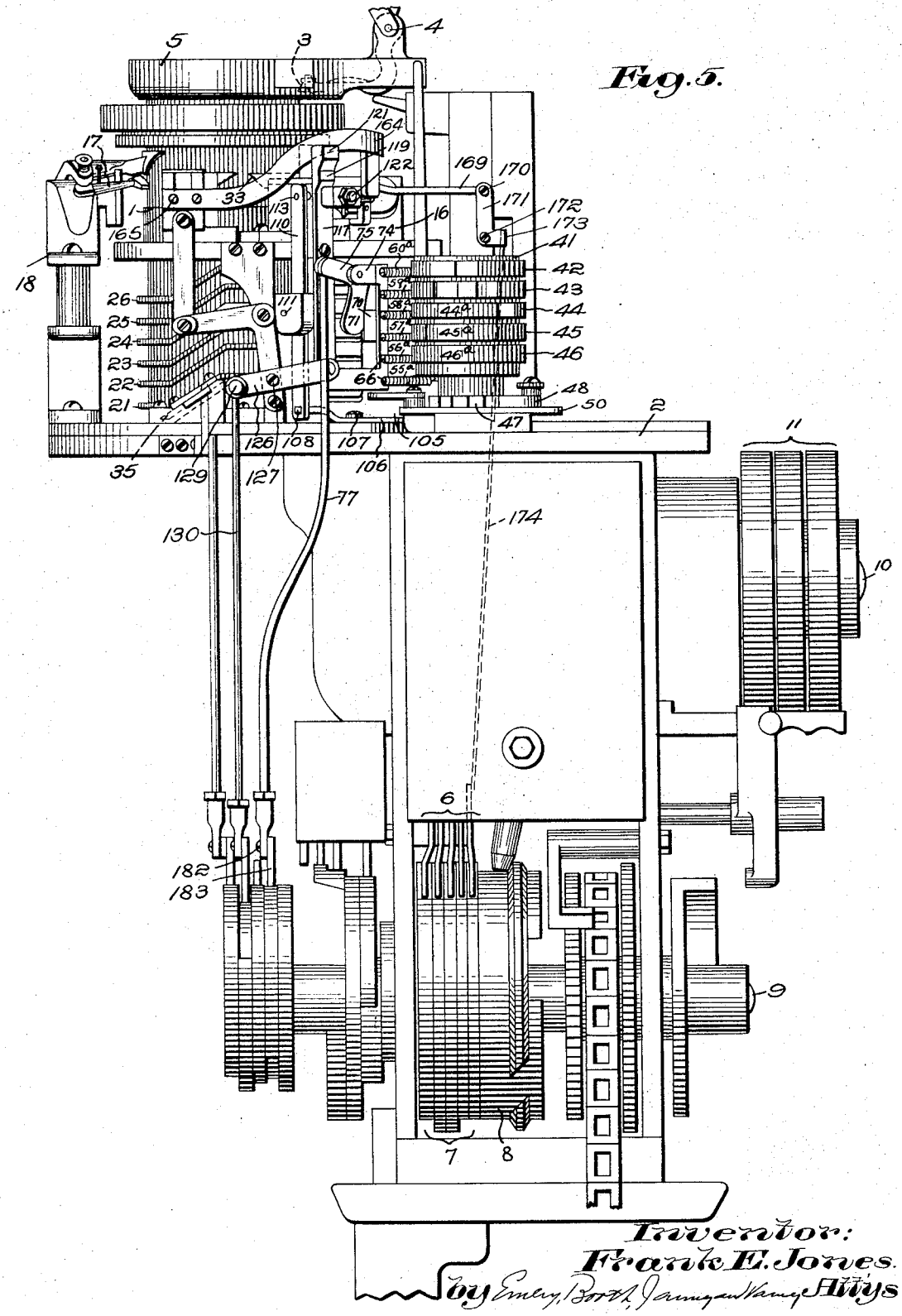
Fig. 5.



Inventor:
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By Emery, Booth, Janney & Varney Attys

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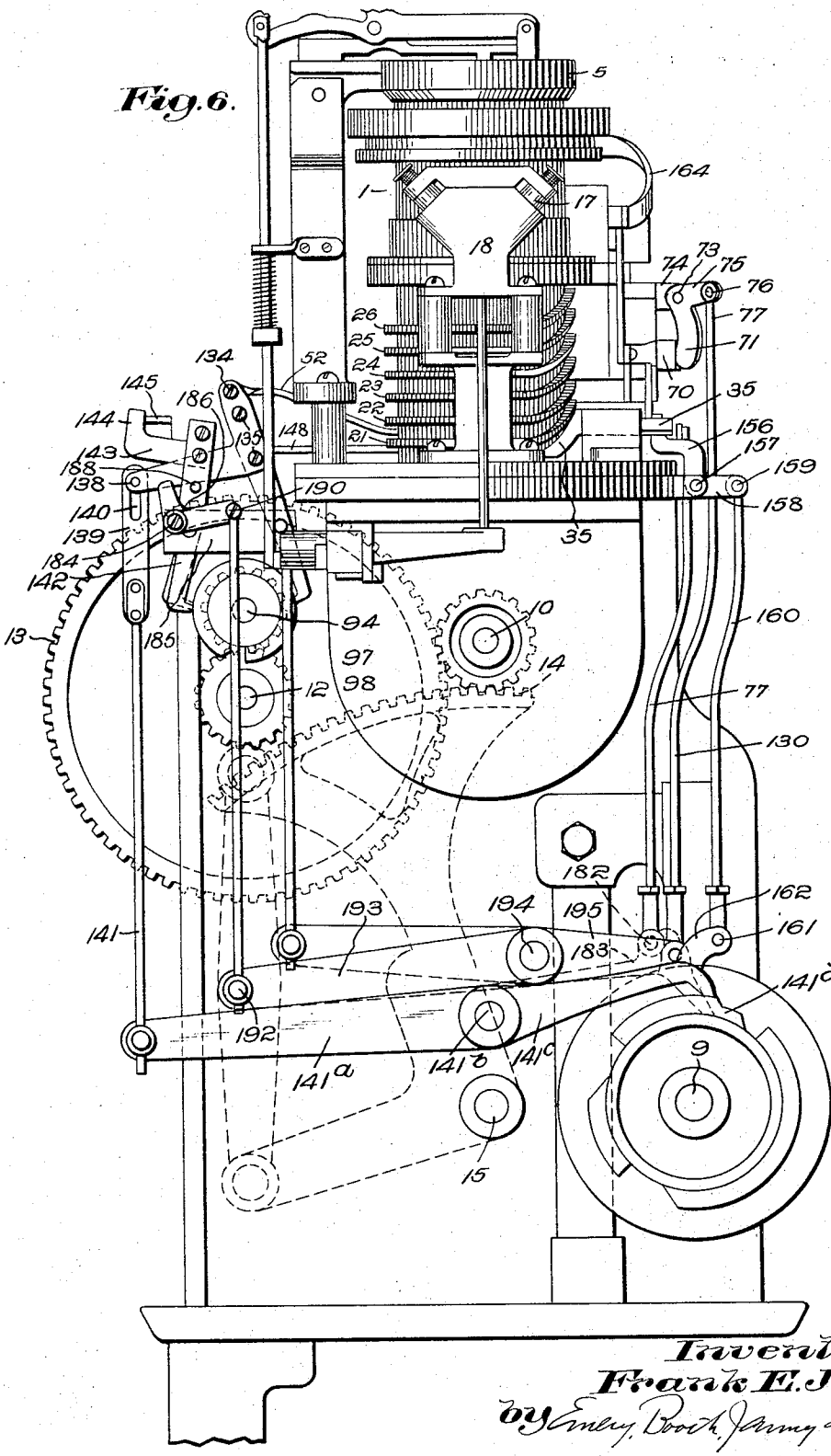
PATTERN-PRODUCING CIRCULAR KNITTING MACHINE

Original Filed March 6, 1926 17 Sheets-Sheet 4

Fig. 6.



Inventor:
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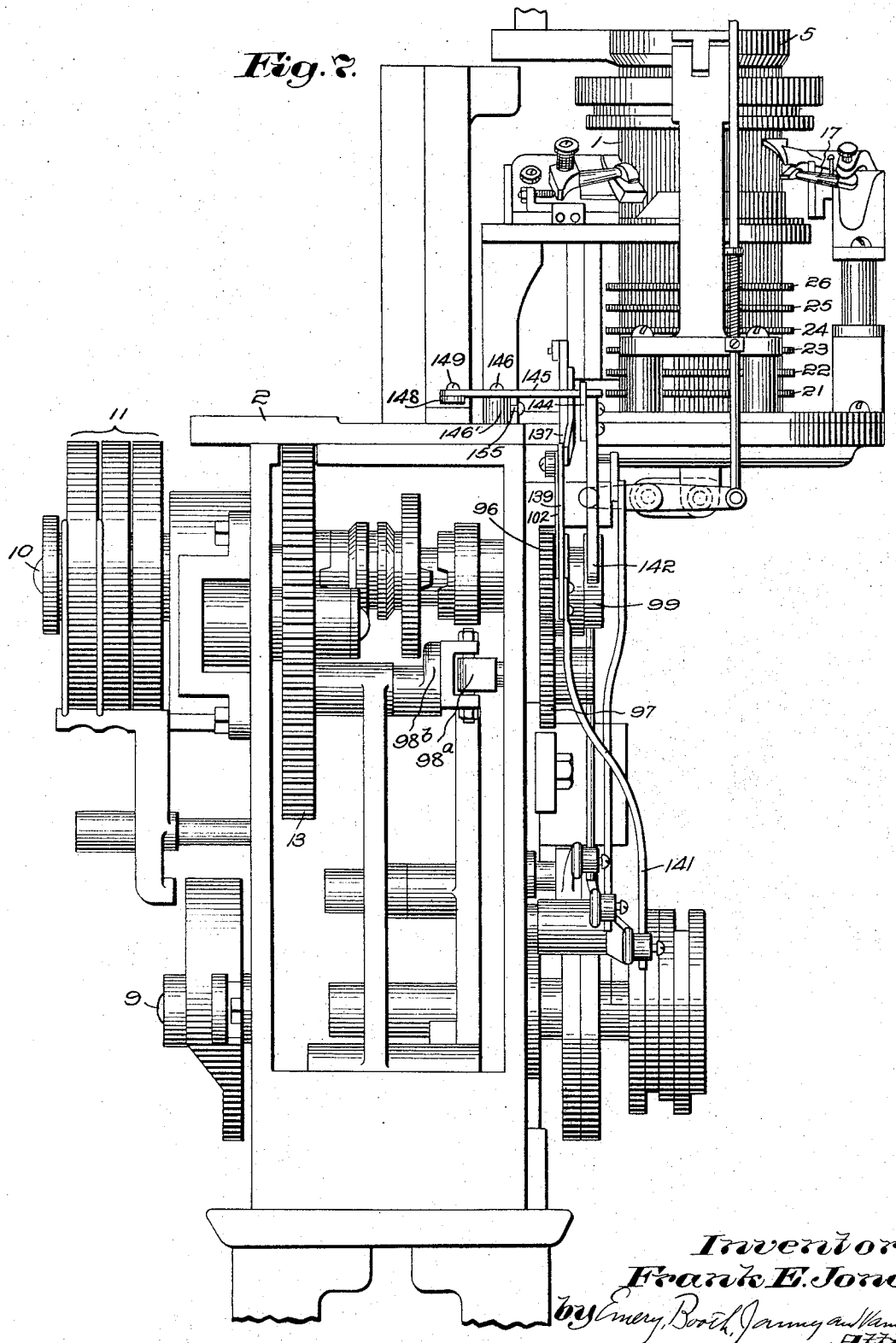
Sept. 9, 1941. F. E. JONES 2,255,693

PATTERN-PRODUCING CIRCULAR KNITTING MACHINE

Original Filed March 6, 1926 17 Sheets-Sheet 5

Fig. 2.



Inventor:
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Sept. 9, 1941. F. E. JONES 2,255,693

PATTERN-PRODUCING CIRCULAR KNITTING MACHINE

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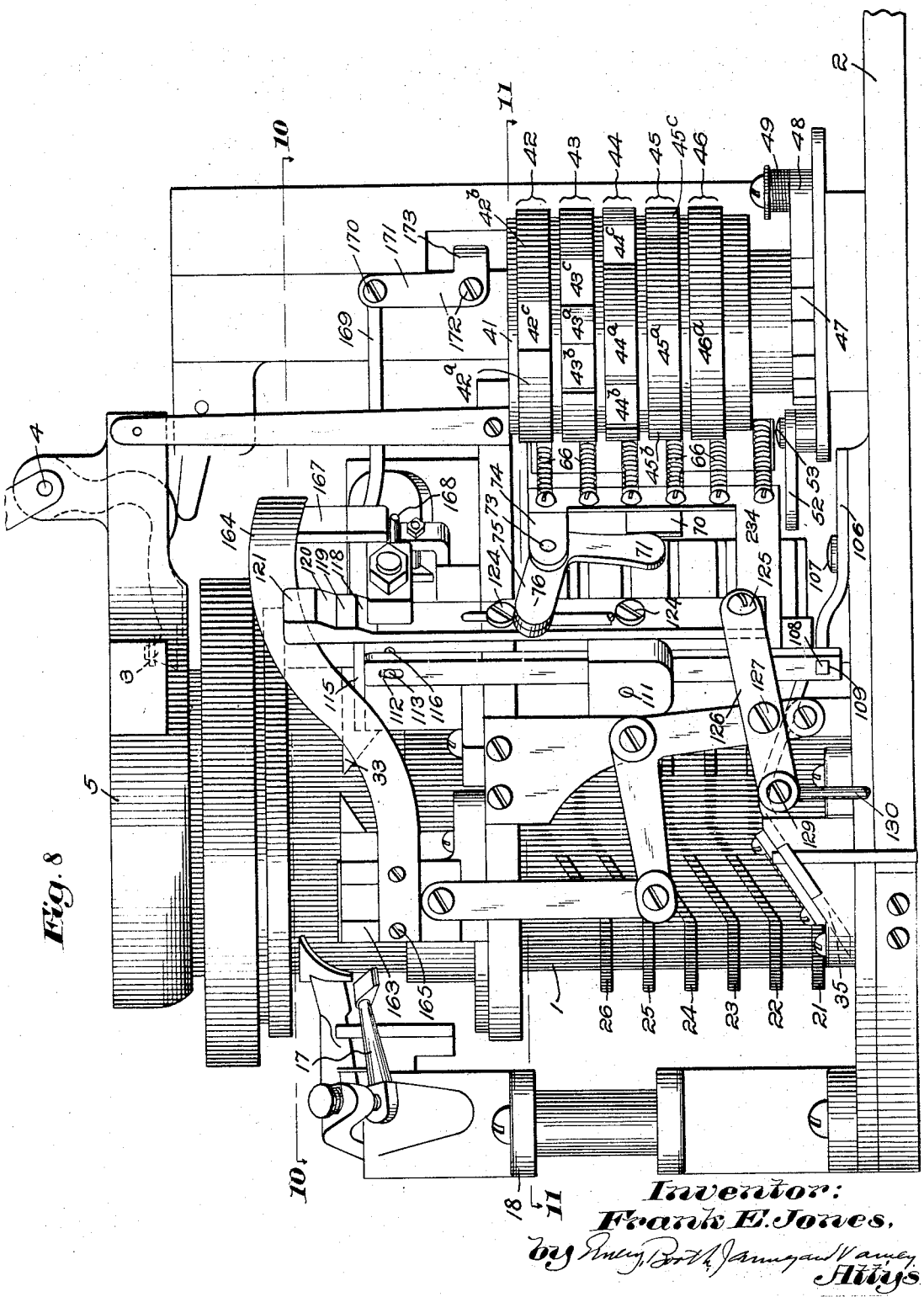

Fig. 8

Inventor:
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Sept. 9, 1941. F. E. JONES 2,255,693

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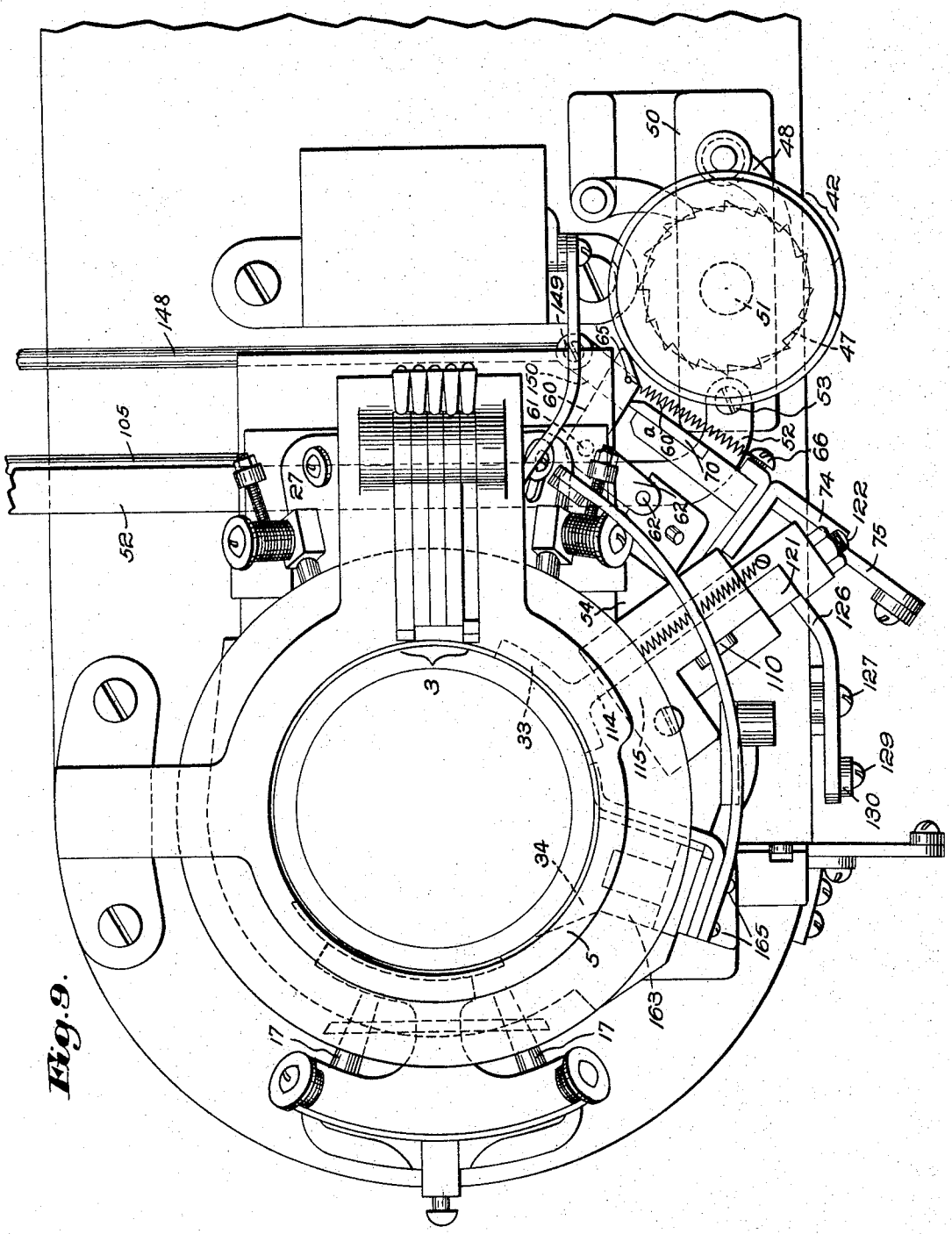

Fig. 9.

Inventor:
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Sept. 9, 1941. F. E. JONES 2,255,693

PATTERN-PRODUCING CIRCULAR KNITTING MACHINE

Original Filed March 6, 1926 17 Sheets-Sheet 8

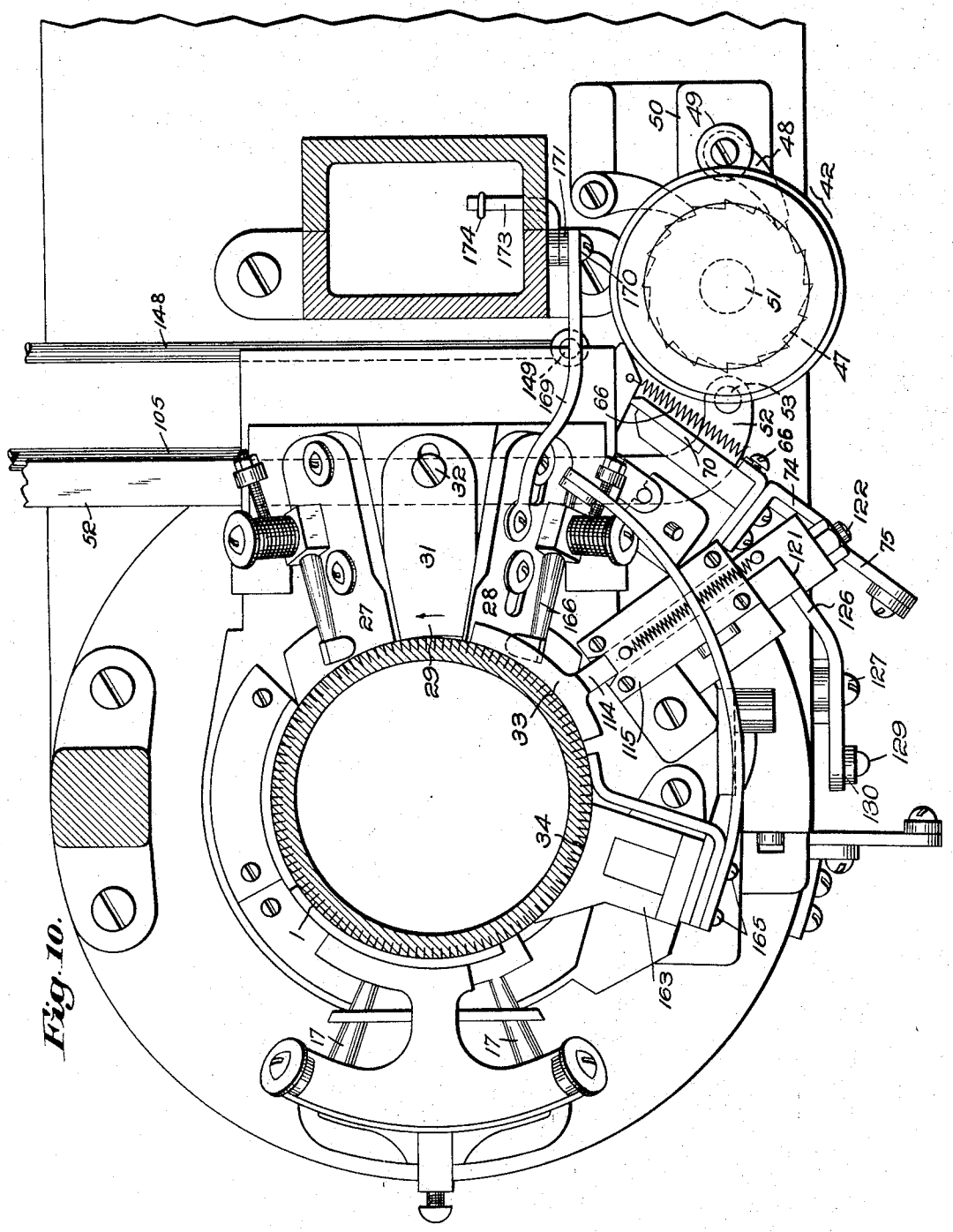

Fig. 10.

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Sept. 9, 1941. F. E. JONES 2,255,693

PATTERN-PRODUCING CIRCULAR KNITTING MACHINE

Original Filed March 6, 1926 17 Sheets-Sheet 9

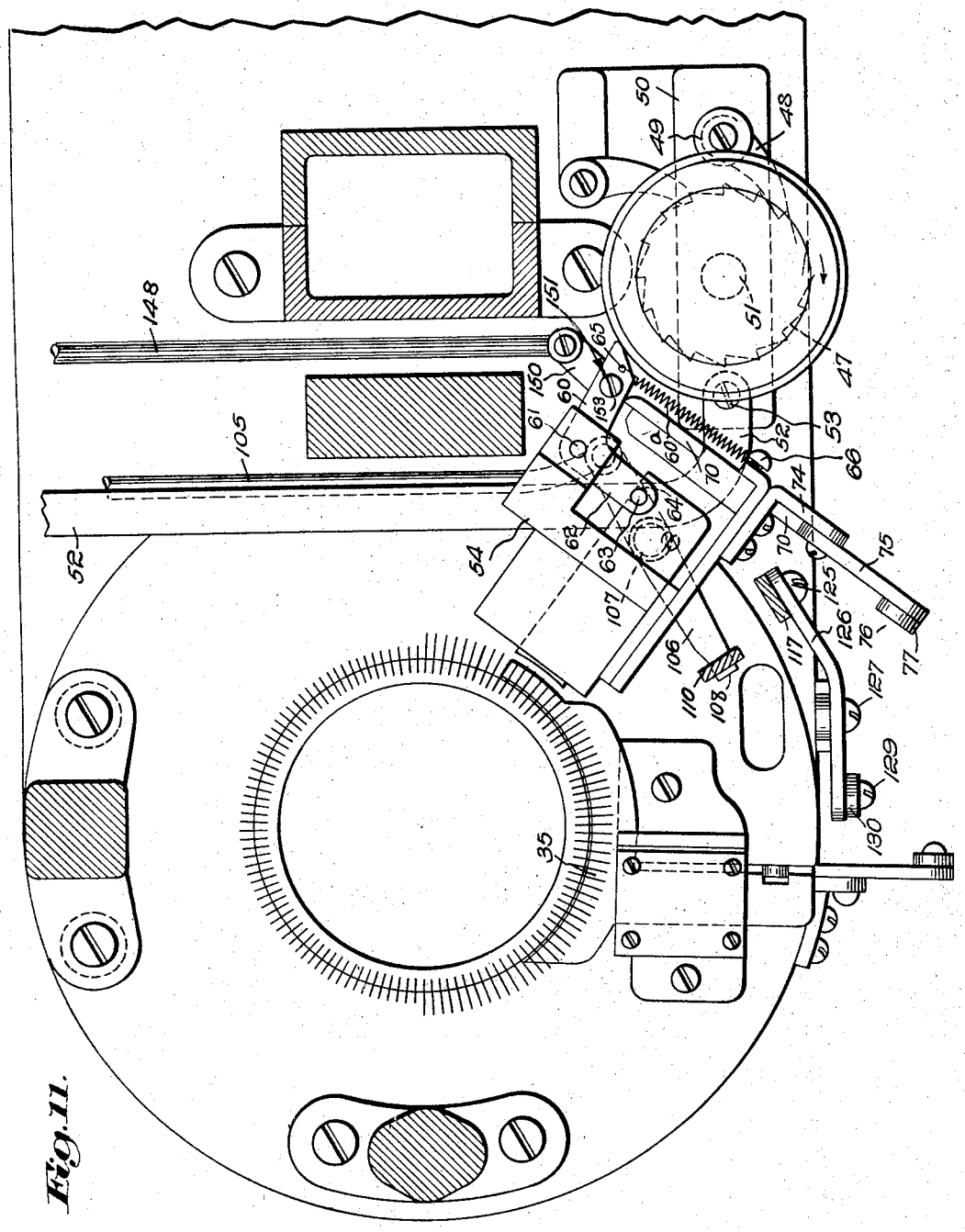

Fig. 11.

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Sept. 9, 1941. F. E. JONES 2,255,693

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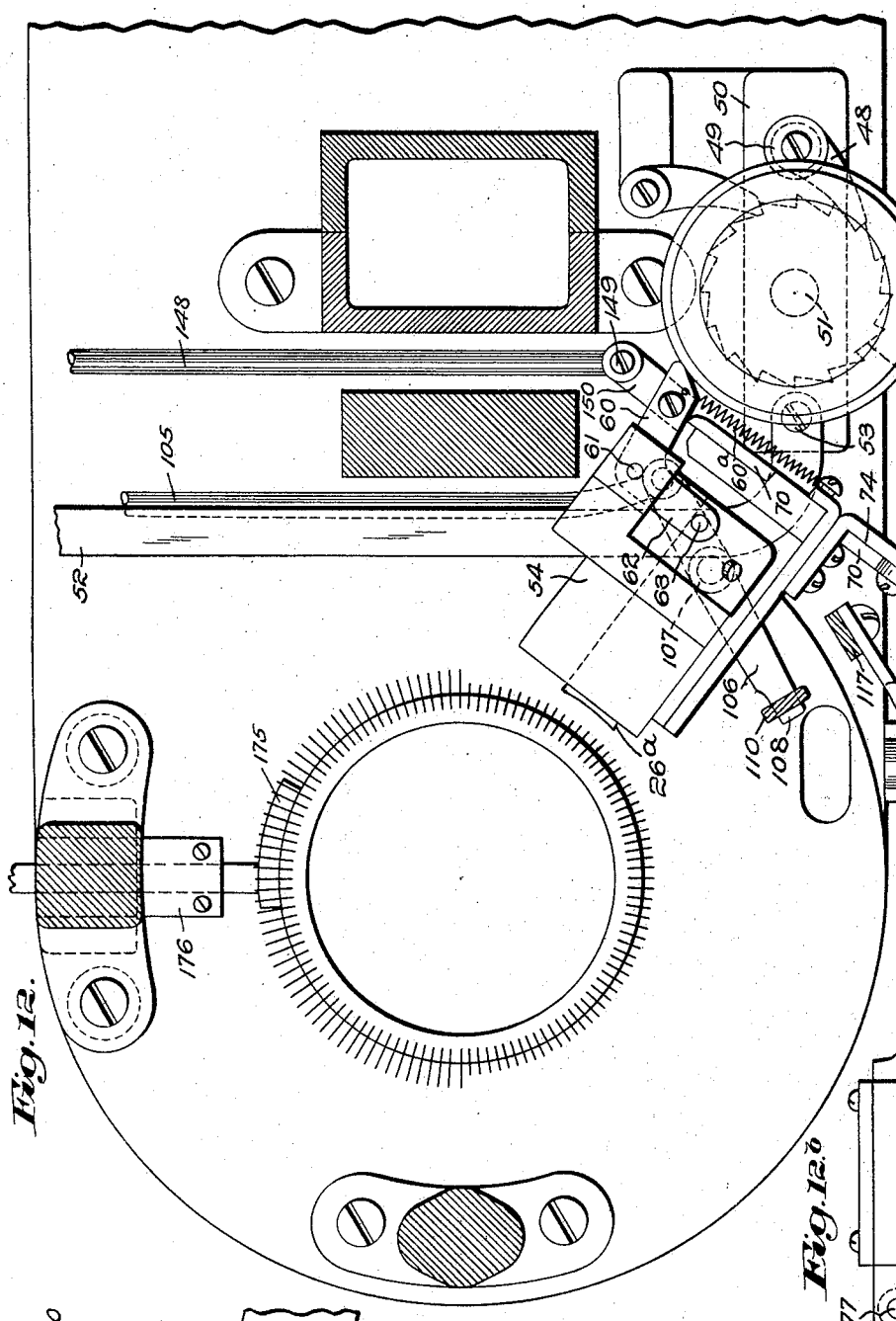

Fig. 12.

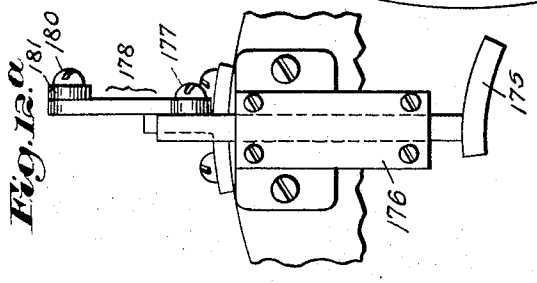

Fig. 12a.

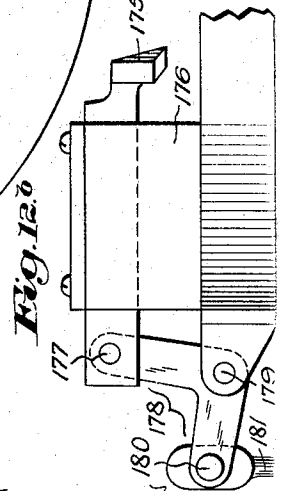

Fig. 12b.

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Sept. 9, 1941. F. E. JONES 2,255,693

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Fig. 13.

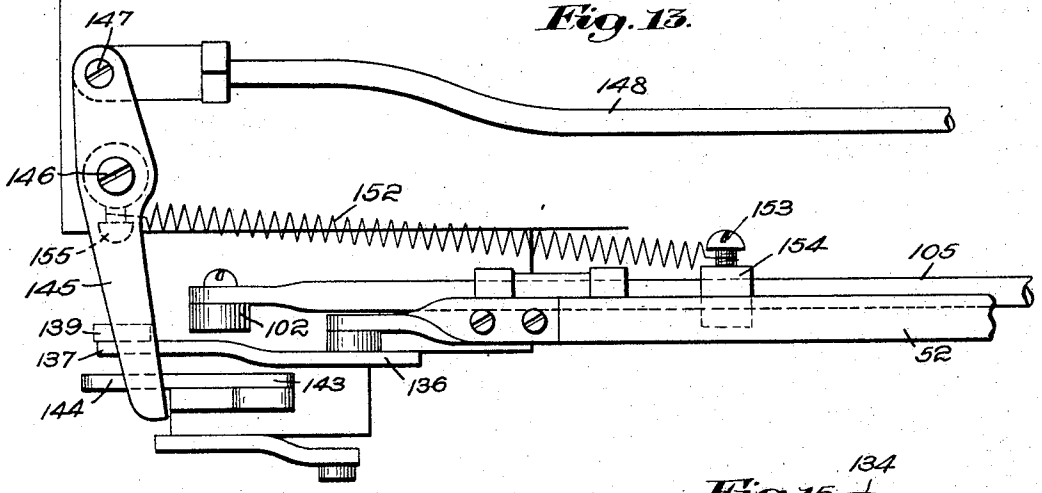


Fig. 14.

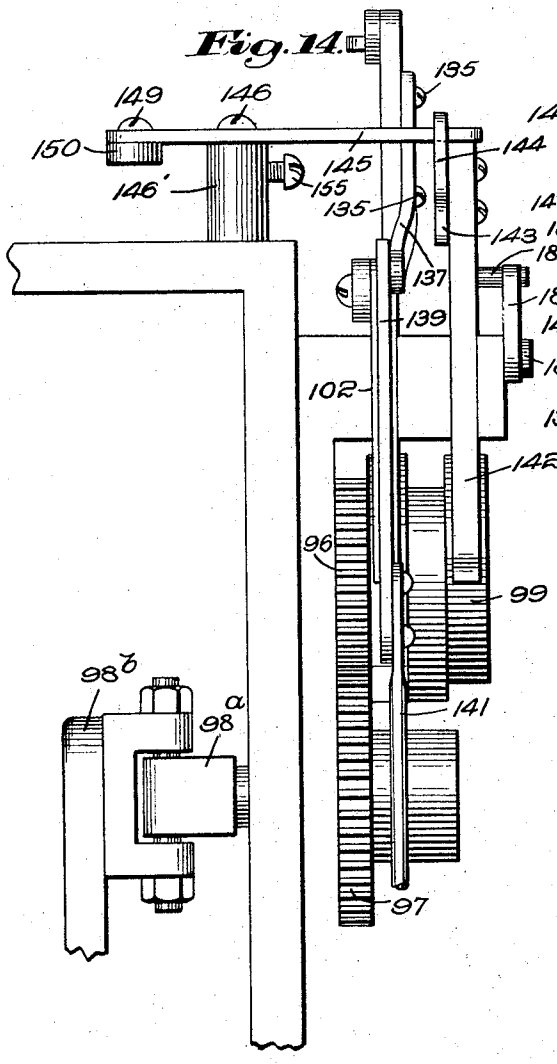
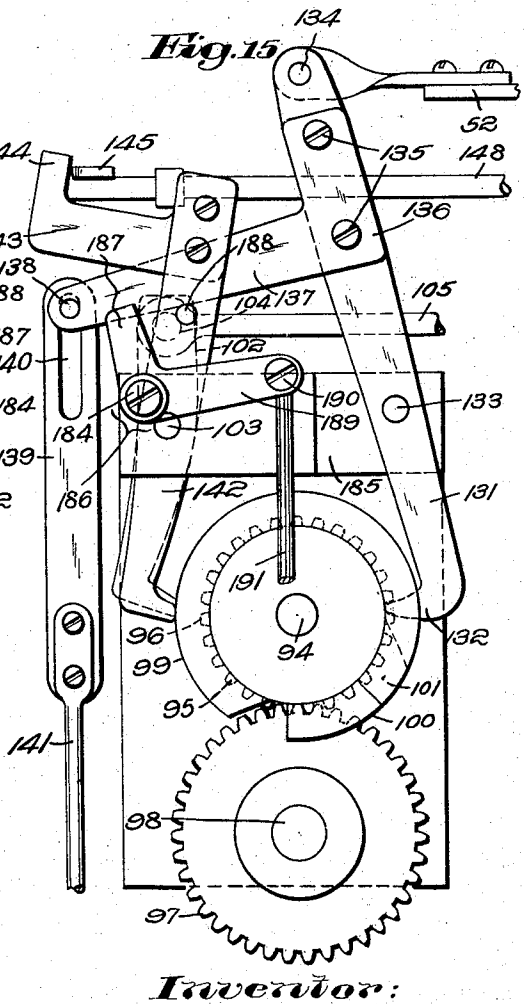


Fig. 15.



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Sept. 9, 1941. F. E. JONES 2,255,693

PATTERN-PRODUCING CIRCULAR KNITTING MACHINE

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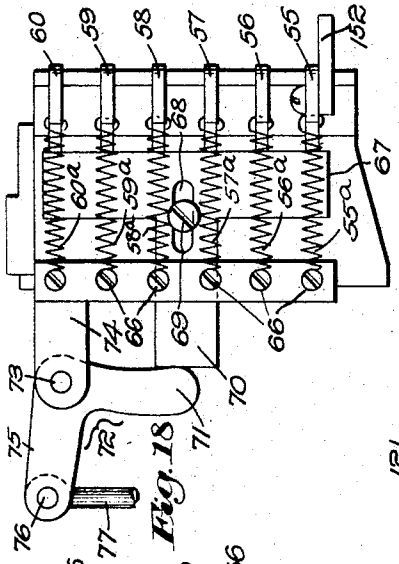

Fig. 18.

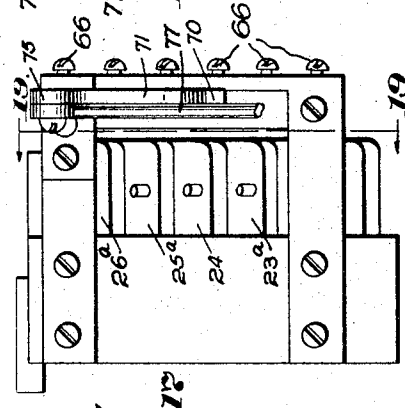

Fig. 17.

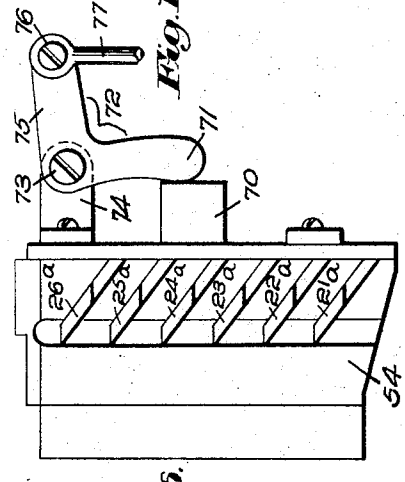

Fig. 16.

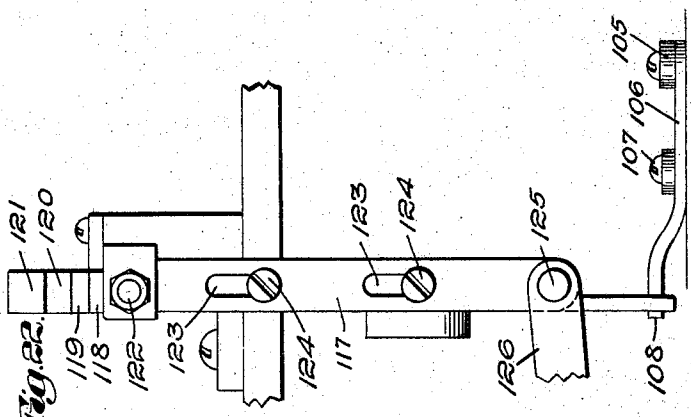

Fig. 22.

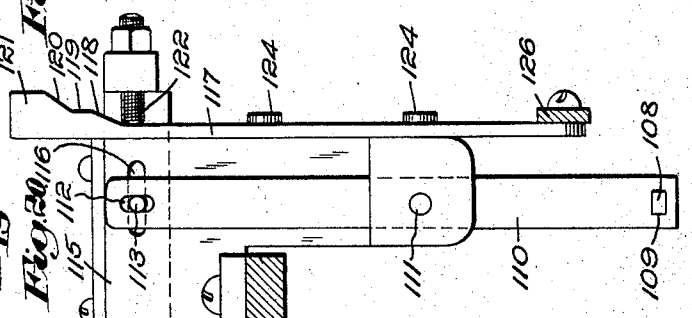

Fig. 20.

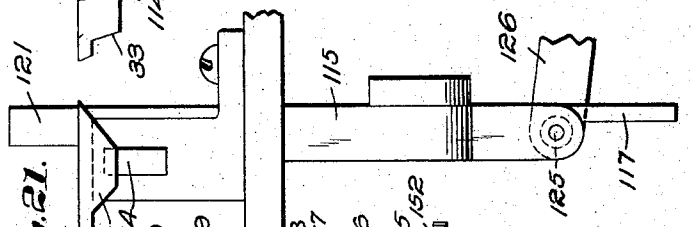

Fig. 21.

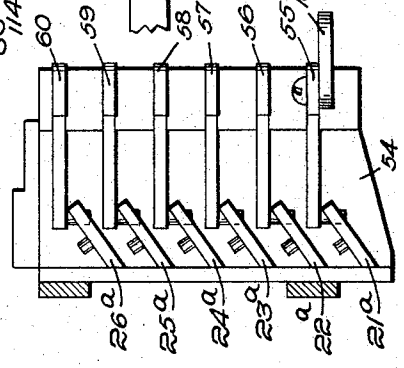

Fig. 19.

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Sept. 9, 1941. F. E. JONES 2,255,693

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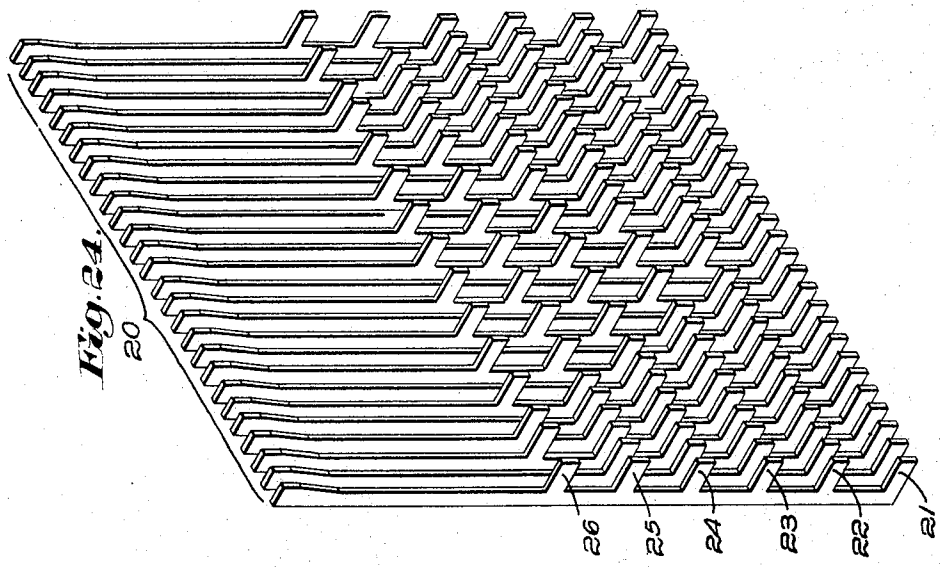

Fig. 24.

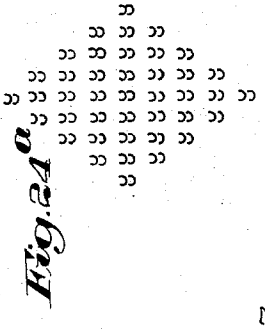

Fig. 24a

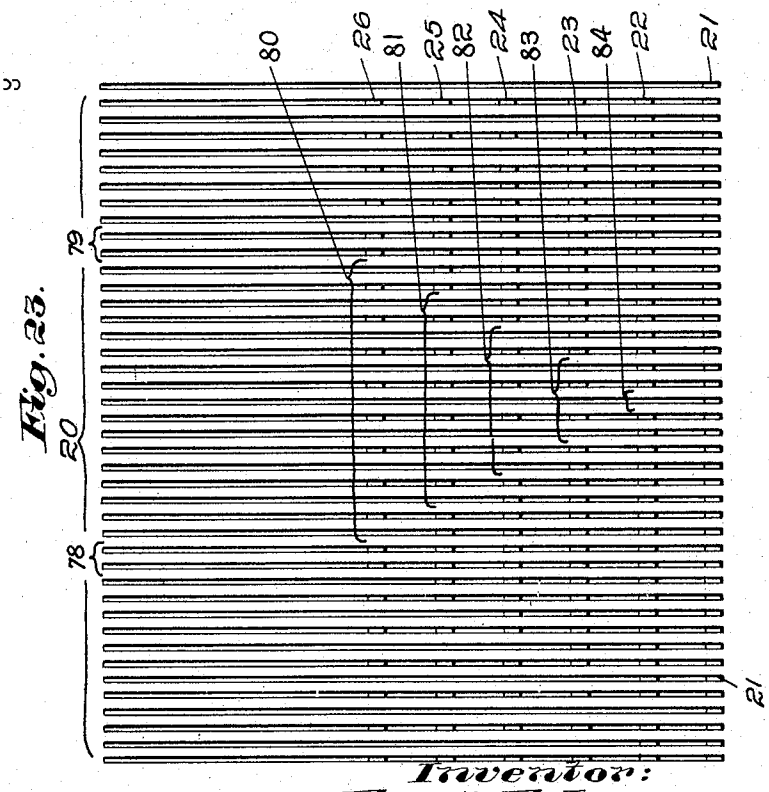

Fig. 23.

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Sept. 9, 1941. F. E. JONES 2,255,693

PATTERN-PRODUCING CIRCULAR KNITTING MACHINE

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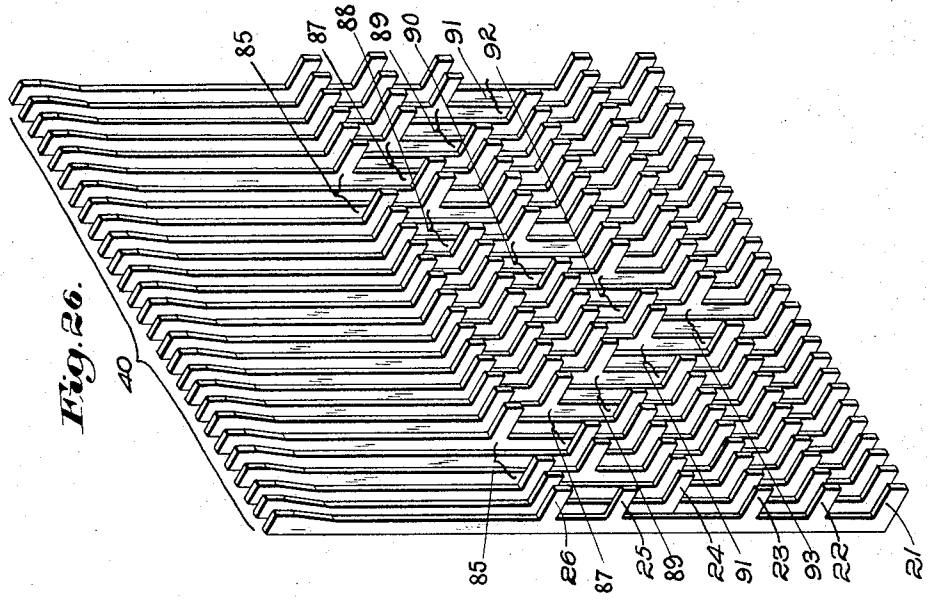

Fig. 26.

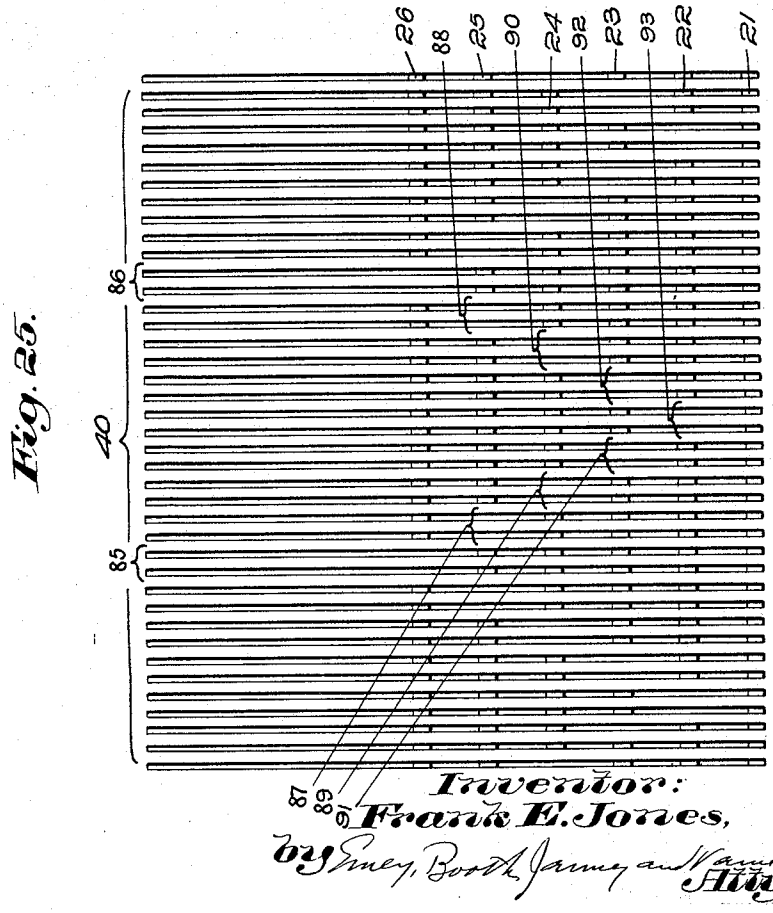

Fig. 25.

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Sept. 9, 1941. F. E. JONES 2,255,693

PATTERN-PRODUCING CIRCULAR KNITTING MACHINE

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Fig. 28.

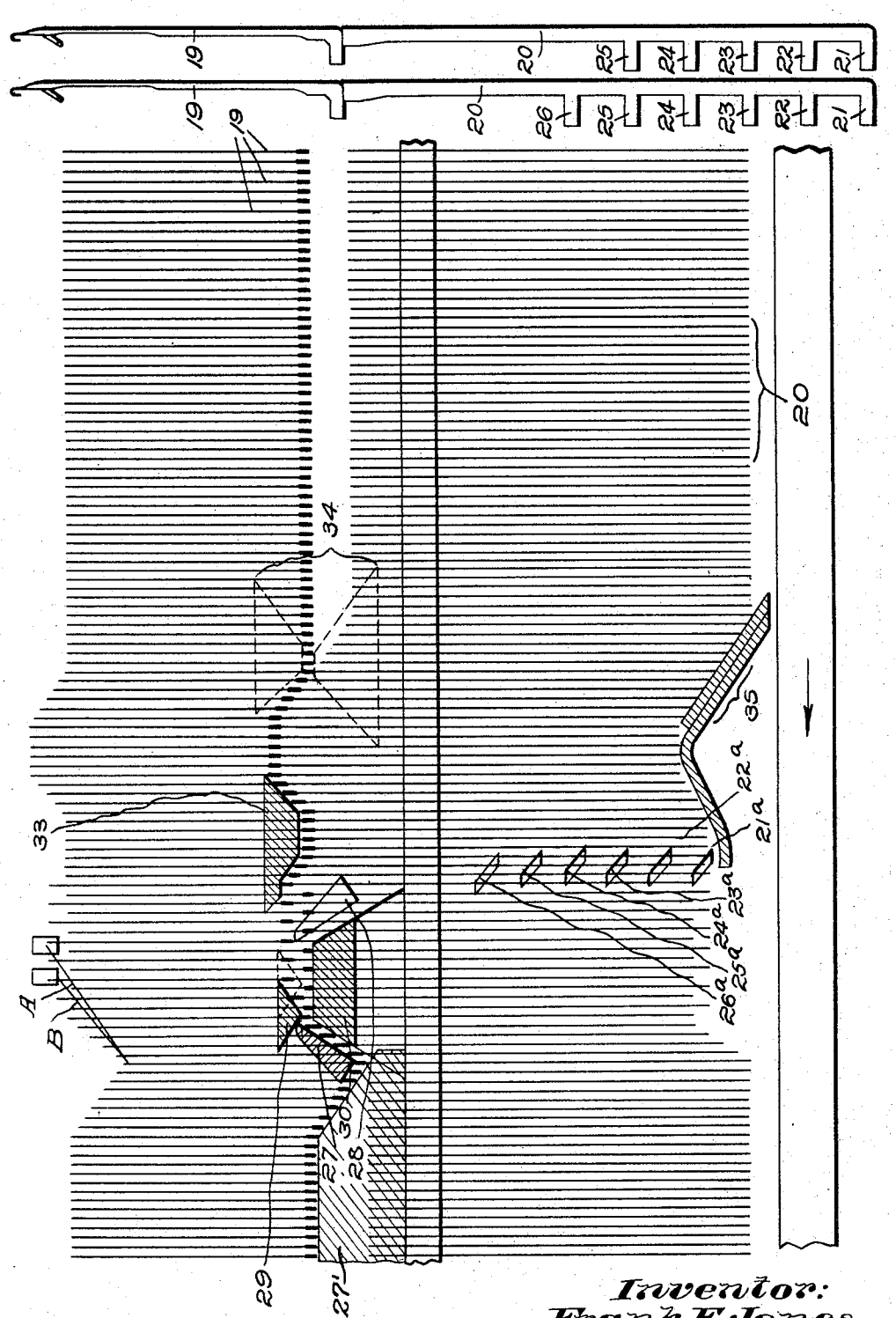

Fig. 27

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Sept. 9, 1941. F. E. JONES 2,255,693

PATTERN-PRODUCING CIRCULAR KNITTING MACHINE

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Fig. 30.

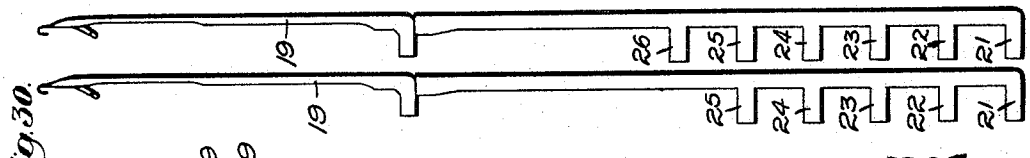
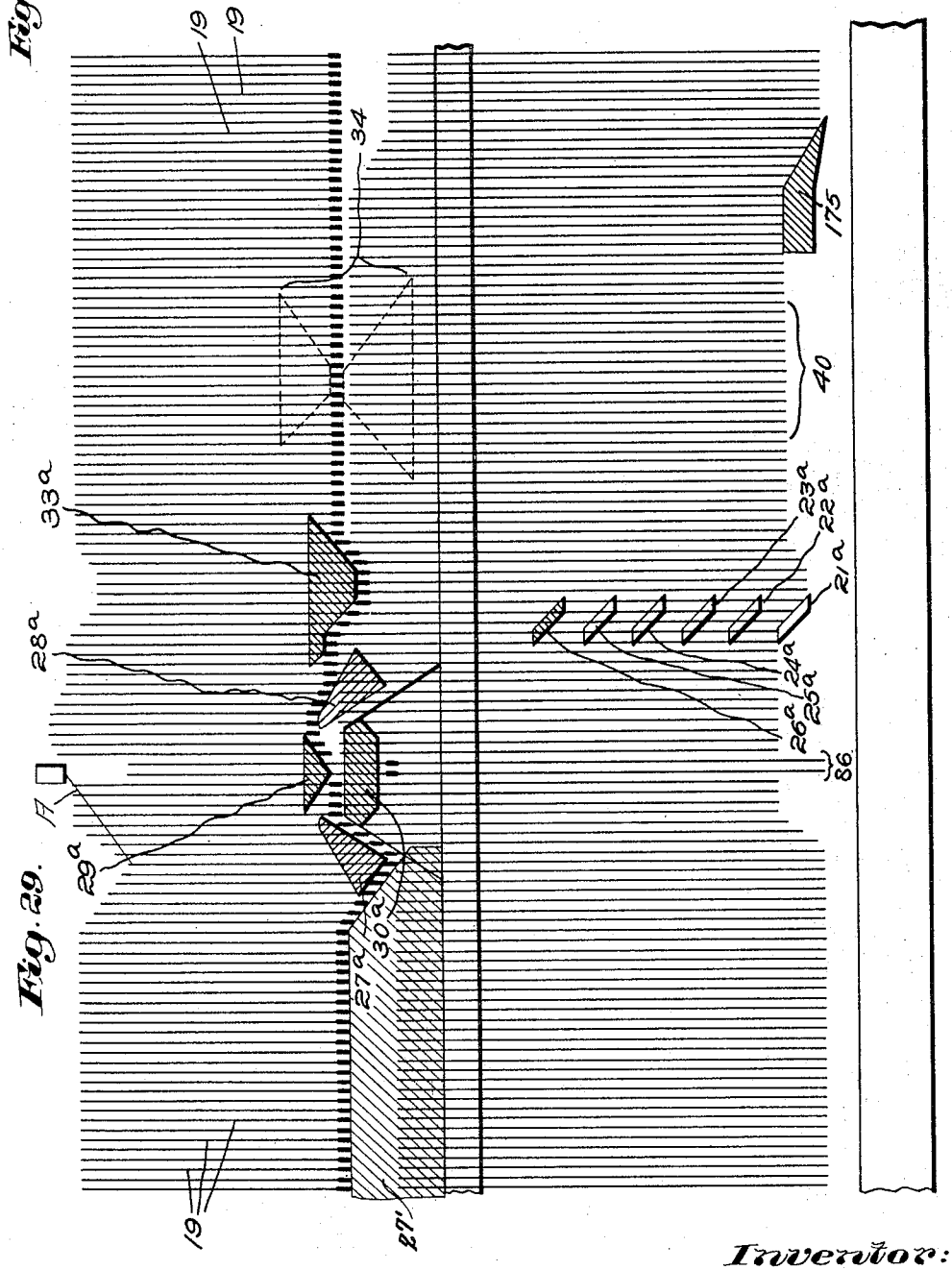


Fig. 29.



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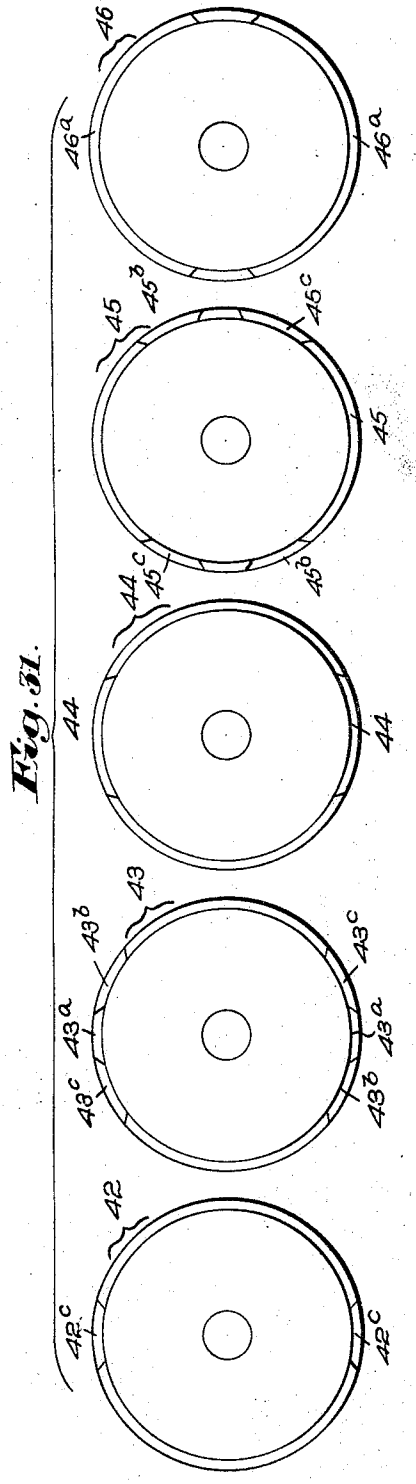

Fig. 31.

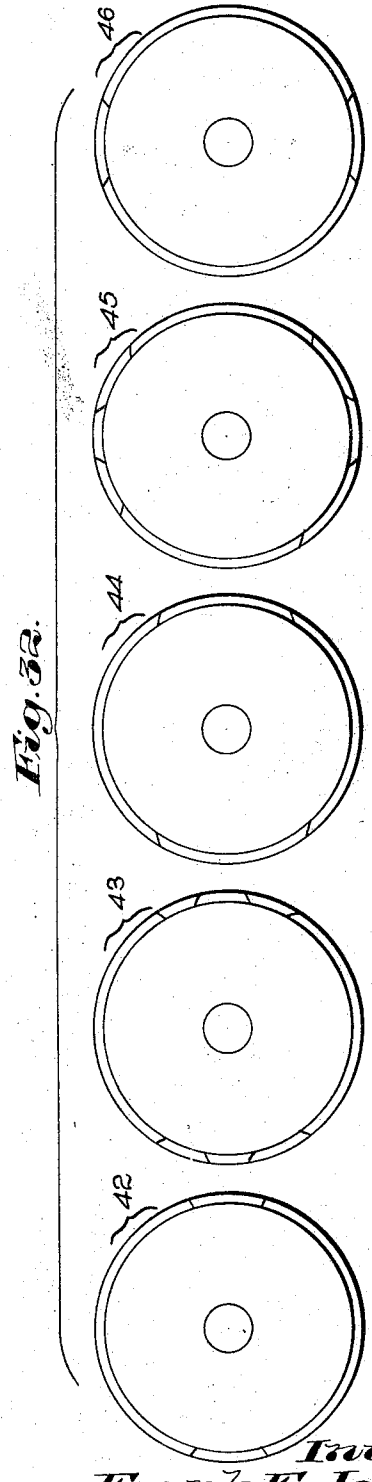

Fig. 32.

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Patented Sept. 9, 1941 2,255,693

UNITED STATES PATENT OFFICE

2,255,693

PATTERN-PRODUCING CIRCULAR KNITTING MACHINE

Frank E. Jones, Pawtucket, R. I., assignor to Hemphill Company, Central Falls, R. I., a corporation of Massachusetts

Application March 6, 1926, Serial No. 92,746
Renewed November 9, 1934

12 Claims. (Cl. 66—50)

This application is a continuation as to common subject-matter of my co-pending application Serial No. 647,518, filed June 18, 1923.

This invention relates to circular knitting machines, the purpose thereof being to produce patterns of various shapes and sizes, either by a two-color effect as by plating at predetermined points, or by a so-called "lace" effect, as by the formation of draw stitches or other stitch variations at predetermined points, all in accordance with the pattern control.

In certain aspects thereof the invention is an improvement upon that disclosed in the patent to Lomax, No. 1,236,189, August 7, 1917.

While the invention is not restricted for all purposes to the pattern producing means shown, I have herein disclosed (first) means for producing patterns by color effect as by predetermined plating and (secondly) means for producing patterns by a stitch effect, as by predetermined formation of draw stitches.

In the drawings:

Fig. 1 is a side elevation of a stocking having a pattern effect produced by plated work or color control;

Fig. 2 is a greatly enlarged detail of a unit of the pattern indicated in Fig. 1, to show the plating or color effect;

Fig. 3 is a side elevation of a stocking having a pattern effect produced by stitch control or variation;

Fig. 4 is a greatly enlarged detail to show the stitch control or variation in a unit of the pattern;

Fig. 5 is a front elevation of a circular latch needle knitting machine having my invention applied thereto;

Fig. 6 is a left hand end elevation of the mechanism shown in Fig. 5;

Fig. 7 is a rear elevation thereof;

Fig. 8 is a front elevation of the upper part of the mechanism shown in Fig. 5;

Fig. 9 is a plan view of the top of the mechanism shown in Fig. 5;

Fig. 10 is a horizontal section thereof taken under the latch ring, as upon the line 10—10 of Fig. 8;

Fig. 11 is a horizontal section upon the line 11—11 of Fig. 8, the mechanism there shown being adapted for plating work;

Fig. 12 is a horizontal sectional view similar to Fig. 11, but showing the cam construction for stitch variation, as by the formation of draw stitches at predetermined points;

Fig. 12*a* is a detail in plan of the cam for raising all the jacks and the immediate connections thereto;

Fig. 12*b* is a detail in side elevation of the construction shown in Fig. 12*a*;

Fig. 13 is a plan of the connections for operating certain parts including a control drum or cylinder for the selecting cams and certain other cams hereinafter referred to;

Fig. 14 is a rear elevation of the mechanism shown in Fig. 13;

Fig. 15 is a side elevation of said mechanism;

Fig. 16 is an inside elevation of all the selecting cams for the jacks and the cam controlling the draw-down cam;

Fig. 17 is a side elevation of the mechanism shown in Fig. 16;

Fig. 18 is a rear elevation of the mechanism shown in Fig. 16;

Fig. 19 is a section thereof upon the line 19—19 of Fig. 17;

Fig. 20 is a side elevation of the top cam for depressing all needles and jacks and the immediate connections thereto;

Fig. 21 is an inside elevation of the construction shown in Fig. 20;

Fig. 22 is a rear elevation of the construction shown in Fig. 20;

Fig. 23 is a full or actual size front elevation showing a group of jacks for controlling the needles to produce the pattern effect by two-color work, desirably plating work;

Fig. 24 is a perspective view of the structure shown in Fig. 23, the parts being shown of full or actual size;

Fig. 24*a* is a diagram of the pattern effect produced by the jack arrangement of Figs. 23 and 24;

Figs. 25 and 26 are views similar to Figs. 23 and 24, but of the construction and arrangement of jacks for producing the pattern effect by stitch variation or control, the parts being shown as of full or actual size;

Fig. 27 is a development or diagram indicating the course of the needles and jacks in the formation of a pattern by color control, preferably by plating;

Fig. 28 is a side elevation of a jack and needle employed in such color work, said parts being shown as of full or actual size;

Fig. 29 is a view similar to Fig. 27 but indicating the construction employed in producing the pattern by stitch variation or control;

Fig. 30 is a side elevation of a jack and needle used in the organization represented in Fig. 29, said parts being shown of full or actual size;

Fig. 31 is a diagram indicating in plan view the

several cams upon the drum 41 for plating work; and

Fig. 32 is a similar view of the cams for stitch variation work.

My invention relating, as it does, to circular knitting machines, may be applied to or embodied in various types of such machines, but I have chosen to represent the same as applied to a machine of the well-known Banner type disclosed in the patent to Joshua D. Hemphill, No. 933,443, dated September 7, 1909. In this type of machine the needle cylinder rotates while the cams remain stationary and, although the machine disclosed is for the purpose of producing hosiery, it is obviously not limited to this class of work. I will, however, describe my invention as applied to a machine of such type without limiting it thereto excepting when expressly so stated in the claims.

Generally speaking, the machine includes a rotating needle cylinder 1, mounted upon a suitable table 2, constituting a part of the frame of the knitting machine and, as is customary in this type of machine, said cylinder is arranged to be rotated to form the leg and foot and to be reciprocated to form the heel and toe of the stocking.

The means for effecting the rotary and reciprocating movements are substantially the same as those shown and described in the said Hemphill patent and, being well known, require no further description.

A plurality of yarn feeding elements is provided at the usual position characteristic of the Banner machine, and a series of said elements is indicated at 3 in Fig. 9, and one of them is indicated at 3 in Figs. 5 and 8. Desirably, as many as four or five yarn guides may be mounted side by side at the same place, each to introduce its yarn or thread as called for by the controlling cams, as, for example, for the leg, the heel and toe, and the foot, etc. All said yarn guides are pivoted at 4 upon a latch ring 5, itself suitably pivoted, so that it may be swung up out of action to afford access to the needles or for any other purpose. Since the particular type of machine here shown is the latch needle type, I have represented the member 5 as a latch ring, but if the machine be equipped with spring beard needles, as it may be within certain aspects of my invention, then the member 5 is of the form of a partial ring, as well understood in this art.

Each of the yarn guides is normally pressed or urged into action in the general manner disclosed in said Hemphill patent as by a series of levers suitably mounted upon a standard rising from the bed plate 2, suitable springs being employed for the purpose of moving the yarn guides respectively down into feeding position. Such movement downward into position is opposed and overcome at times by means including levers and connecting wires, a portion of said levers being represented at 6 in Fig. 5. The said levers respectively ride upon suitable cams, indicated at 7 in Fig. 5, upon the drum 8, on a cam shaft 9, in a manner not necessary herein to describe, as it is desirably similar to the construction shown in the said Hemphill patent. Assuming that there are four or five levers in the said group, it is evident that, according to the dictates of the cams 7, upon the disk or drum 8, the said yarn guides are permitted to act in suitable order as, for example, to supply a yarn or thread for the leg of the stocking, another for the heel, another for the foot, etc.

Each of the said yarn guides supplies its yarn or thread in proximity to the knitting point, and each yarn so taken is knitted upon all the needles in action unless, as hereinafter pointed out as in one form or aspect of my invention, there is a stitch variation, so that the yarn or thread is floated past one or more needles, or is caused to tuck thereat in effecting the pattern hereinafter referred to.

The machine is provided with the usual driving shaft 10, having the customary pulleys 11 and in the rear thereof with a shaft 12 driven from the shaft 10 and having fast thereon the large gear 13 known as the 104 gear. Controlled from the shaft 12 is the usual quadrant 14 pivoted at 15 and operated in a manner not herein necessary to describe in effecting the reciprocation of the needle cylinder in forming the heel and toe. These parts, being desirably of customary construction, here need no further description.

The machine is provided with the usual narrowing pickers mounted, as customary, upon a block indicated at 16 in Fig. 5, and with the customary widening pickers, one of which is indicated at 17 in Fig. 5, being mounted upon a suitable bracket 18, preferably of the usual construction.

Having thus referred to the main parts of the usual mechanism of the plain or rotary Banner machine, it is pointed out that my invention, shown for convenience as applied to such type of machine, is concerned particularly with the formation of pattern effects in the fabric. Such pattern effects may be produced in various ways as, for example, (1) By a color effect, which may be secured by introducing at least two yarns which, at times, are so controlled as to produce plated work and, at other times, but one of said yarns being taken by the needles, so as to produce a different color effect; (2) By a stitch control or variation, as by forming tuck stitches or draw stitches according to the pattern dictation, or (3) By a combination of 1 and 2. While not limiting my invention thereto, I will herein disclose means for producing a pattern effect by the said first and second ways.

A stocking having a pattern effect produced according to the first plan is indicated in Fig. 1 and in Fig. 2 is shown an enlargement of the stitches of a portion of such pattern, while Figs. 3 and 4 respectively show a stocking and enlargement of a portion thereof wherein the pattern is produced by stitch control or variation—herein specifically by the formation of tuck or draw stitches positioned so as to produce the desired pattern effect.

Hereinafter, for mere convenience of description, I shall refer to the pattern as the diamond pattern, but it is to be understood that, within the principle of my invention, the pattern may be obviously varied within wide limits, as to both shape and size, and also as to position upon the stocking or other fabric.

I shall first describe the disclosed means for producing the pattern by a color effect and to that end shall first refer to Figs. 1 and 2 and to the diagram or development in Fig. 27 and, after having described the same, I shall then refer to Figs. 3 and 4 and the diagram or development shown in Fig. 29.

The needles, one of which is indicated at 19 in Figs. 28 and 29, are herein shown as of the latch needle type but, as already stated, they may be of the spring beard type, in which case

suitable pressers and other cooperating parts are employed.

Each of the needles is mounted, as is customary, within its groove in the needle cylinder and said cylinder, as clearly indicated in Figs. 5, 6, etc., is of increased height, so that the grooves may be prolonged below the needles and receive in each of them a controlling jack 20, a group whereof is represented in Figs. 23 and 24. The said jacks are distinct from the needles and are mounted so as to be reciprocated with suitable friction within their grooves by the cams to be hereinafter described, and they are positioned directly below the needle butts, so that when elevated or depressed the needles are correspondingly elevated or depressed.

The jacks are each provided with at least a single butt or with a plurality of butts in vertical alignment, according to the pattern effect to be produced and the various jacks, so differentiated among themselves, are distributed in the proper needle grooves, so as to secure the proper pattern by elevating their respective needles at the proper time. In the selected embodiment of the invention, the butt formation of the jacks is as follows:

Referring to Figs. 23 and 24, it will be observed that all of the jacks 20 have the lower butts 21. To effect the knitting of a patterned instep and plain or non-patterned sole, the jacks companion to the needles that knit the instep of the stocking are provided with short butts 21, the cam 21*a* being maintained in semi-advanced position to act upon the long needle butts 21 only throughout the knitting of the plain sole and patterned instep. Certain of said jacks have thereabove a second butt, 22; certain only of the remaining jacks have thereabove a butt 23; certain of the remaining jacks have thereabove a butt 24; certain of the still remaining jacks have thereabove a butt 25; and certain of the remaining jacks have thereabove a butt 26. Such butts as are present upon any one jack are vertically spaced, as clearly indicated, for example, by the left hand jack in the group shown in Fig. 24.

The said butts 21 to 26 inclusive are adapted to be acted upon by a series of cams 21*a*, 22*a*, 23*a*, 24*a*, 25*a* and 26*a*, all diagrammatically indicated in Fig. 27. The said cams 21*a* to 26*a* are mounted one above another, as hereinafter more fully described, and are capable of movement into and out of engagement with the respective butts controlled thereby, this movement being preferably a radial one with relation to the axis of the needle cylinder. The cam 21*a*, not being a selecting cam is not controlled from the drum or cylinder 41 but is controlled by other means to effect its advance prior to the knitting of the foot and its retraction at the completion of the knitting of the foot. The remaining cams just referred to, namely cams 22*a* to 26*a* inclusive, are known as selecting cams, and it is their function, when moved radially into position by the means hereinafter described, to act upon the jack butts similarly numbered herein so as to elevate the needles pertaining thereto, for the reception of the plating yarn.

Referring to the form of the upper ends of the jacks 20, especially in Figs. 24 and 26, it will be observed that the jack which is distinct from but is adapted to move in the needle groove independently of its needle and also to move the needle, has the main portion of its stem of normal (i. e. substantially unreduced) cross section, but has its upper end materially thicker from front to rear than the main portion of its stem and is flat thereat so as to present materially increased lifting surface to the lower end of the needles, and thereby avoid tilting of its needles upon engagement therewith.

Referring to diagram Fig. 27, it will be observed that the group of knitting cams is there represented and is shown as consisting of the stitch cams 27, 28, the upper guard cam 29, and the lower cam 30. In this embodiment of my invention the guard cam 29 is mounted upon a member 31, Fig. 10, which is pivoted at 32 upon the cam block, so that it is adapted to be swung laterally for the purpose of permitting the needles, when traveling toward the left in the direction of the arrow shown in Fig. 27, to pass with perfect freedom of movement into contact with the stitch cam 27 to be depressed thereby, being then elevated by the usual cam 27'.

The stitch cam 28 is adapted to be moved out of action, preferably radially, during or for the production of the pattern work, by means hereinafter described. In addition I employ a top cam 33, which is adapted to be moved into and out of action, desirably radially, in a manner hereinafter described. Cam 33 functions upon needle butts after jacks and needles have been raised by cam 35 and, depending upon its position, will move certain of the needles and their jacks downwardly to a lower level so that the jacks may properly approach cams 21*a*—26*a* at a predetermined level. Other or customary cams are provided as, for example, the instep cams indicated at 34 and, in addition, I employ, for a purpose hereinafter set forth, a cam 35, here briefly referred to as a cam for raising all the needles and jacks. In the diagram Fig. 27, the selecting cam 26*a*, which is shown "hatched", is supposed to be in action or in operative relation to the jack butts, and the remaining selecting cams are out of action.

When, as in the first disclosure of my invention, the pattern effect is produced by a color effect, as by plating, I introduce, through two yarn guides or fingers, Fig. 27, two yarns A and B of contrasting color. For convenience of description I shall refer to the yarn A as the red yarn and the yarn B as the white yarn. These yarn guides or fingers are properly located (being two of the group of yarn guides 3) and the tension condition thereof is such as to produce a plated effect when both yarns are taken by the needles. As the customary plating operation is well understood, it is unnecessary to describe the same in detail.

The needles which are not elevated, because of lack of a butt formation upon the jack at the determining point or level, therefore take only the white yarn, being so low when they pass the red yarn that they miss the same. The needles whose jacks have butts calling for elevation in effecting the pattern take the red yarn and immediately thereafter take the white yarn, and thus effect the plating operation as the stitch is completed.

Viewing Fig. 27, it will be noted that as the needles move toward the left they are slightly depressed by the top cam 33 and thence (since the stitch cam 28 is radially out of action during the patterning) unless the needle is elevated by its jack, it moves along at so low a level as only to engage the white yarn and, after taking the same, is depressed by the stitch cam 27 in the usual manner. If, however, the needle is elevated by

its jack by one of the selecting cams, then it passes along at a sufficiently higher level to take the red yarn A as well as the white yarn B, and plating results.

Referring to Figs. 1 and 2, it is to be understood that the apparently solid red effect as at 36 is made by plating, whereas the spotted, or white effect, indicated at 37 is produced by localized plating interspersed with non-plating.

It being, of course, understood that the shape or units 36 and 37 of the pattern of the figures is merely arbitrarily selected and may be varied as desired, it is also to be understood that the so-called spotted effect of the figures 37 may also be varied in said figures or units. For example, the white spots are produced by causing all the needles to take the white thread; the selected needles are raised and take also the red thread and, as the needles which are not raised do not take the red thread, there results the white spots referred to. This creates horizontal rows of spots in each diamond or unit of the figure. The length of these horizontal rows of spots is varied according to the dictates of the pattern, so as to give the diamond effect or such other effect as is being produced. Between said horizontal rows of white spots in the diamonds or figure units there are two-course rows of plating, which rows of plating may be omitted if desired. Also the vertically spaced effect of the white spots can be replaced by unbroken vertical lines of white (of varying length) so as to produce the diamond effect vertically considered. Thus the diamond effect may be produced in any of the following ways:

(*a*) In solid color (white for example);

(*b*) With solid vertical lines of white, between which would be plating, which plating would appear as red;

(*c*) With spots of one color (white for example) spaced both horizontally and vertically.

In order to produce the white spot effect (*c*), I desirably fully raise part only of the needles for two revolutions, the fully raised needles taking the red thread as well as the white thread, thus producing a red effect, and the remaining needles which were not fully raised taking only the white thread, and so making white spots. Then I fully raise all the needles for two revolutions, thus producing a red effect; then I fully raise only another selected set of needles for two revolutions, thereby again making white spots; then I fully raise all needles for two revolutions, etc.

When the red thread is not taken it floats and the extent of the float varies according to the pattern. This, broadly considered, is according to the principle disclosed in the German patent to Sturgess, No. 94,884, wherein a figured effect is secured by causing selected needles to take either one yarn or both yarns, the yarn when not taken by said needles floating across the same at the back thereof. The disclosure is also according to the broad principle disclosed in the British patent to Salzer and Walther, No. 17,087 of 1907, wherein a pattern effect is produced by causing certain needles to take both yarns and selected needles to take only one yarn.

Referring to the particular pattern selected as typical of the practice of my invention, it is to be noted that if the floats are only one wale wide at each localization, the floats are so short as to be practically unappreciable. By forming longer floats the spots or white stripes can be made wider and theoretically I may make said spots or stripes of full width throughout the diamond, which would then be of solid color on one face, with the other yarn floated at the back, and in between the diamonds, spots or stripes, the two yarns are plated.

It is obvious that the pattern effect may be varied in each unit or even in desired units in various ways. For example, I may form a vertical stripe upon every other needle or I may form a vertical stripe, then a wide space, then another vertical stripe of the same or differing width; and by different variations, according to the capacity of the disclosed mechanism, a great number of different patterns may be produced.

Having thus generally referred to the manner in which the pattern effect is produced by color, I will now refer to the production of the pattern effect by stitch control or variation, and for that purpose will refer particularly to Figs. 3, 4 and 29.

Figs. 3 and 4 differ from Figs. 1 and 2 in that, in Figs. 3 and 4 but a single thread is taken by the needles, so that the color is uniform as, for example, white. The diamond or other pattern effect is produced by causing predetermined jacks so to act upon their needles as to create a stitch variation distributed so as to produce the outline of the figure as, for example, the diamond or, if desired, to produce the entire figure or any part thereof by stitch variation. Referring to Figs. 3 and 4, it will be observed that each diamond 38 is produced by normal loops outlined by draw stitches 39 distributed as illustrated, to produce the desired pattern effect. It is to be understood that my invention is not limited to that type of stitch variation known as a draw stitch, as I may form a tuck stitch, which term "tuck stitch" is often treated in the art as of general application, so that a draw stitch is frequently defined as one type of tuck stitch.

In order to produce the draw stitch effect of Figs. 3 and 4 I provide jacks generally indicated at 40 in Figs. 25 and 26. These jacks have butt formations similar to those shown in Figs. 23 and 24 and are therein indicated by the same numerals. It is unnecessary at this point to describe them in detail, it being here sufficient to state that the number of butts upon each jack and the arrangement of the butts is according to the dictates of the pattern, the butts not needed by the pattern, in accordance with my usual practice, having been removed, this being done customarily by me by placing a complete jack in a vise and giving a light tap with a hammer or like tool, which tapping action breaks off the butts not required for the pattern.

Referring to Fig. 29, it will be observed that I have there shown stitch cams 27*a* and 28*a*, also the upper guard cam 29*a* and the lower cam 30*a*, together with a top cam 33*a* and the same selecting cams 22*a* to 26*a* inclusive, and the same cam 21*a*, the selecting cam 26*a* being here represented as hatched and therefore in action.

The top guard cam 29*a* is here represented as fixed, that is, as not mounted for swinging position like the cam 29 of Fig. 27. But one yarn guide is in action at the yarn receiving point as, for example, the yarn finger or guide supplying the white yarn A. Unless a needle is elevated by its jack through the selecting cams, such needle passes under the cam 28*a* when moving toward the left in the direction of the arrow, and hence does not take the yarn A and a stitch variation, in this instance a draw stitch, will finally result. If, however, a needle is elevated by its jack so as, in its movement to the left, to

pass above and along the upper slope of the cam 28a, such needle takes the yarn A, and a normal stitch results.

A stitch variation, in order to produce a pattern effect through the use of jacks having differentiated or contrasting butts, is disclosed broadly in said patent to Lomax, No. 1,236,189, wherein is provided a series of lifting cams 13, to cause selected needles to be lifted to the clearing point and therefore to form normal stitches, the other needles forming tuck stitches. My invention, in one important aspect thereof, is intended to provide improved means for operating according to the general or broad principle disclosed in said Lomax patent, as well as to provide means for rendering the entire action automatic, and also to provide for extensive and readily effected variation of pattern effect, both as to color effect and stitch variation.

Instead of providing a cylinder below and in alignment with the cam cylinder or ring for control of the jacks and instead of mounting the selecting cams in such depending cylinder, I have, as herein shown and referring particularly to Fig. 5 and Figs. 8 to 11, mounted upon the bed plate 2 a relatively small upright drum or barrel, indicated generally at 41. The drum or barrel 41 is provided with five encircling pattern bands 42, 43, 44, 45 and 46, which are provided with elevations and interposed spaces or depressions arranged according to the particular pattern effect desired. For the purpose of producing the pattern effect herein specifically disclosed, the pattern band 42 is shown as having at the face or part in view an elevation 42a and another elevation 42b and between the same a depression 42c and this construction is repeated at the part or face not in view, preferably once, in the band, and the same is true of each of the bands 42 to 46 inclusive. The band 43 is shown as having an elevation 43a and, opposite the sides thereof, spaces or depressions 43b and 43c. The band 44 is shown as having a much larger elevation 44a and at opposite sides thereof spaces or depressions 44b and 44c respectively.

The band 45 is shown as having a still larger elevation 45a and at the opposite sides thereof the spaces or depressions 45b and 45c, and the band 46 is shown as having a still larger elevation 46a, the depression not appearing in this view.

The said drum or barrel 41 is mounted for rotation upon a vertical axis and for that purpose has fast thereon at its lower end a ratchet 47, to be engaged and operated by the pawl 48, see particularly Fig. 11. The said pawl is pivoted at 49 upon a horizontal plate or member 50, which itself is mounted coaxially with the axis 51 of the drum or barrel 41 so as to be rocked by suitable means, and thereby to move the drum or barrel in a step-by-step manner. While any suitable means may be employed to rock the plate or member 50, I have herein represented a bar or link 52 pivoted to the plate 50 at 53 and extending horizontally across the machine to the operating means therefor shown in Figs. 13 to 15 and hereinafter more fully described.

The cams 22a to 26a, being the selecting cams, and also the needle-raising cam 21a, are mounted one above another in a suitable support, frame or casing, rising from the bed plate 2 between the drum or barrel 41 and the needle cylinder, as clearly evident from Figs. 5, 8 and 11. Said support, frame or casing is indicated at 54 in the several views and therein are suitably pivoted bell crank levers, one only of which is indicated at 60 in Fig. 11 and the entire number of which are indicated at 55, 56, 57, 58, 59 and 60 in Fig. 18 and elsewhere and which are, in number, one greater than the number of pattern bands 42 to 46 inclusive, and which when moved swing upon their pivots, one of which is indicated at 61 in Fig. 11, so as to move the corresponding selecting cam or the needle-raising cam 21a in or out. In Fig. 11 the bell crank lever 60 is shown as provided with a second arm 62 having a pin 63, the end whereof engages a notch 64 in the edge of the corresponding cam 21a to 26a, as the case may be, so as to move the same radially inward into position to cause the elevation of the jacks whose butts are at such a height or level as to come under the influence of such cam when moved into position. The cam 21a, not being a selecting cam, is not controlled from the drum or cylinder 41, but the controlling bell crank lever 55 therefor is moved by other means, hereinafter referred to. The other bell crank levers 56 to 60 are directly controlled from the drum or cylinder 41. As clearly shown in Fig. 16, the cams 21a to 26a are inclined, being received in corresponding inclined grooves or ways within the supporting frame 54 so that, when projected inwardly into functioning position, the jack butts at that level engage the same and are thereby elevated for the purpose set forth.

Each of the bell crank levers 56 to 60 is held normally in contact with its cam band 42 to 46 inclusive, and the bell crank levers 56 to 60 are stressed to the position shown in Fig. 11, by means of a corresponding coil spring 55a to 60a, said springs as shown in Figs. 8, 11 and 18 being each secured at one end in a suitable hole as 65 in its bell crank lever and at the other end to a screw 66 upon the frame or support 54.

The diamond or other figure-forming pattern is discontinued not only for the heel but also for the toe and therefore when it is discontinued one of the selecting cams 22a to 26a remains in action, the particular cam so left in action varying according to the completeness of the pattern or figure thereof at the termination of the foot. Therefore, I provide means brought into action before the next stocking is commenced, to throw out of action whichever selecting or other cam of the series of cams 21a to 26a had been left in action, such throwing out action taking place preparatory to the throwing in of the first desired selecting cam upon the commencement of the next stocking, or rather on the commencement of the figured portion thereof below the garter top. For this purpose I have, as shown most clearly in Figs. 16 and 18, provided a plate 67 of sufficient height to contact with all the bell crank levers 55 to 60, so that movement of the plate throws out of action any of the cams 21a to 26a which may be in action. For this purpose I have represented said plate 67 as provided with a horizontal slot 68 receiving a guide pin or screw 69. Said plate 67 is provided with a narrow rear extension 70 adapted to be engaged and pushed by the arm 71 of a bell crank lever 72 pivoted at 73 on a small bracket 74 extending from the support 54. The opposite arm 75 of the bell crank lever 72 has pivoted thereto at 76 an operating link 77 controlled as hereinafter stated.

Referring again to Figs. 23, 24 and 27 (and also referring to diagram Fig. 24a), it is pointed out that in the selected pattern each diamond has a number of white spots caused by the knitting only of the white thread at such points and the

floating of the red thread immediately behind it at such points. There may be, for example, at the vertical tip of the diamond one white spot and in consecutive rows therebelow the following number of spots symmetrically arranged, namely three, five, seven, nine, seven, five, three, one. The grouping of the jacks in Figs. 23 and 24 is that necessary for the purpose of making such number and arrangement of spots. Viewing Figs. 23 and 24 it will be observed that, with certain exceptions to be referred to, every other jack is provided with six butts, whereas the other, alternating, jacks are provided with fewer butts, according to the dictates of the pattern. Each and every jack is provided at its lower end with a butt 21, this being for the purpose of effecting the raising of all the jacks and their needles, so as to bring said jacks within the range of their selecting cams. It is to be noted that the jack butts 21 are long beneath the long butt needles and are short beneath the short butt needles, it being understood that, as usual, the instep needles are provided with long butts and the heel needles with short butts. In the travel of the needles toward the left, viewing Fig. 27, all of the butts 21 ride up the inclined cam 35, so as to bring them properly within the control of the cams 21*a* to 26*a*. The top cam 33 is withdrawn from action at the completion of the diamond formation but, as the withdrawal of the cam 33 is not quick enough to prevent the leading needles from being depressed thereby, the cam 21*a* is provided for the purpose of raising any of the jacks whose needles may thus have been unintentionally depressed, and thus sufficiently re-raising such needles. Therefore the cam 21*a* is not, strictly speaking, a selecting cam, since it acts upon the jacks of all the needles and hence the drum or barrel 40 is not provided with a cam band corresponding to this cam, but said cam 21*a* is operated by other means, to be later described. All the other cams 22*a* to 26*a* are, however, strictly selecting cams and each is, as stated, controlled by its cam band 42 to 46.

Referring again to Figs. 23 and 24, it will be observed that, at the bracket indication 78 and at the bracket indication 79 there are two adjacent jacks provided with upper-level butts 26. These jacks, therefore, will effect plating or the formation of red work, and represent respectively the solid red between the outermost white spots of a diamond at the widest part thereof—that is, at the outside of the first and ninth spot of such diamond at its widest point.

Between the brackets 78 and 79 it will be observed that there are nine jacks lacking the upper-level butt 26, said jacks alternating with other jacks having all six butts. Said nine jacks lacking the butts 26 therefore provide for the making of the nine white spots at the widest part of the diamond, since said jacks fail to be lifted by the uppermost selecting cam 26*a* and therefore do not cause their needles to take the red yarn or thread. I have indicated said nine jacks by a bracket 80. Beneath said bracket 80 and of lesser extent is a bracket 81, which includes seven jacks each lacking the butt 25 and said jacks therefore cause the formation of the seven white spots in the next horizontal row of spots below the row having nine spots. Similarly, below the bracket 81 are the bracket 82 having five jacks each lacking the butt 24; the bracket 83 including three jacks each lacking the butt 23, and the bracket 84 including one jack lacking the butt 22. The described selection of jacks and needles, by inward movement of the proper selecting cams, is repeated in a reverse direction for the formation of the first half of the next diamond, to be followed by a selection in the order just stated in detail and so on through the entire pattern.

The arrangement of the jacks with respect to the number of butts thereon in Figs. 25 and 26 differs from that in Figs. 23 and 24, due to the fact that the diamond, in the chosen illustration, is merely outlined by the production of draw stitches along and constituting said outline. Referring to said Figs. 25 and 26, it is to be understood that any jack lacking a butt at any of its levels 22 to 26 inclusive causes the production of draw stitches, and within the scope of my invention, this may be varied according to the pattern desired. It will be observed that in Figs. 25 and 26 at the level 26 there are fourteen consecutive jacks having butts at that level. This provides for the formation of fourteen regular loops in the course at the widest part of the diamond to be outlined. Next beyond said fourteen jacks at the left are two jacks beneath the bracket 85 lacking butts 26, and two at the right beneath bracket 86 lacking said butts 26. This, therefore, provides for draw stitches at said points thus outlining the diamond at the widest part by draw stitches. It will be noted that two of the said fourteen jacks having the butts 26 lack butts 25 at the bracket 87 and two others lack said butts 25 at the bracket 88. This provides for the formation of draw stitches in the next course or the next narrower part of the diamond. Similarly brackets 89 and 90 indicate the absence of butts 23 from certain of said jacks; the brackets 91 and 92 indicate the absence of certain of the butts 23, and the single bracket 93 indicates the absence of butts 22 upon the two innermost jacks of the series of fourteen referred to, thus making the lowermost point of the diamond. This arrangement is, of course, reversed at the right and left of this group so as to provide for the adjacent diamonds at right and left, and the next diamond below is formed by proper movements of the selecting cams to cause the diamond to be begun at its upper point and gradually widened and then narrowed.

Having described the various cams and the functions thereof, I will now describe the disclosed means for operating the same. At the rear of the machine, as shown most clearly in Figs. 14 and 15 there is mounted an auxiliary cam shaft 94 having thereon a drum 95 provided with a gear 96 driven by a gear 97 upon the shaft 98, itself driven through universal joint 98*a* and arm 98*b* from the 104 gear 13. Upon said drum 95 are provided side by side three peripherally extending cams 99, 100 and 101, which respectively control the top cam 33 of Fig. 27; the ratchet 47 upon the drum or barrel 41; and the bottom or lowermost cam 21*a*. These cams, 99, 100 and 101, are shaped according to the requirements of their particular functions.

The cam 99 controlling, as stated, the top cam 33 of Fig. 29 (said top cam being shown in detail in Figs. 20 and 21) has resting thereon a lever 102 indicated most clearly in Figs. 14 and 15. Said lever is pivoted at 103 upon the framing. The upper end of said lever 102 has pivotally connected thereto at 104 a horizontally extending link 105 which, as shown most clearly in Fig. 22, is connected to one end of a short horizontal lever 106 pivoted at 107, the opposite

end 108 of said lever taking into an opening 109 of an upright lever 110 pivoted at 111 upon a bracket forming part of or attached to the frame. The upper end of said lever 110 is provided with a vertical slot 112 to receive a pin 113 upon the stem 114 of said cam 33 whereby, in the proper movements of said parts, the top cam 33 is withdrawn from action at the proper times. The housing 115 for the stem 114 of said cam 33 is longitudinally slotted, as indicated at 116, to permit the described movements.

It is desirable that said cam 33 shall be moved into different radial positions and I have here indicated means, in addition to that already described, for moving the same into three different radial positions according as said cam 33 is intended, (1)—to act upon the butts of all needles; (2)—to act upon the long butt needles only, and (3)—to be moved entirely out of action during the formation of the garter top and the heel and toe.

For this purpose I have provided a slide 117, mainly of a certain minimum width, having a sloping portion 118 succeeded by a flat part 119 providing an operating portion of greater width, following which is an incline 120 succeeded by a flat portion 121 providing a part of greatest width. The slide 117, at its several parts, acts upon a lateral projection 122 from the stem 114 of the cam 33, so as to move said cam outwardly according to the shape of the slide 117, it being understood that said cam 33 is normally inwardly spring pressed. The narrowest part of the slide 117 functions when the cam 33 is to act upon all needle butts, the portion 119 functions when only the long-butt needles are to be acted upon, and the portion 121 functions when the cam 33 is to be moved out of action during the formation of the garter top, the heel and the toe.

The slide 117 is provided with longitudinal slots 123 receiving pins or screws 124, whereby the same is guided in its vertical movement. At its lower end slide 117 is pivoted at 125 to a lever 126 which, as shown in Fig. 8, is pivoted at 127 and at its opposite end is pivoted at 129 to a downwardly extending link or wire 130 operated by a suitable cam upon its cam shaft 9.

In order to drive the ratchet 47, the following connections controlled by the cam 100 are provided; a lever 131 is provided with an end 132 to bear upon said cam 100, said lever being pivoted at 133 upon the framing and having pivotally secured thereto at 134 the link 52 shown also in Fig. 11.

I have already stated that the pattern producing mechanism does not function during the formation of the heel and toe; therefore I provide means for suspending the rotative movement of the drum or barrel 41 during the formation of the heel and toe. While for this purpose any suitable means may be provided, I have herein represented means connected with the lever 131 for moving the nose or end 132 thereof out of the path of movement of the cam 100 at proper times. To this end said lever 131 has secured thereto by screws 135 a bracket 136 having an arm 137 extending at substantially right angles rearwardly from said lever 131 and pivoted at its end at 138 to a downwardly extending link 139, the latter having a lengthwise slot 140 to receive the pivot pin 138.

The link 139 is continued downwardly or has connected thereto a wire or rod 141 which extends downwardly to a lever 141a pivoted at 141b upon the framing. Said lever 141a has an arm 141c adapted to ride upon a suitable cam 141d mounted upon the drum on the main pattern shaft 9. By means of the described connections the lever 131 is moved out of control of the cam 100 during heel and toe knitting.

The cam 101 upon the auxiliary cam shaft 94 controls the position of the cam 21a below the selecting cams 22a to 26a. The operating connections between the cam 101 and said cam 21a are herein as follows. Lever 142 is pivoted at 103 in parallelism with the lever 102. Said lever 142 at its upper end has rigidly secured thereto a rearwardly extending arm 143 having an upwardly extending or hooked portion 144 adapted to be engaged at certain times by a horizontally extending lever 145 which, as shown most clearly in Fig. 13, is pivoted at 146 upon a hub 145' upon the framing. Said lever 145 is pivotally connected at 147 to a link 148 which, as shown in Fig. 11, extends in parallelism with the link 52, and at 149 has pivotally secured thereto a short link 150. Said link 150 is connected at 151 to the bell crank lever 55 controlling the elevating cam 21a.

In order to keep the lever 102 upon the cam 99, I employ a coiled spring 152 shown in Fig. 13 as connected to a screw 153 upon a collar 154 on the rod 105. On its opposite end said coiled spring is connected to a screw 155 upon the hub 146'. I have previously described the cam 35 for raising all the needles and jacks in that form of my invention shown in Fig. 27, namely, that wherein the figure is effected by a plating action. Said cam 35 is moved radially into and out of action by the following means. The outer end of said cam 35 is shown in Fig. 6 as engaged by an arm 156 of a bell crank lever pivoted at 157 and having an arm 158, which at 159 is pivotally connected to the upper end of a rod or link 160 extending downwardly and pivotally connected at 161 to an ear 162 upon the lever arm 141c.

When the machine is thrown into circular knitting following reciprocating knitting for the heel or toe, I desirably provide means for lifting into an inoperative position the narrowing pick which is nearest the instep cam, and also for withdrawing the stitch cam nearest that pick. Said pick is withdrawn merely to prevent all possibility of engagement with the butts of the needles, and said cam is withdrawn because it is not used in circular knitting. It is desirable particularly to throw said narrowing pick out of action for and during circular work, since the selective or pattern mechanism is in operation throughout circular work at all times, and with said selective mechanism in operation, there is a possiblity that the butts of selected needles might be engaged by the narrowing pick. Therefore I provide what may be termed a safety device.

While for this purpose any suitable means may be provided I have, as most clearly shown in Figs. 8 and 10, provided upon the outer end 163 of the instep cam 34 an arm 164 secured thereto at 165 and extending, as indicated in Figs. 8 and 10, over the narrowing pick indicated at 166. Said arm 164 has a depending portion 167 adapted, when the arm is depressed, to engage the pin 168 on said pick 166, so as to throw the functioning end of the pick entirely out of the way of the needles. The stitch cam 28, shown most clearly in Fig. 10, has secured thereto a link 169, which is connected at 170 to a lever 171

pivoted at 172. Said lever 171 has a laterally extending arm 173 which, as shown most clearly in Fig. 5, is connected to a wire or link 174 extending downwardly to and connected to one of the yarn guide controlling levers 6.

In that form of my invention indicated in Fig. 27, by which plating is effected, I have, as stated, employed a cam 35 to elevate all the jacks and needles. In that form of my invention shown in Fig. 29, I do not provide the cam 35, but provide a cam 175 positioned at the opposite side of the machine from the cams 21 and 26, as shown most clearly in Figs. 12, 12a and 12b. The function of said cam 175 is substantially the same as that of the cam 35, but it does not lift the jacks quite so high, as will be evident from a comparison of Figs. 27 and 29. It, however, acts upon all the jacks to elevate the same. Said cam 175 is mounted for radial movement in a housing 176, and at its outer end is pivotally connected at 177 to an arm of the bell crank lever 178 pivoted at 179. Said bell crank lever is itself pivotally connected at 180 to a downwardly extending link 181, which extends to the proper level to be controlled from the pattern drum. Desirably it is connected to the lever 141a in a manner not herein necessary to show. This is the same lever to which the operating means for the cam 35 is connected.

I have referred to the link 77 for controlling the plate 67. Said link 77, as shown most clearly in Fig. 5, extends downwardly, and at 182 is pivotally connected to a lever 183 riding upon a suitable cam upon the pattern cam shaft 9.

It is desirable to move the lever 142 (shown in Figs. 14 and 15) away from the controlling cam 99, particularly during the formation of the garter top, the heel and the toe. While, for this purpose, any suitable means may be provided, I have, as shown most clearly in Figs. 6 and 15, provided upon a pivotal screw or pin 184 on a bracket 185 a bell crank lever 186, the arm 187 whereof is adapted to engage a pin 188 upon the lever 142. The opposite arm 189 of said lever has connected thereto at 190 a downwardly extending link or rod 191 which, as shown in Fig. 6, is pivotally connected at 192 to an arm 193 of a lever pivoted at 194 upon the framing. The opposite arm 195 of said lever bears upon a suitable cam on the main pattern drum, so as at the proper time to swing the bell crank lever 188 for the purpose stated.

It will be understood from the foregoing description that I provide for securing a pattern effect during circular knitting, either by a two color effect (this being itself desirably effected by a plating operation) or by stitch variation, which is itself desirably accomplished by providing a draw stitch or some other suitable stitch variation. The draw stitch is, in the disclosed embodiment of the invention, represented as outlining the diamond shape or other figures (see Figs. 3 and 4), but obviously within the scope of my invention the stitch variation may extend throughout the figure, so that not only the outline or contour of the figure is made by stitch variation, but the entire figure is itself so made. Also I may provide for effecting both types of patterning; that is, both by a color effect and a stitch variation, or I may quickly change the connections for operating by a color effect, so as to operate by a stitch variation.

It is evident from the foregoing description that I have provided a machine by which a pattern effect can be produced either by color change or by stitch variation, it being evident that the plating yarn guide can be readily swung up out of action in customary manner, and that in such case the needles will at desired times all be caused to take the single yarn, so as to produce plain knitting, and at other times, according to the dictates of the pattern control, selective needles only will fail to take the yarn, whereby the pattern effect is produced by stitch variation. My machine, therefore, embodies means whereby patterns can be produced either by a color effect or by stitch variation. Also, obviously the change may be quickly made, so that in a single fabric the pattern effect can be produced partly by controlling the plating as described and partly by stitch variation.

It will be evident from the foregoing description that I have herein disclosed a circular, independent needle, knitting machine having a needle cylinder with needle grooves and a cam carrier with knitting cams, and means relatively to rotate said needle cylinder and cam carrier; that the needles are respectively mounted for lengthwise movement in the needle grooves; that I have provided needle-cooperating means individual to each needle, structurally separate therefrom, located in the groove for said needle, and including a lengthwise movable jack for each needle, each said lengthwise movable jack having a formation to engage its needle and thereby to elevate said needle so as through the action of a knitting cam to take a knitting yarn, and if not so elevated to miss said yarn; that I have provided an upright pattern barrel or drum like member mounted on a vertical axis in proximity to the needle cylinder for relative movement of the needles and said barrel or drum-like member past each other; that I have provided means to rotate said barrel or drum-like member step by step upon its axis so as to present its pattern formations for action upon said needle cooperating means; that I have provided a series of needle cooperating means selecting cams mounted in close proximity one above another between said barrel or drum-like member and the needle cylinder, in operative relation to said barrel or drum-like member and said needle cooperating means, so that each selecting cam as operated on by a formation on the barrel or drum-like member is moved inward toward the needle cylinder and thereby controls, determines or governs the lifting or non-lifting of the respective needles; and that said needle-cooperating means have a series of butts distributed therealong at various heights to be engaged by the selecting cams respectively, whereby each selecting cam controls, determines or governs the lifting or non-lifting of the needles in accordance with the indications of the said barrel or drum-like member.

Having thus described one illustrative embodiment of my invention, I desire it to be understood that although specific terms are employed, they are used in a generic and descriptive sense, and not for purposes of limitation, the scope of the invention being set forth in the following claims.

I claim:

1. A circular hosiery knitting machine of the rotating needle cylinder type having in combination, a circular series of needles, jacks in the respective grooves of said needles below the same and having movement independent thereof, each of said jacks having a lowermost butt and each of said jacks having thereabove one or a greater number of spaced butts according to the pattern

effect to be produced, a cam adapted to act upon the lowermost butts of all the jacks, a series of selective cams above the first mentioned cam and adapted respectively to act upon the spaced butts of said jacks, a pattern drum mounted at one side of the needle cylinder and having a series of cams respectively controlling the jack butt operating cams.

2. A circular hosiery knitting machine of the rotating needle cylinder type having a series of independent needles, jacks respectively controlling said needles and provided with spaced butts ranging from a predetermined minimum to a predetermined maximum, and including butts 21 upon all the jacks and other spaced butts thereabove in accordance with the pattern requirements, a cam 21a to act upon the butts 21 of all the jacks, and a corresponding series of movable selecting cams to act respectively upon the spaced butts of the jacks above the butts 21.

3. A circular hosiery knitting machine having a series of independent needles, jacks respectively controlling said needles and provided with spaced butts ranging from a predetermined minimum to a predetermined maximum, and including butts 21 upon all the jacks and other spaced butts thereabove in accordance with the pattern requirements, a cam 21a to act upon the butts 21 of all the jacks, movable selecting cams to act respectively upon the spaced butts of the jacks above the butts 21, a cam 35 adapted to elevate all needles and jacks, and a top cam 33 movable radially.

4. A circular knitting machine having a series of independent needles, jacks respectively controlling said needles and provided with spaced butts ranging from a predetermined minimum to a predetermined maximum, and including butts 21 upon all the jacks and other spaced butts thereabove in accordance with the pattern requirements, a cam 21a to act upon the butts 21 of all the jacks, movable selecting cams to act respectively upon the spaced butts of the jacks above the butts 21, a cam 35 adapted to elevate all needles and jacks, and a top cam 33 movable radially, a guard cam 29 having lateral movement, a stitch cam 28 movable radially into and out of action, and means automatically to control said cams.

5. A circular hosiery knitting machine having a circular series of independent needles, means for introducing a backing yarn and a plating yarn in a plating relation so as to produce a solid color at each face of the fabric as desired, jacks for raising all the needles to cause them to take both yarns, thereby to produce a solid color said jacks being positioned in the respective needle grooves and having only lengthwise sliding movement therein, in parallelism with the axis of the needle cylinder, selective means including a series of cams at different elevations axially of the needle cylinder, to move said jacks axially thereby, to cause needles at intervals to take only one yarn whereby a pattern effect is produced, top cam 33, and means for operating the same according to pattern dictation.

6. A circular knitting machine having a series of independent needles, jacks respectively controlling said needles and provided with spaced butts ranging from a predetermined minimum to a predetermined maximum, a series of selective cams each adapted to act upon certain jack butts, a pattern drum, means automatically to rotate the same step by step, a top cam 33, means automatically to move the same into and out of action, a cam 21a below the selective cams, and means to operate the same automatically.

7. A circular hosiery knitting machine having a series of independent needles, jacks respectively controlling said needles and provided with spaced butts ranging from a predetermined minimum to a predetermined maximum, a cam ring surrounding the needle cylinder, a series of selective cams each adapted to operate upon certain jack butts, a support radially outside the cam ring for said selective cams, a pattern drum upon the bed plate of the machine to control said selective cams, and a series of bell crank levers between said drum and said selecting cams to control the latter.

8. As a new article of manufacture, a jack for imparting movement to a knitting needle of the so-called "independent" type, said jack being distinct from but adapted to move in the needle groove independent of its needle, and also with its needle to move the latter, said jack having the main portions of its stem of normal (i. e., substantially unreduced) cross section but having its upper end materially thicker from front to rear than the main portion of its stem, and flat thereat so as to present materially increased lifting surface to the lower end of the needles and thereby avoid tilting of its needles upon engagement therewith.

9. A circular hosiery knitting machine of the rotating needle cylinder type having in combination, a circular series of needles, jacks in the respective grooves of said needles below the same and having movement independent thereof and lengthwise of the grooves, each of said jacks having a lowermost butt and each of said jacks having thereabove one or a greater number of spaced butts according to the pattern effect to be produced, a cam adapted to act upon the lowermost butts of all the jacks, a series of selective cams above the first mentioned cam and adapted respectively to act upon the spaced butts of said jacks, a pattern drum mounted at one side of the needle cylinder and having a series of cams respectively controlling the jack butt operating cams.

10. A circular hosiery knitting machine of the rotating needle cylinder type having a series of independent needles, jacks respectively controlling said needles and provided with spaced butts ranging from a predetermined minimum to a predetermined maximum, and including butts 21 upon all the jacks and other spaced butts thereabove in accordance with the pattern requirements, said jacks being mounted in the needle cylinder and movable lengthwise within the slots thereof, a cam 21a to act upon the butts 21 of all the jacks, and a corresponding series of movable selecting cams to act respectively upon the spaced butts of the jacks above the butts 21.

11. A knitting machine having independent needles and other instrumentalities in association therewith to knit fabric having variations in the stitches, some of the instrumentalities having long butts and others short butts, the short butt instrumentalities being in association with and acting upon needles having short butts and the instrumentalities having long butts being in association with and acting upon needles having long butts, the said instrumentalities having a plurality of differently arranged conformations and selective, movable cams acting upon the said conformations variably to move the said instru-

mentalities and thereby affect the movements of their companion needles, a cam in one position acting upon the long and short butts of the instrumentalities to cause the instrumentalities having long and short butts to be moved to a position to be acted upon by the said selective cams, and means for withdrawing the cam to such a position as to act upon the short butts only of the instrumentalities.

12. A circular independent needle knitting machine having a rotary needle and jack cylinder, the said cylinder having longitudinal slots extending lengthwise thereof, needles independently mounted in the slots of the said cylinder and jacks also independently mounted in the slots thereof for movements longitudinally thereof, said jacks being movable independently of their companion needles, means for selecting some of the jacks to vary the character of the knitting, said means including a plurality of movable, selective jack cams in combination with a single jack cam, the cams moving their jacks lengthwise of the needle cylinder and in the slots thereof, both jack movements being in the direction of movement of the needles to yarn taking position, the lengthwise movements imparted to the jacks by the selective cams and by the single cam effecting the knitting of a great number of fabric patterns with a comparatively short needle cylinder, and means for selectively acting upon the said selective cams to effect movement thereof to a position to act upon the jacks in the manner aforesaid.

FRANK E. JONES.

CERTIFICATE OF CORRECTION.

Patent No. 2,255,693. September 9, 1941.

FRANK E. JONES.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 3, first column, line 16, after "depressed." insert the following paragraph -

> The jacks are provided with butts, but are not provided with lateral projections or formations for interengagement with any other jacks. Desirably the upper ends of said jacks are enlarged in a direction from front to rear thereof, to prevent all liability of danger of upward movement of said jacks into engagement with their needles causing said needles to tilt in their grooves, as might be the case if said jacks were of the same extent from front to rear throughout, and especially if they were of reduced extent at their upper ends.

page 6, first column, line 39, for "barrel 40" read --barrel 41--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 12th day of May, A. D. 1942.

Henry Van Arsdale,
Acting Commissioner of Patents.

(Seal)