

Feb. 28, 1928.

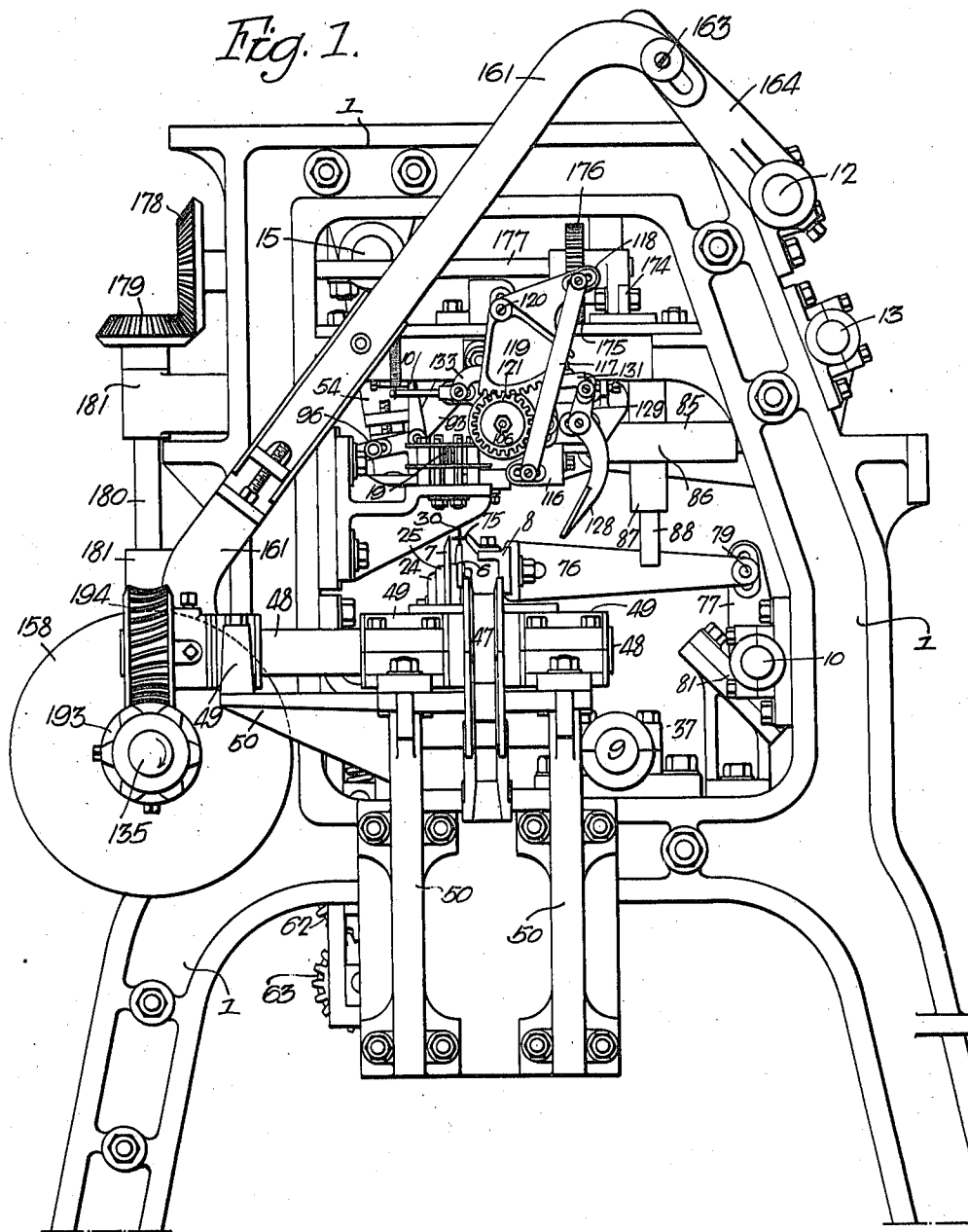
1,661,055

I. SPRINGTHORPE

KNITTING MACHINE

Filed April 18, 1922

26 Sheets-Sheet 1



Inventor—
Isaac Springthorpe.
by his Attorneys—
Howson & Howson

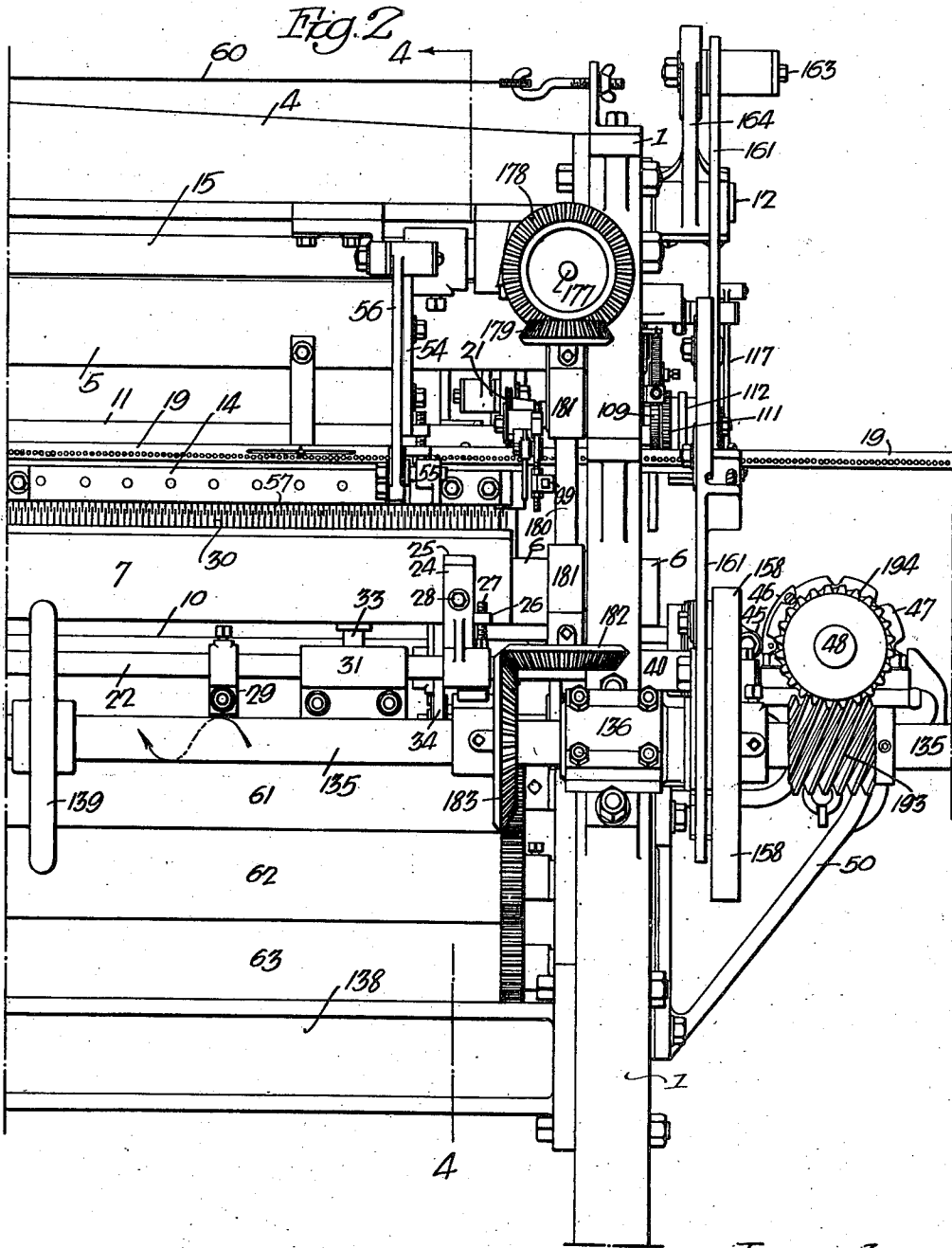
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Inventor—
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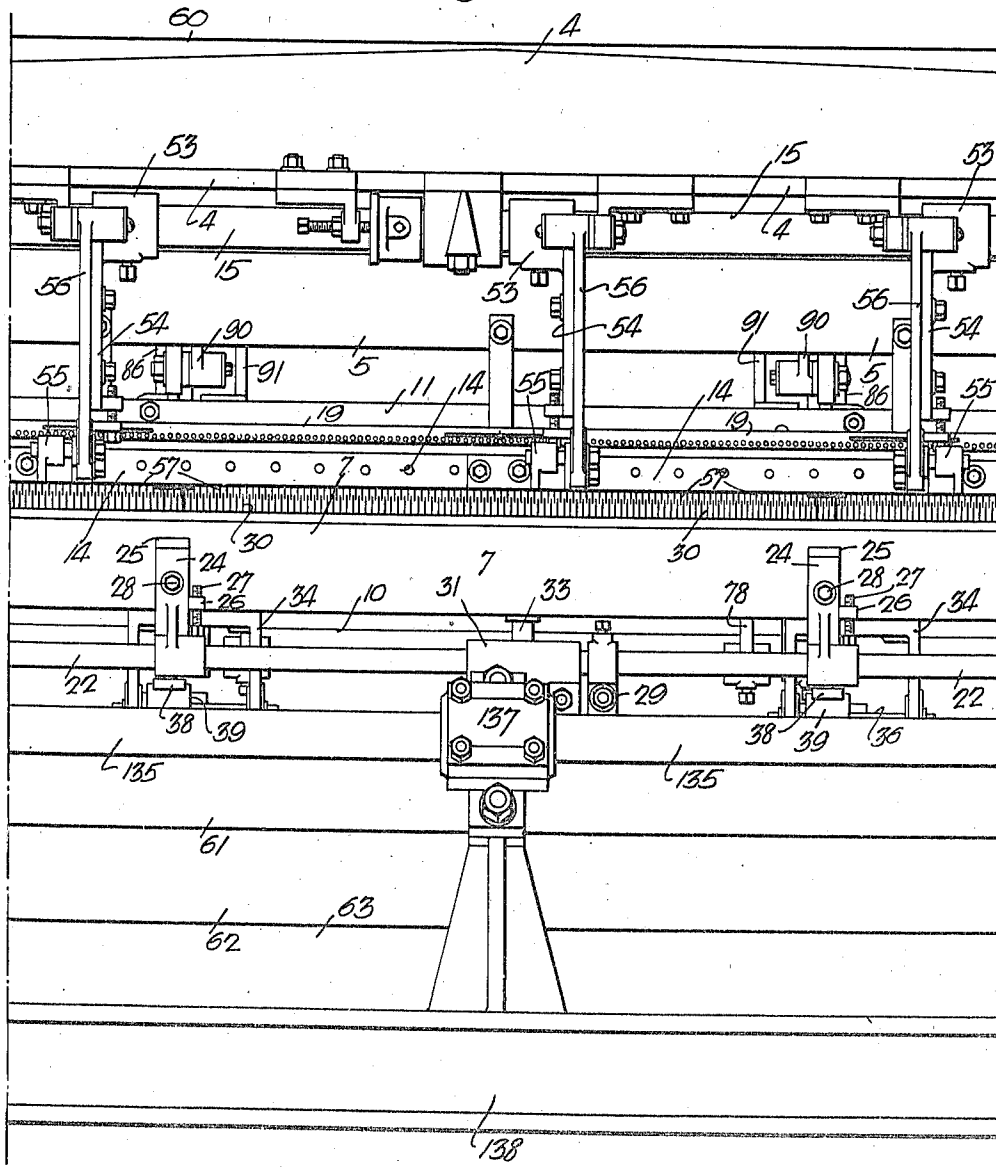
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Fig. 2a.



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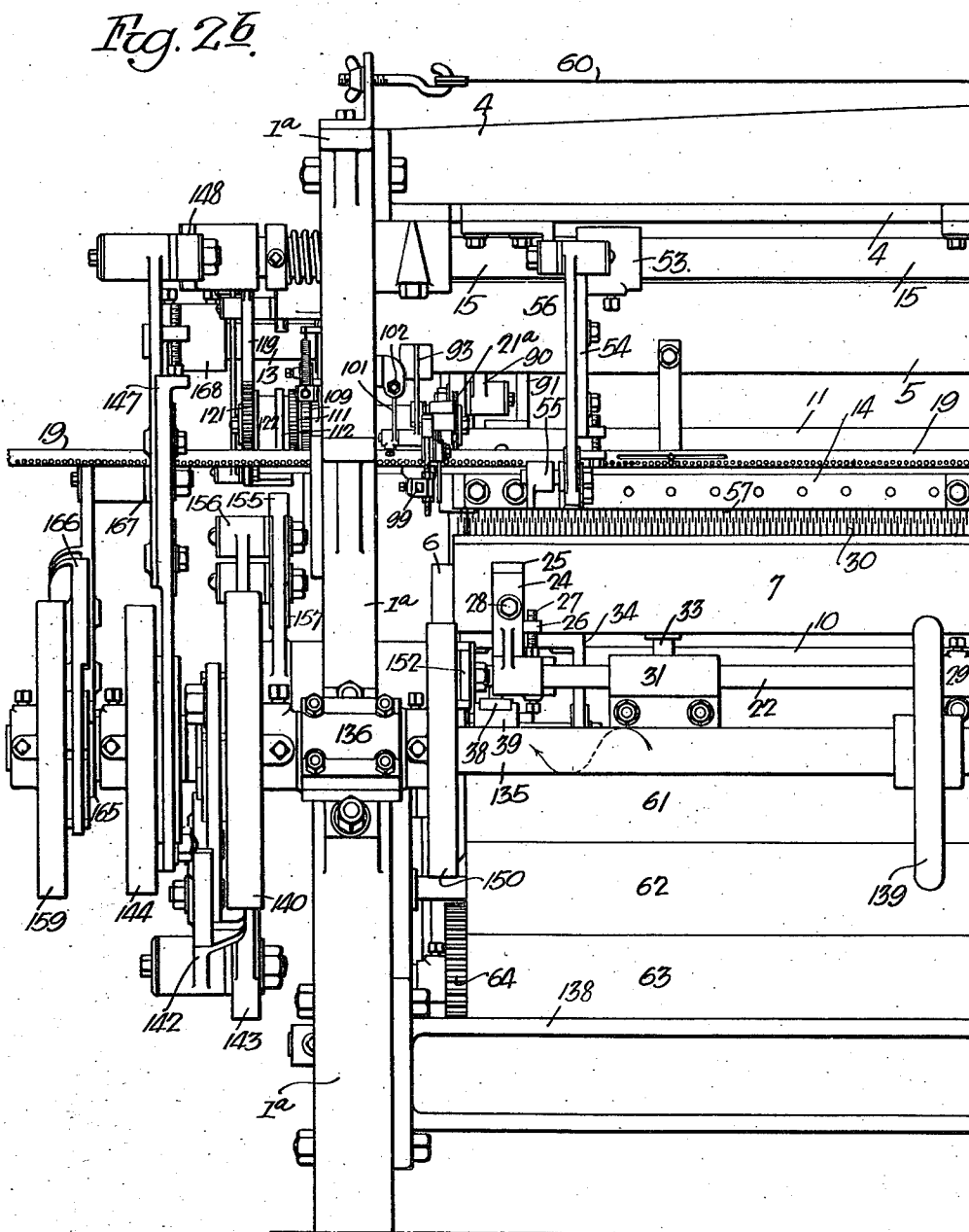
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Fig. 26.



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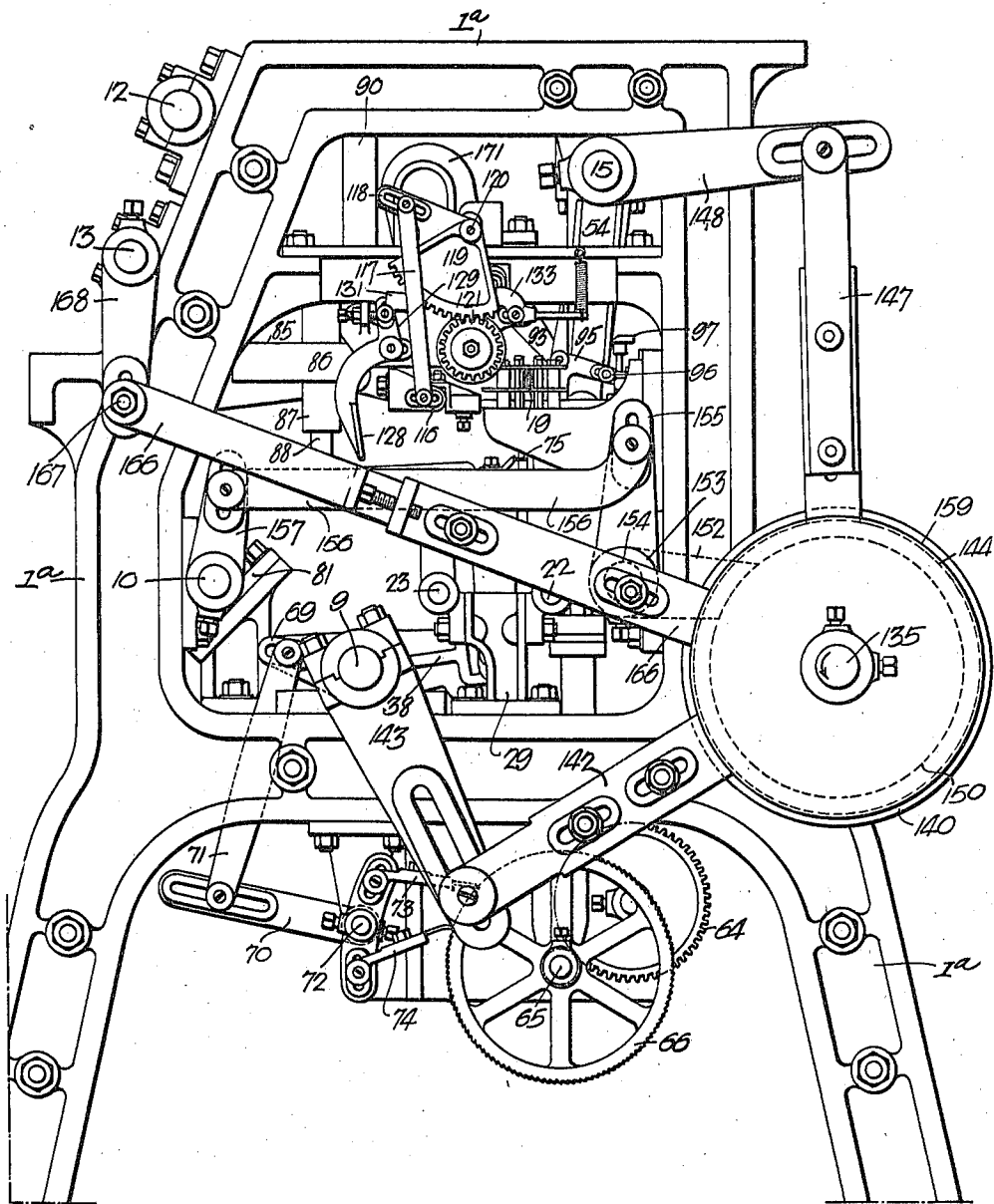
I. SPRINGTHORPE

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Fig. 3.



Inventor—
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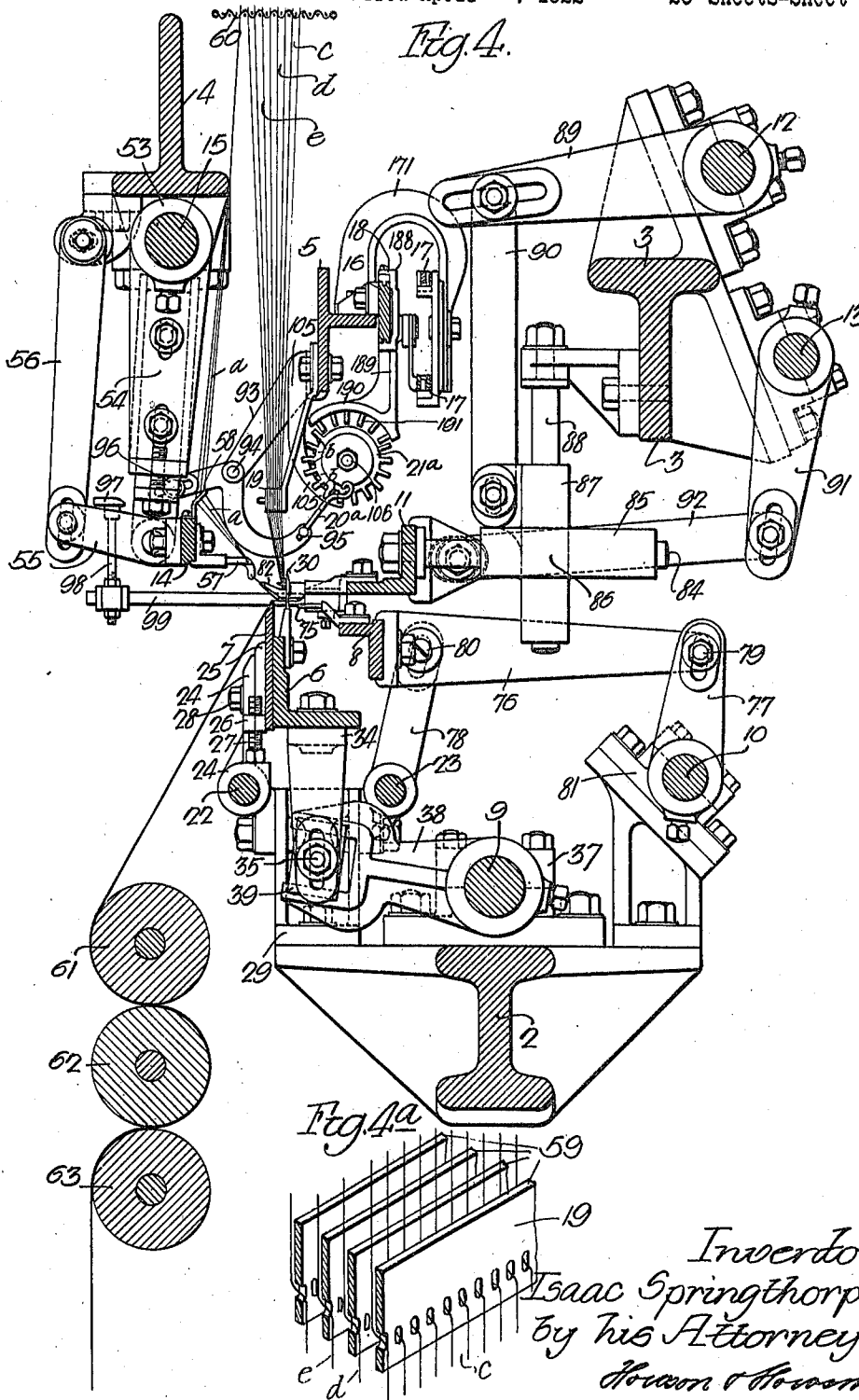
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Fig. 5.

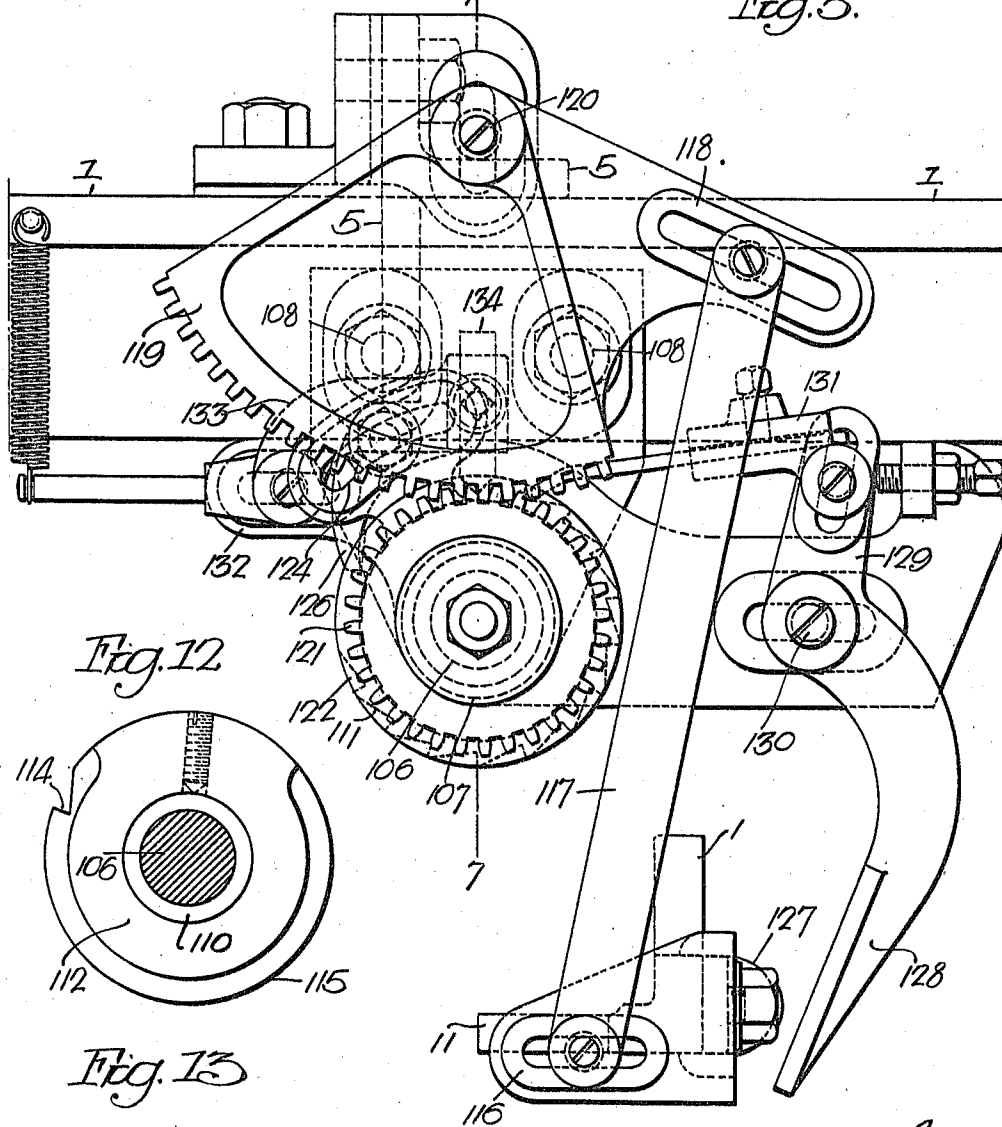


Fig. 12

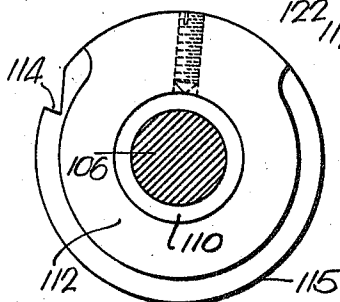


Fig. 13

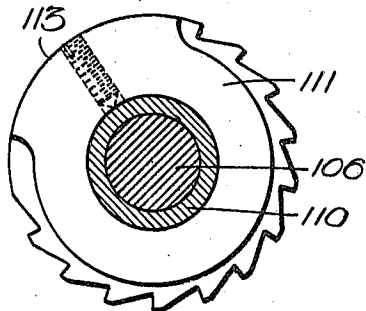
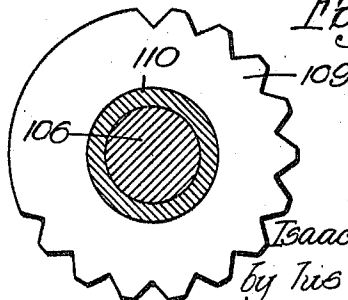


Fig. 14.



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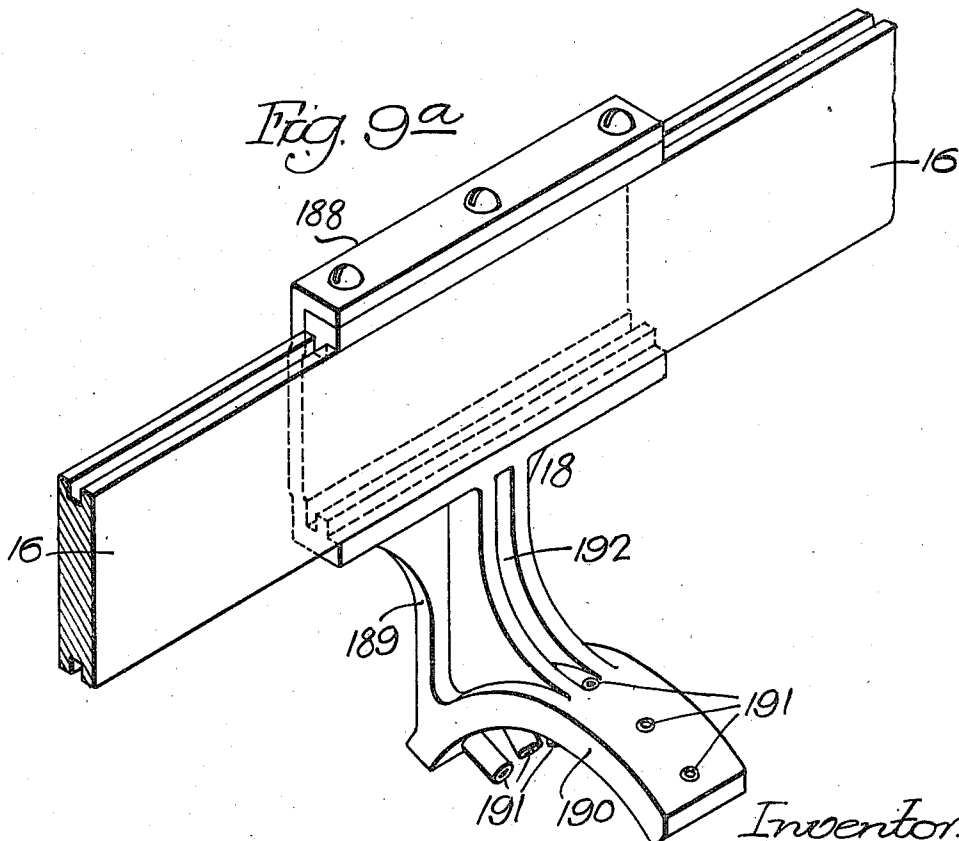
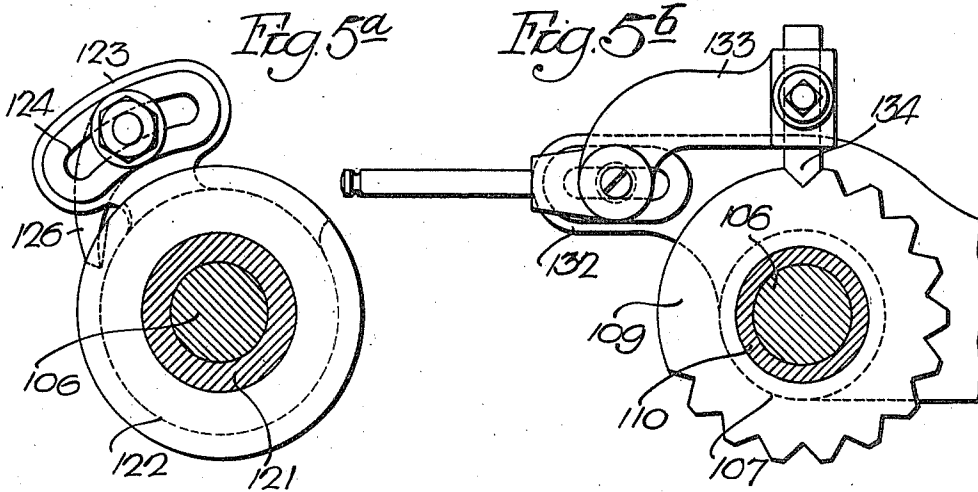
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Inventor:
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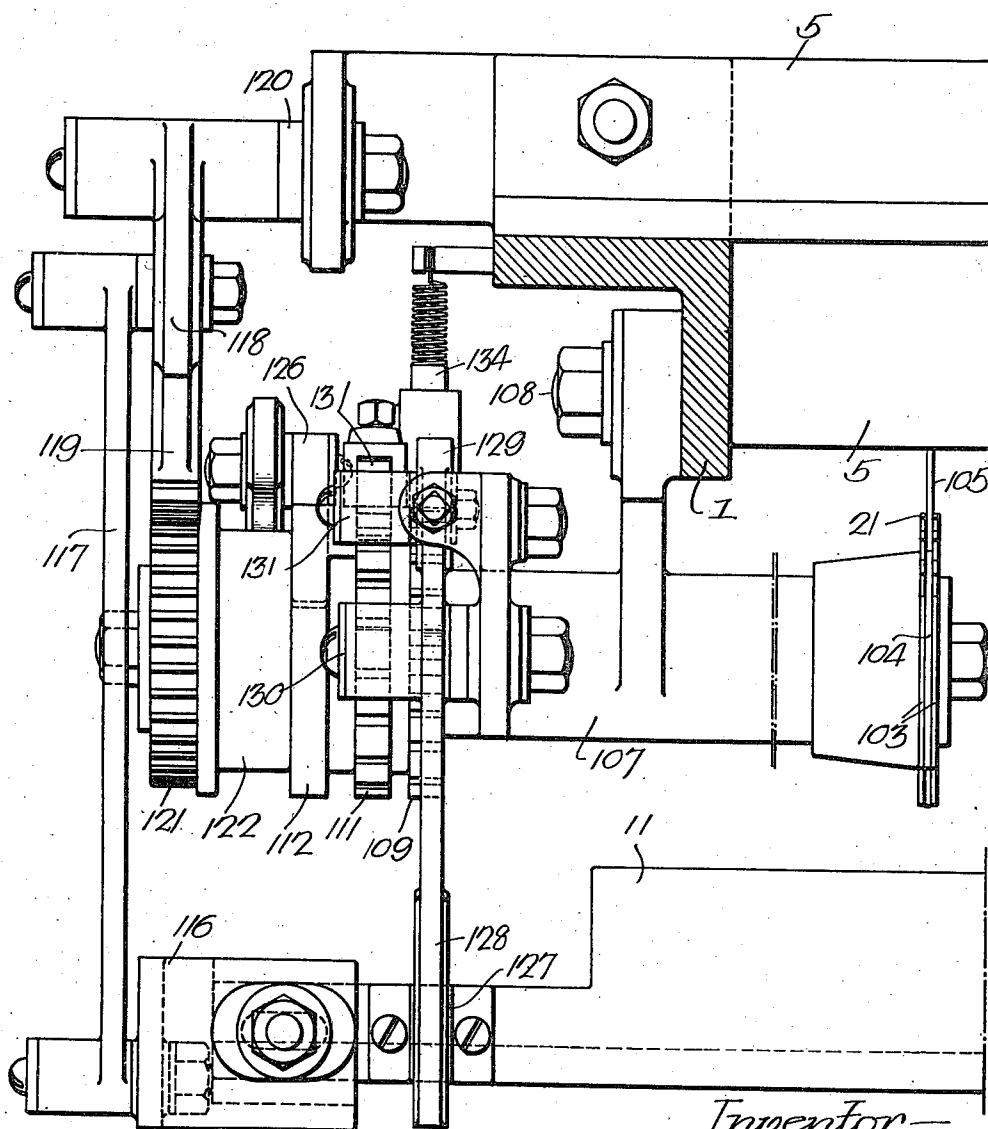
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KNITTING MACHINE

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Fig. 6.



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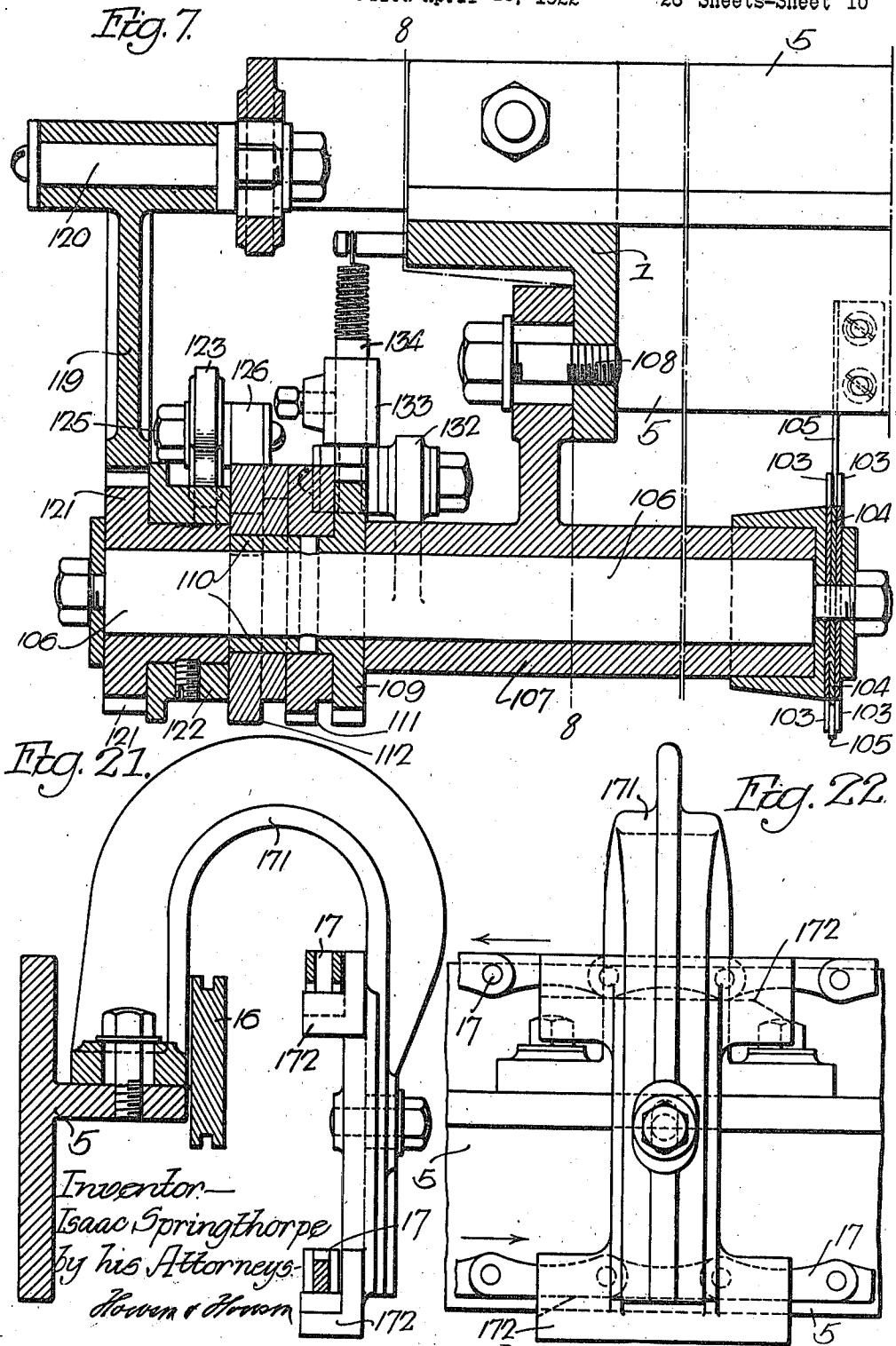
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Fig. 8.

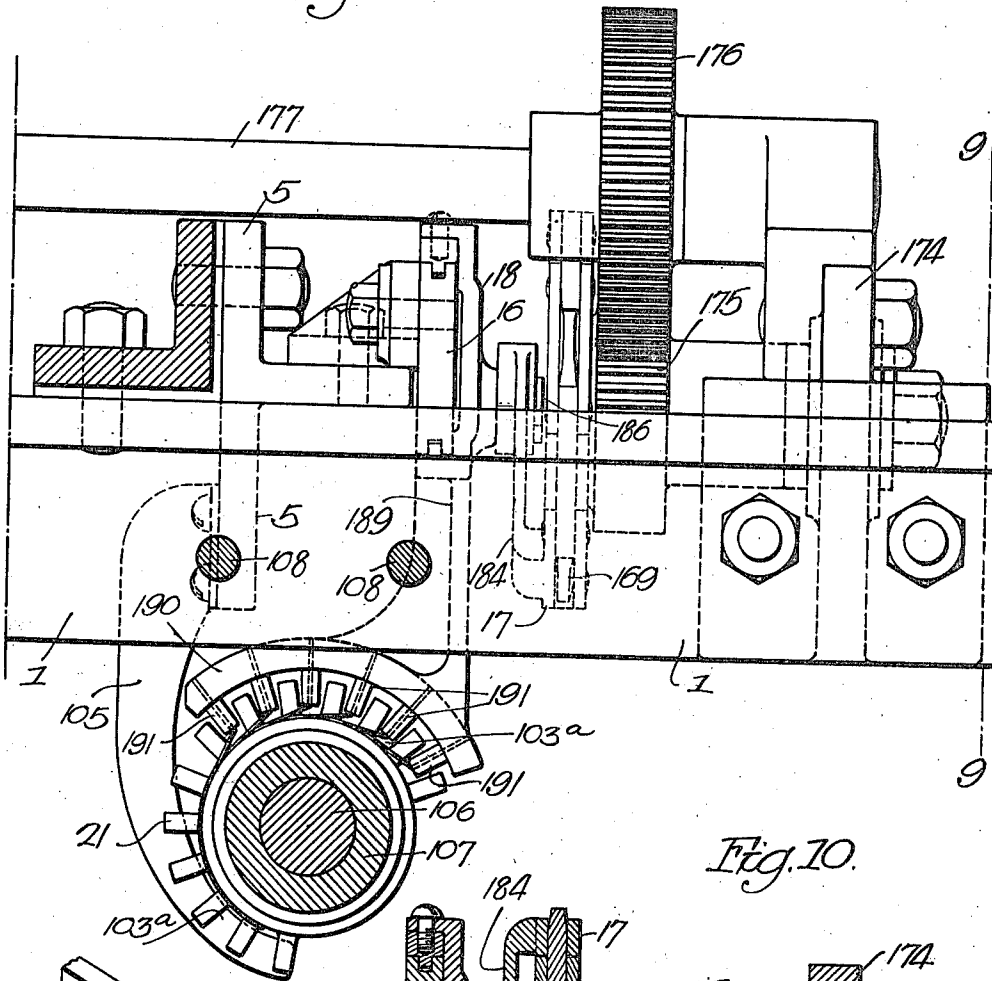
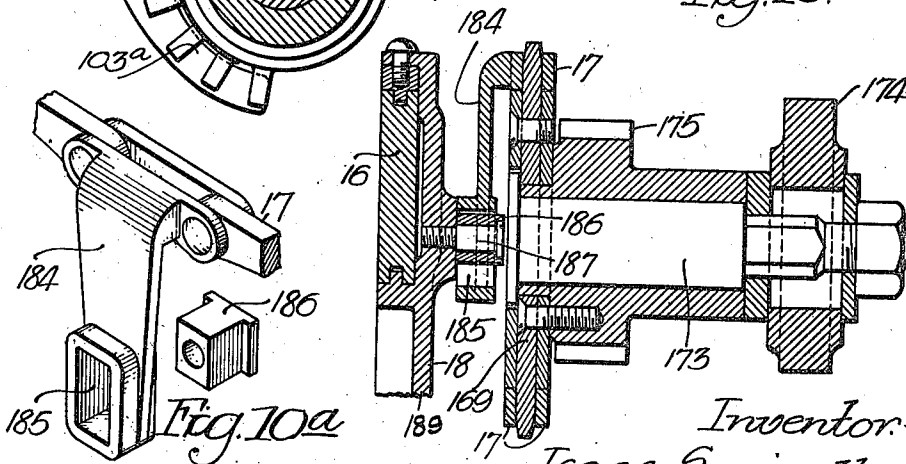


Fig. 10.



Inventor—
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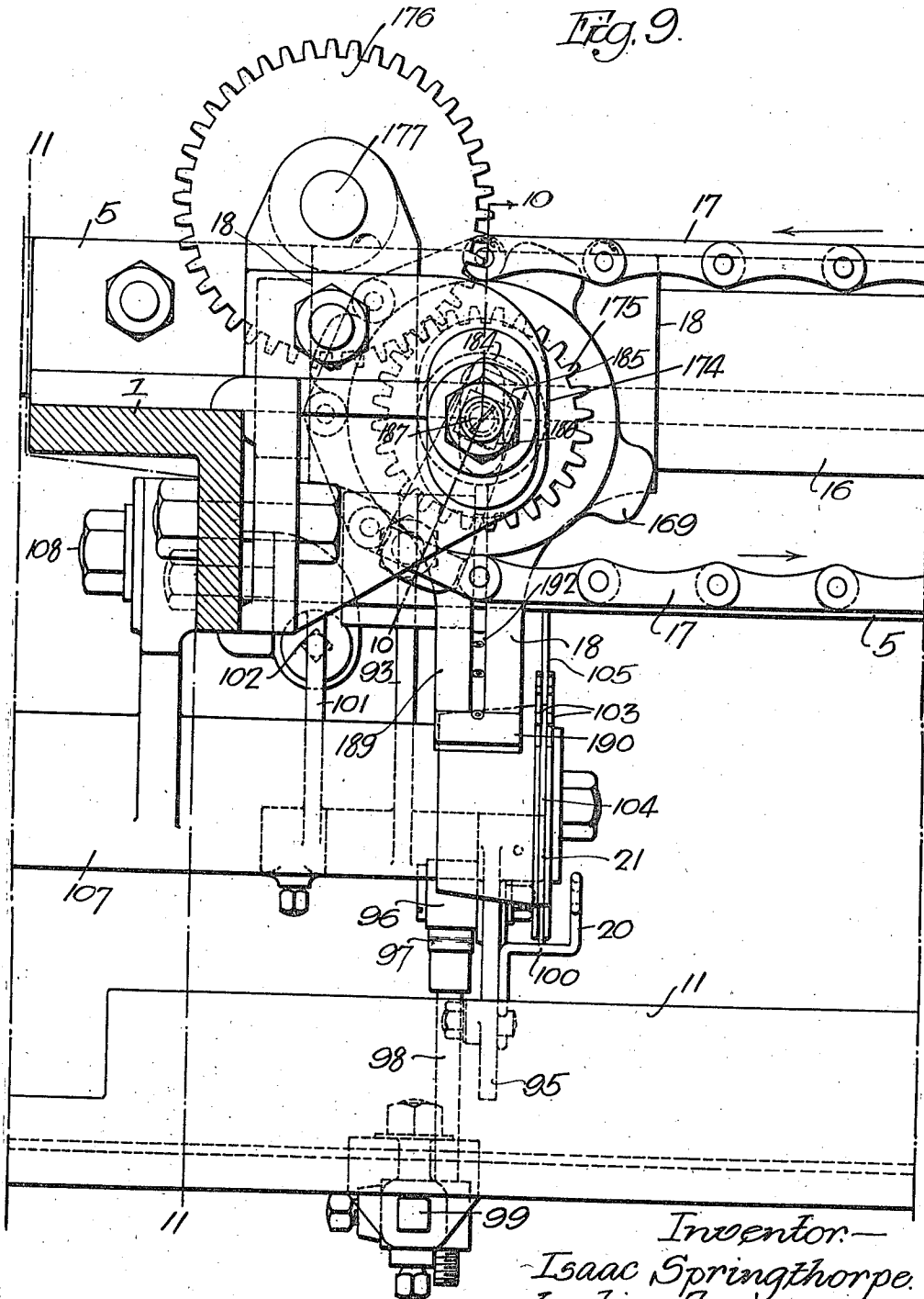
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Fig. 9.



Inventor.—
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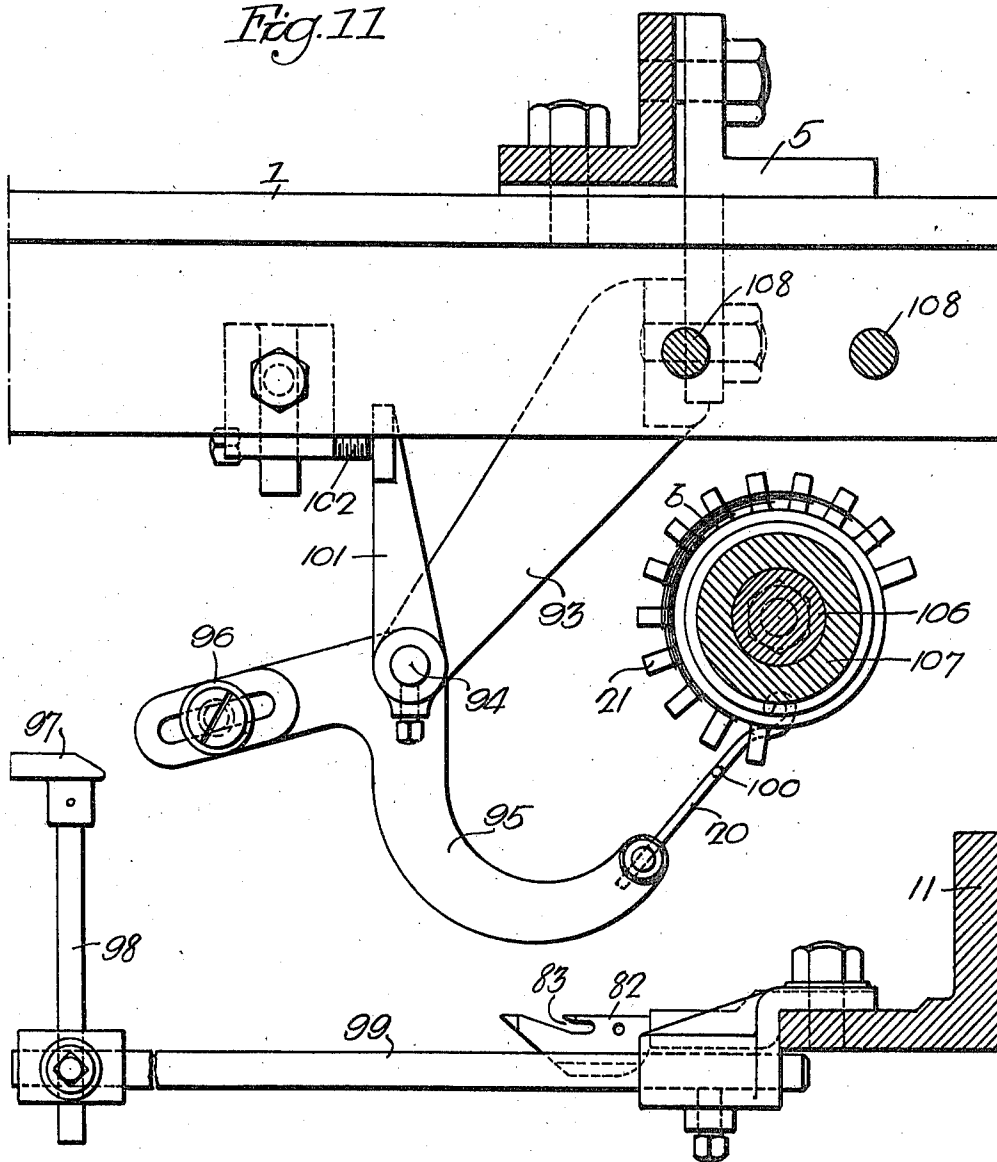
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Fig. 11



Inventor—
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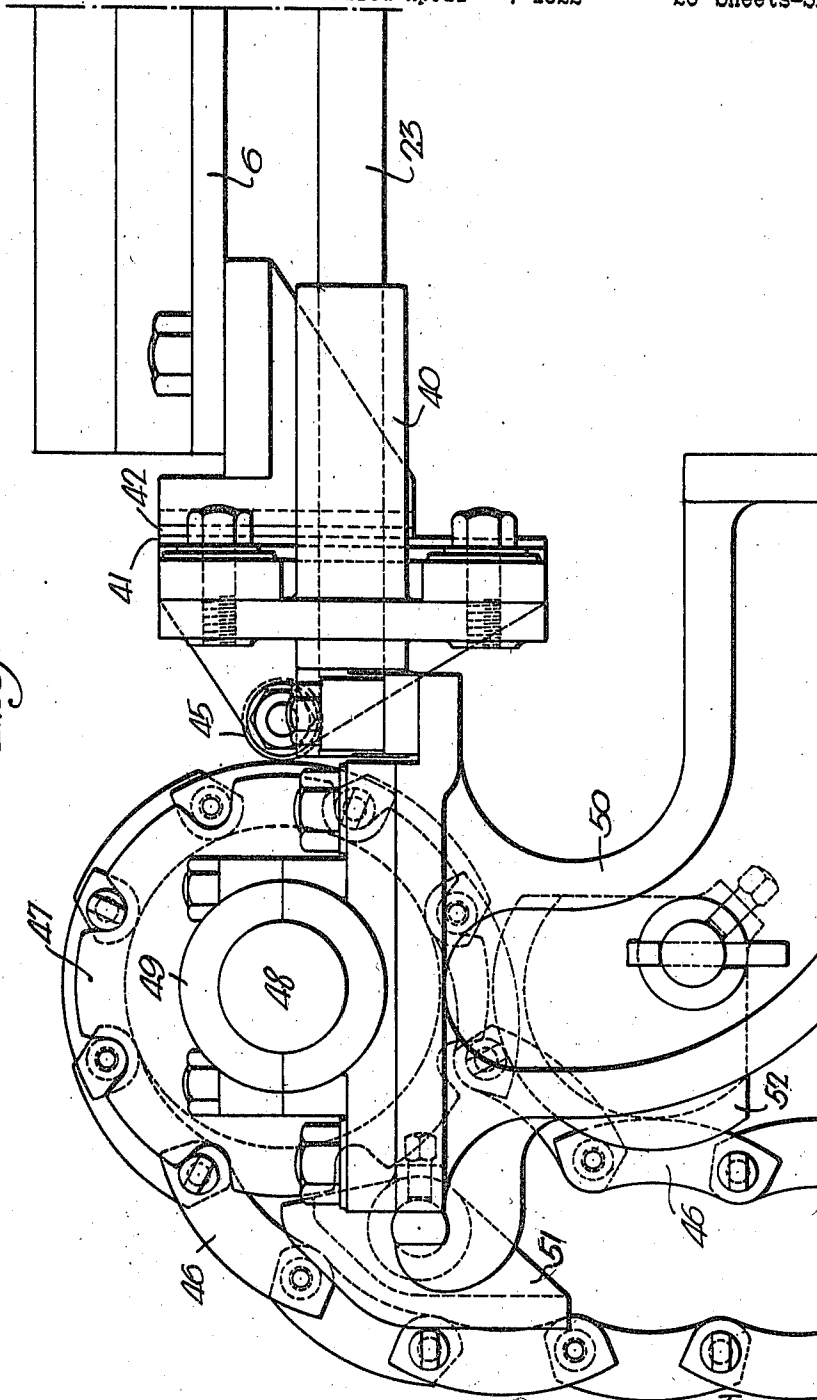
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Fig. 15.



Inventor—
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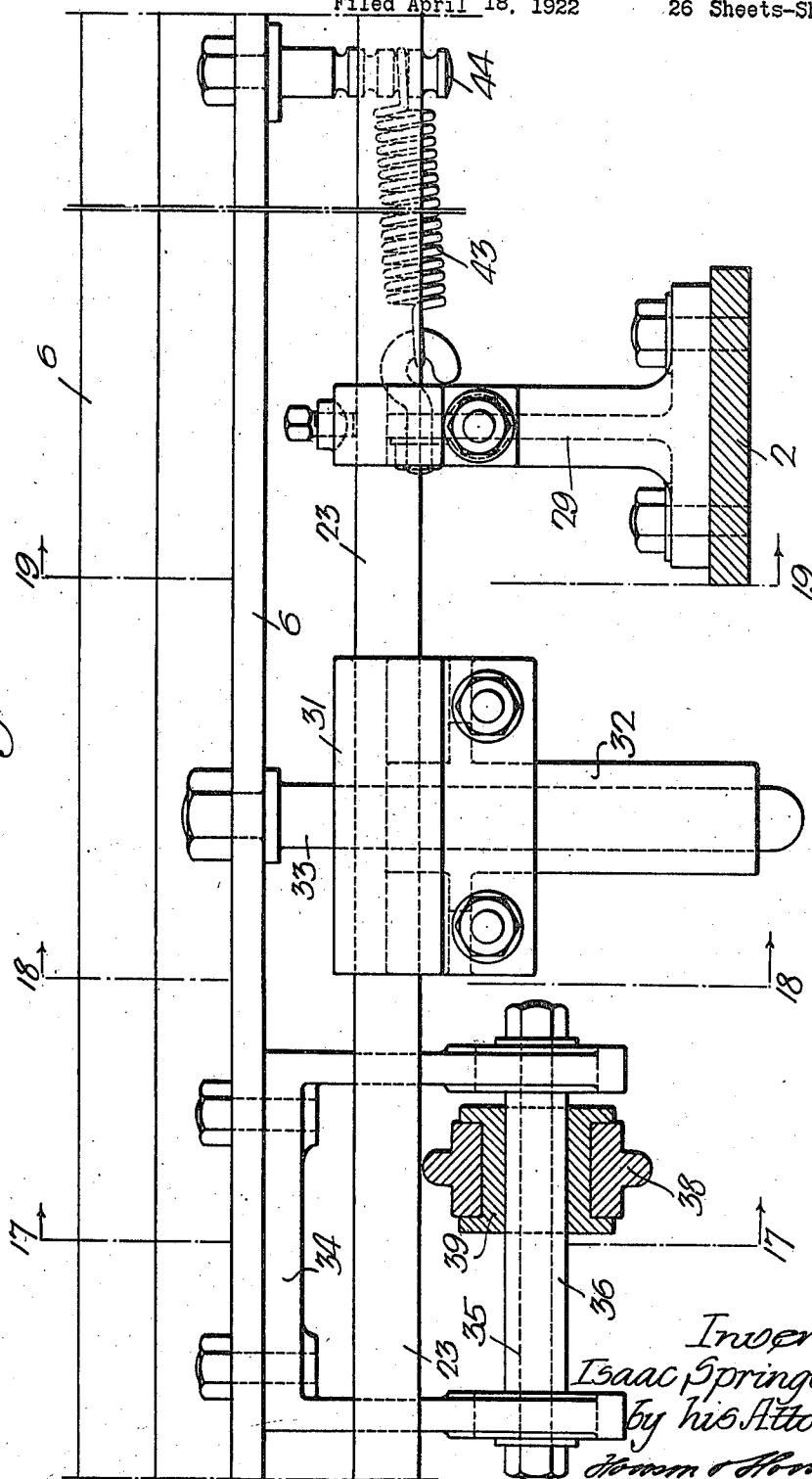
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Fig. 15a



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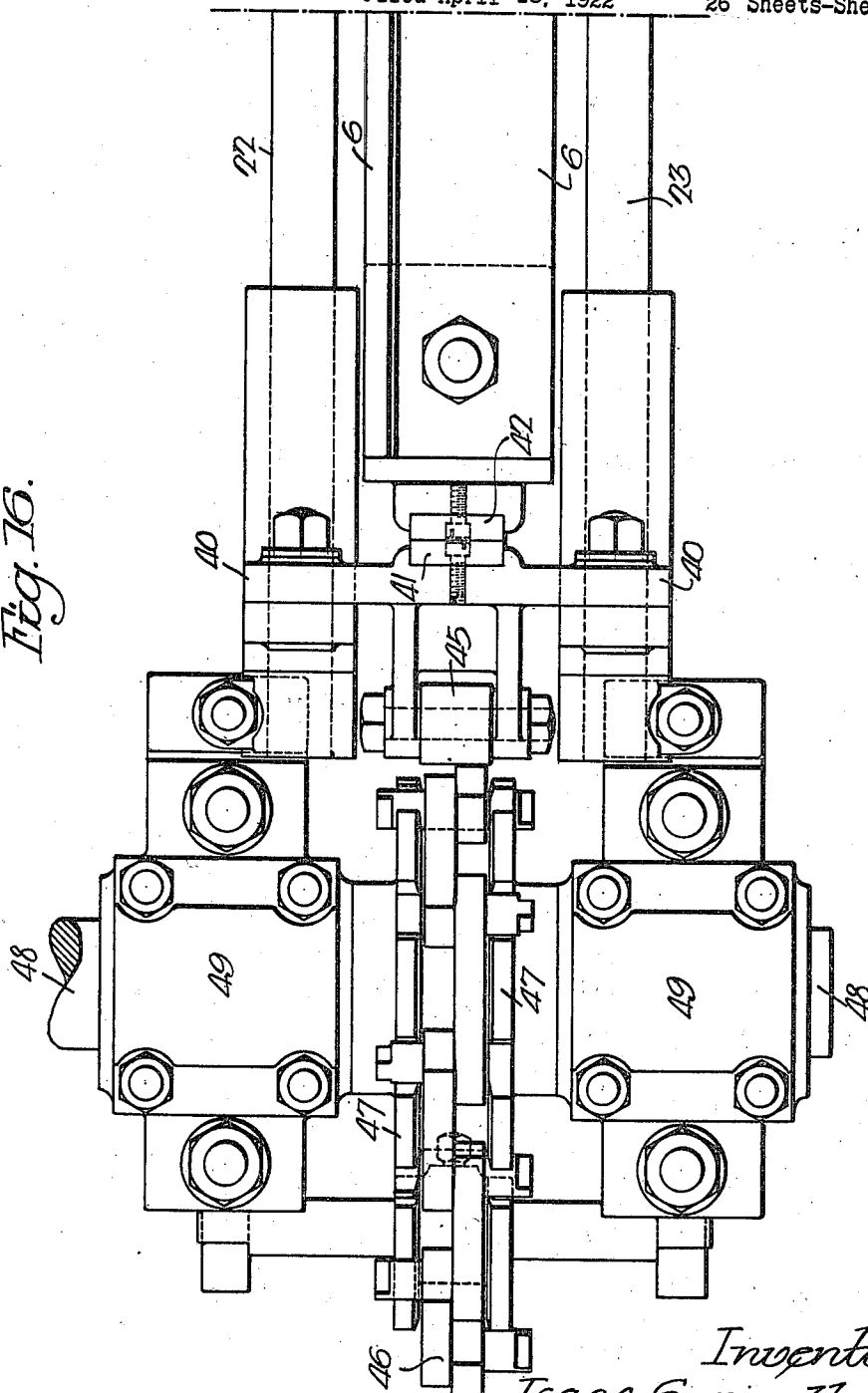
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Fig. 16.



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Fig. 19.

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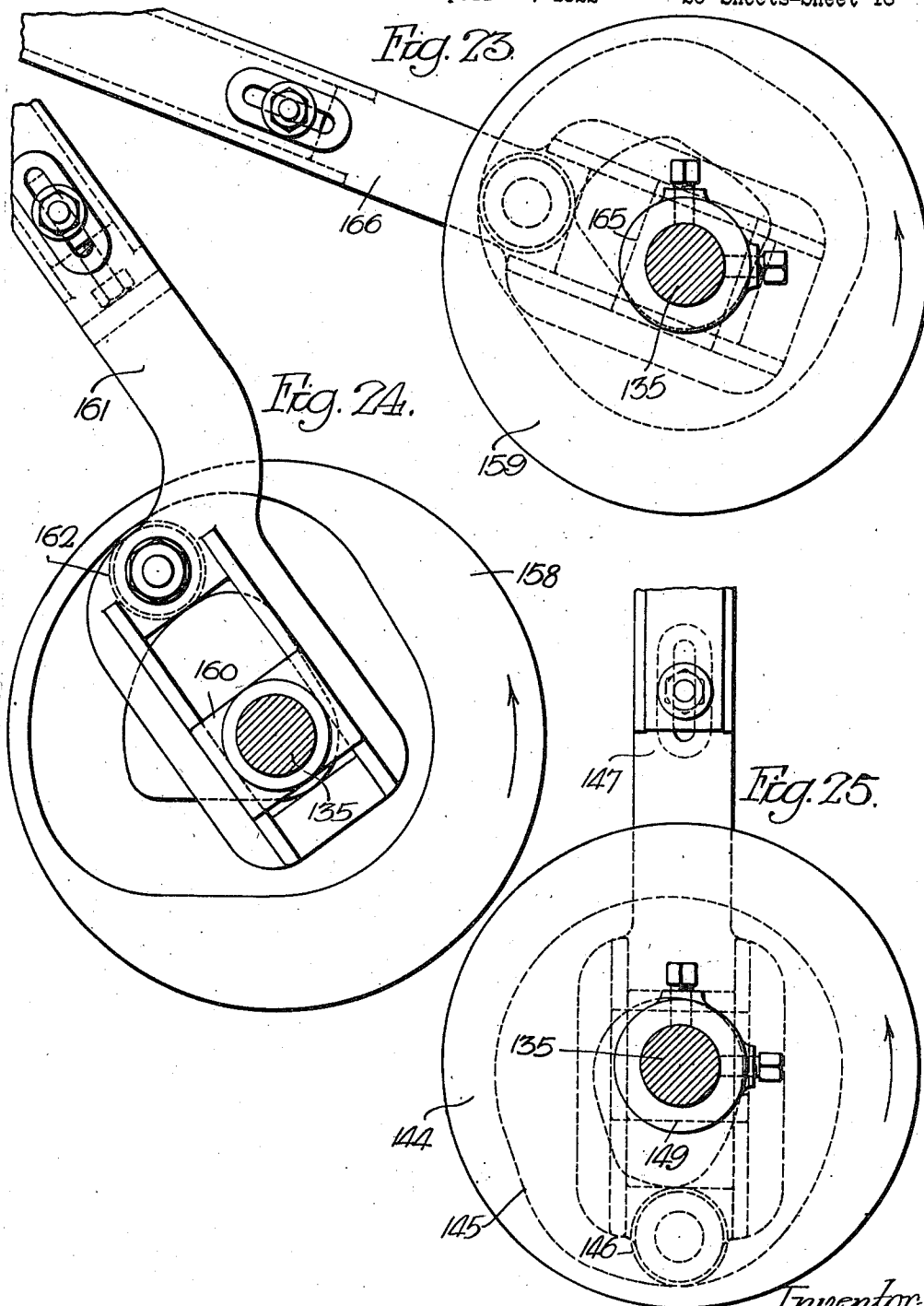
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Inventor:
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Fig. 26.

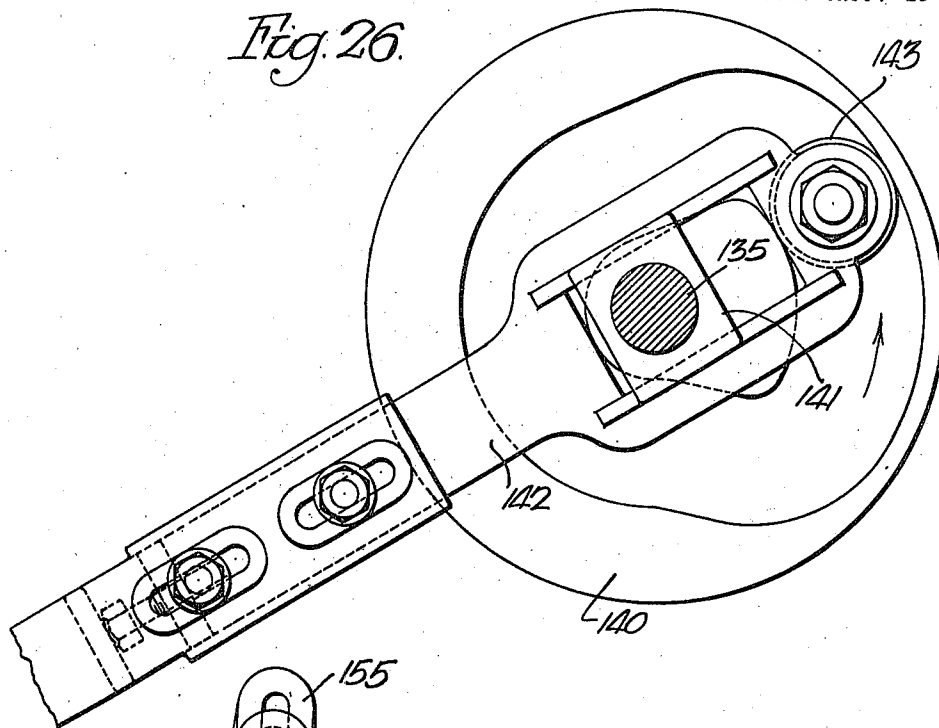
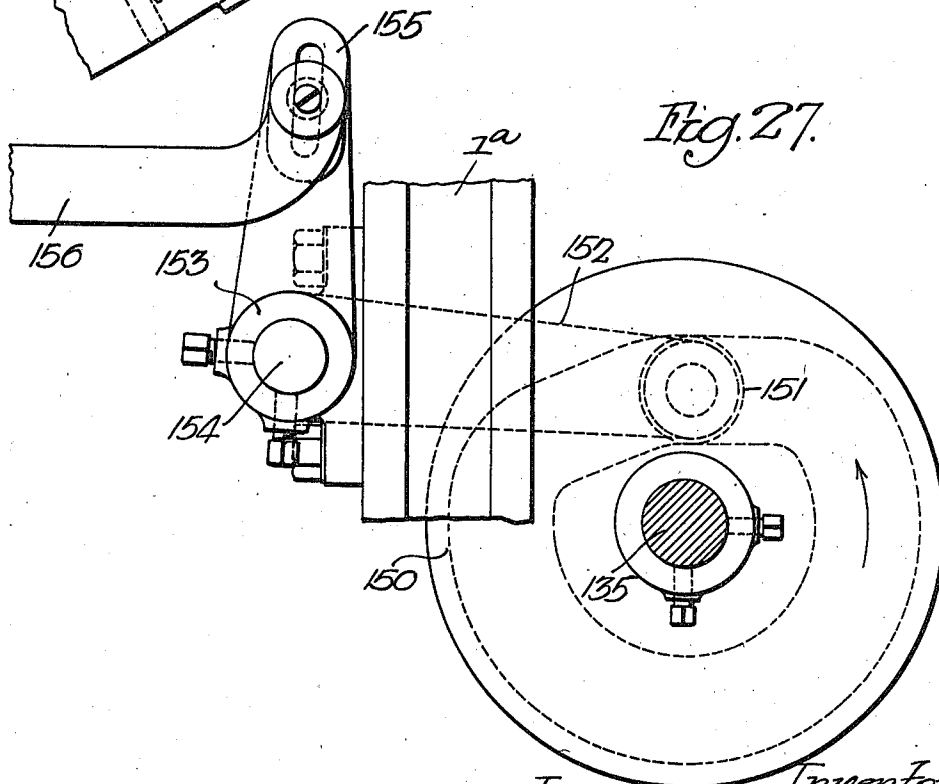


Fig. 27.



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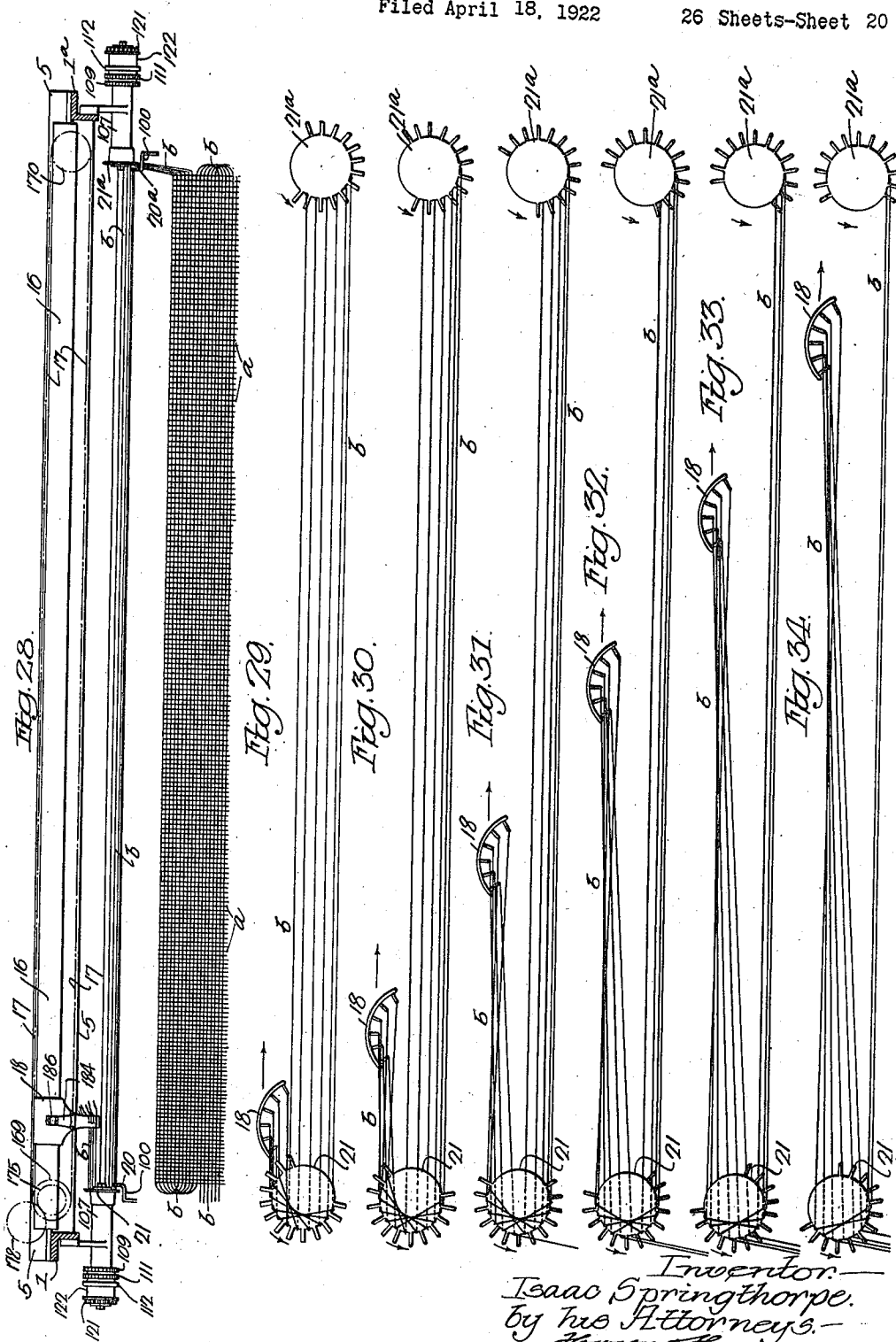
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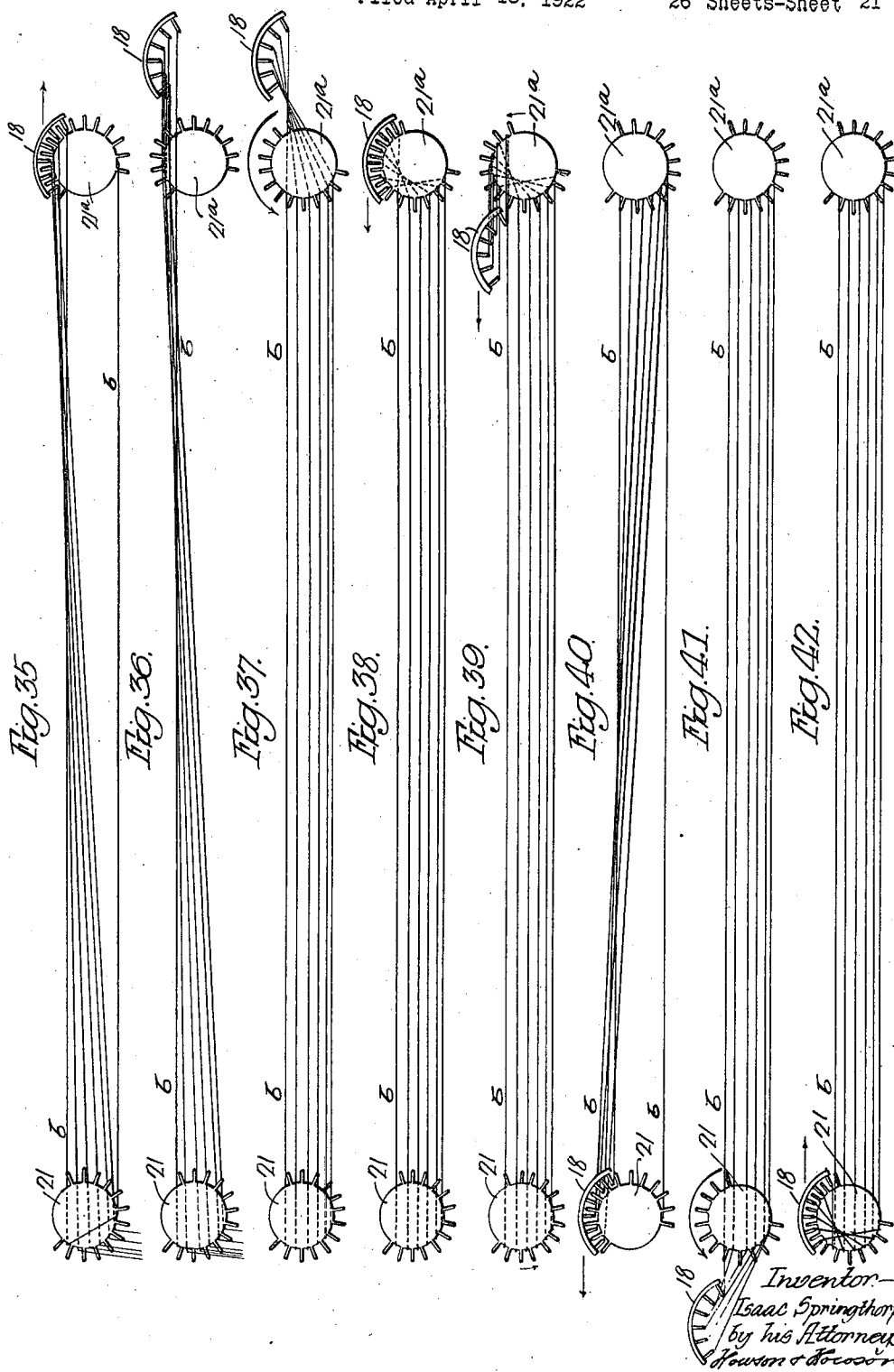
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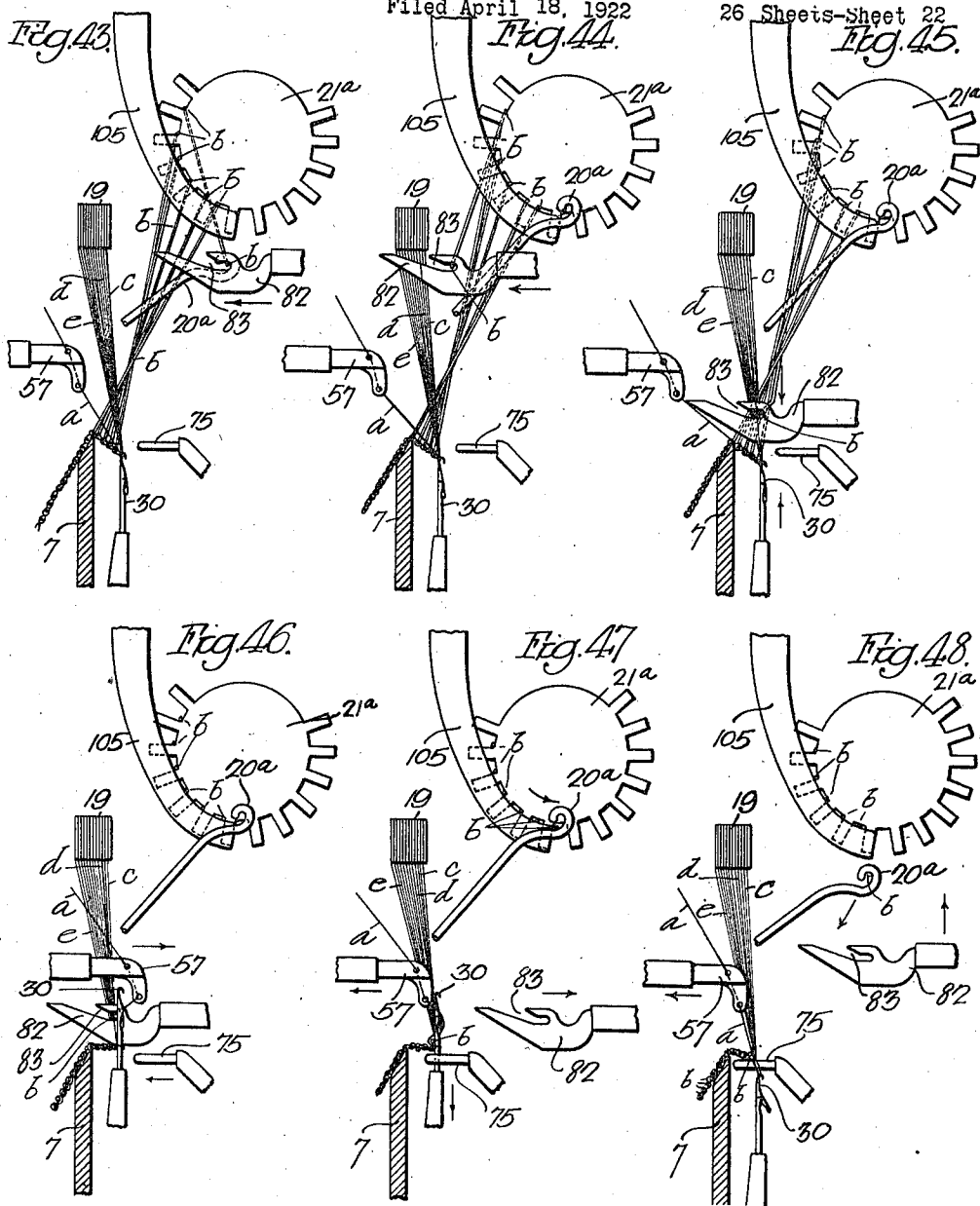
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KNITTING MACHINE

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Inventor-
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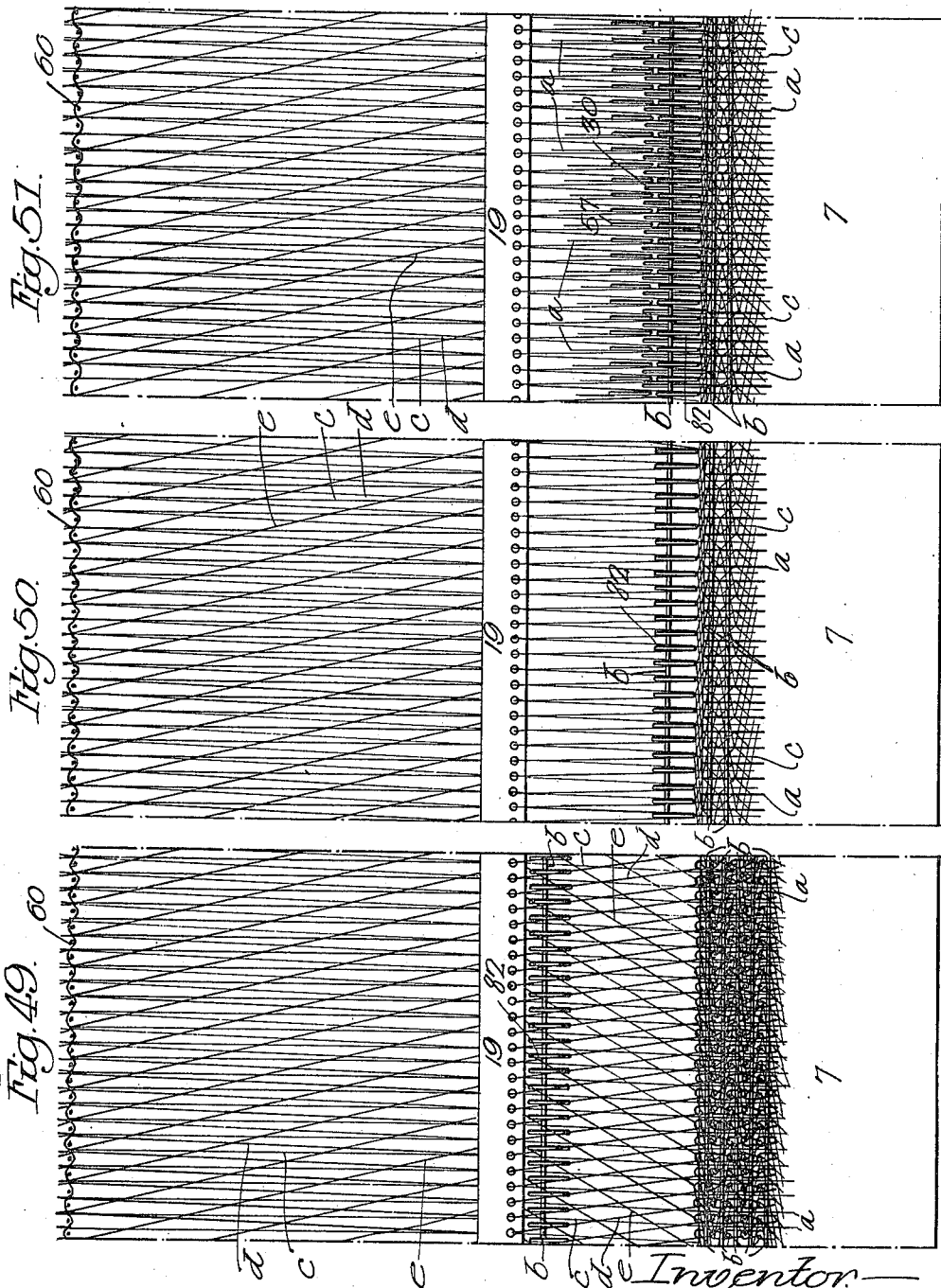
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KNITTING MACHINE

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26 Sheets-Sheet 23



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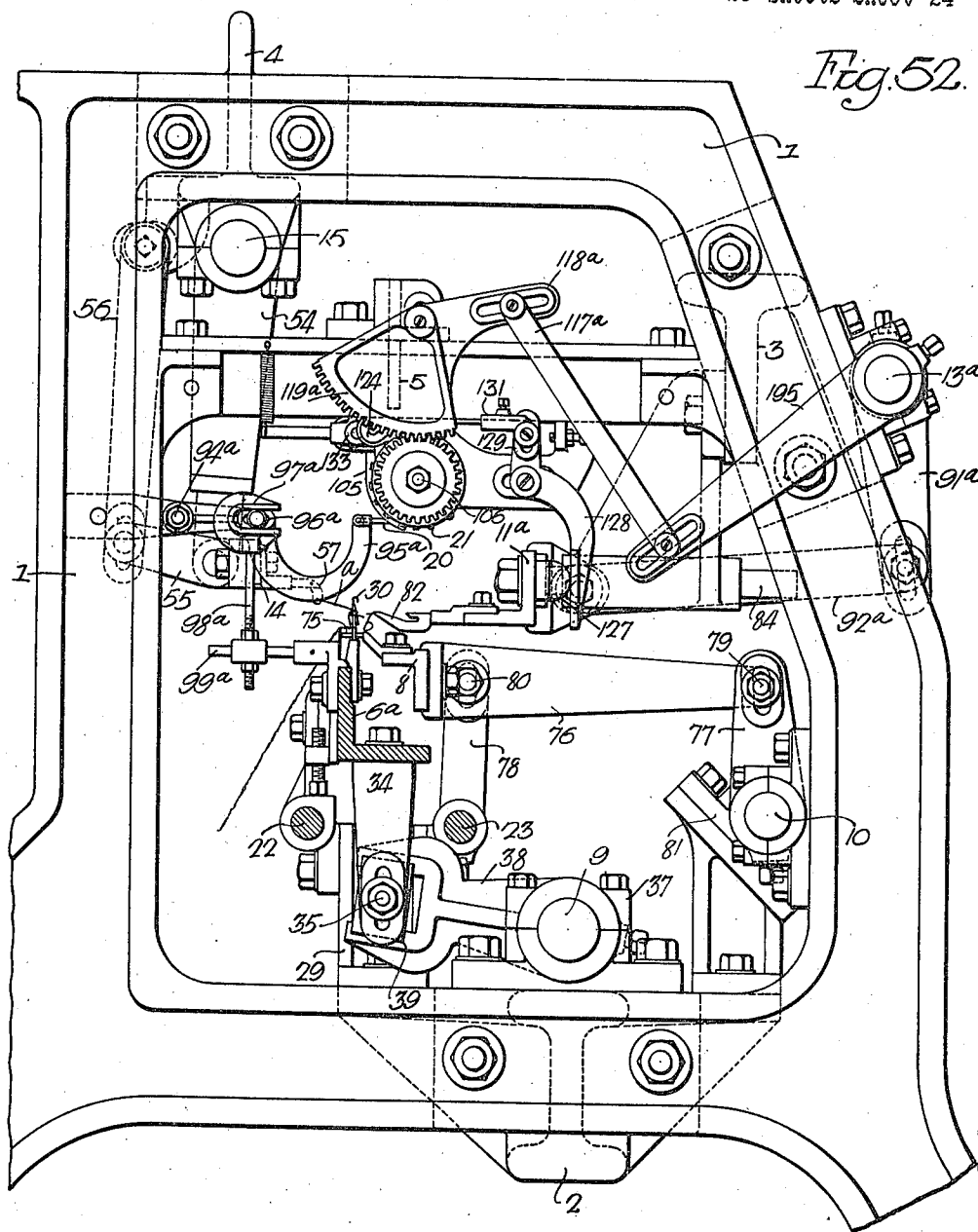
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KNITTING MACHINE

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26 Sheets-Sheet 24



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1,661,055

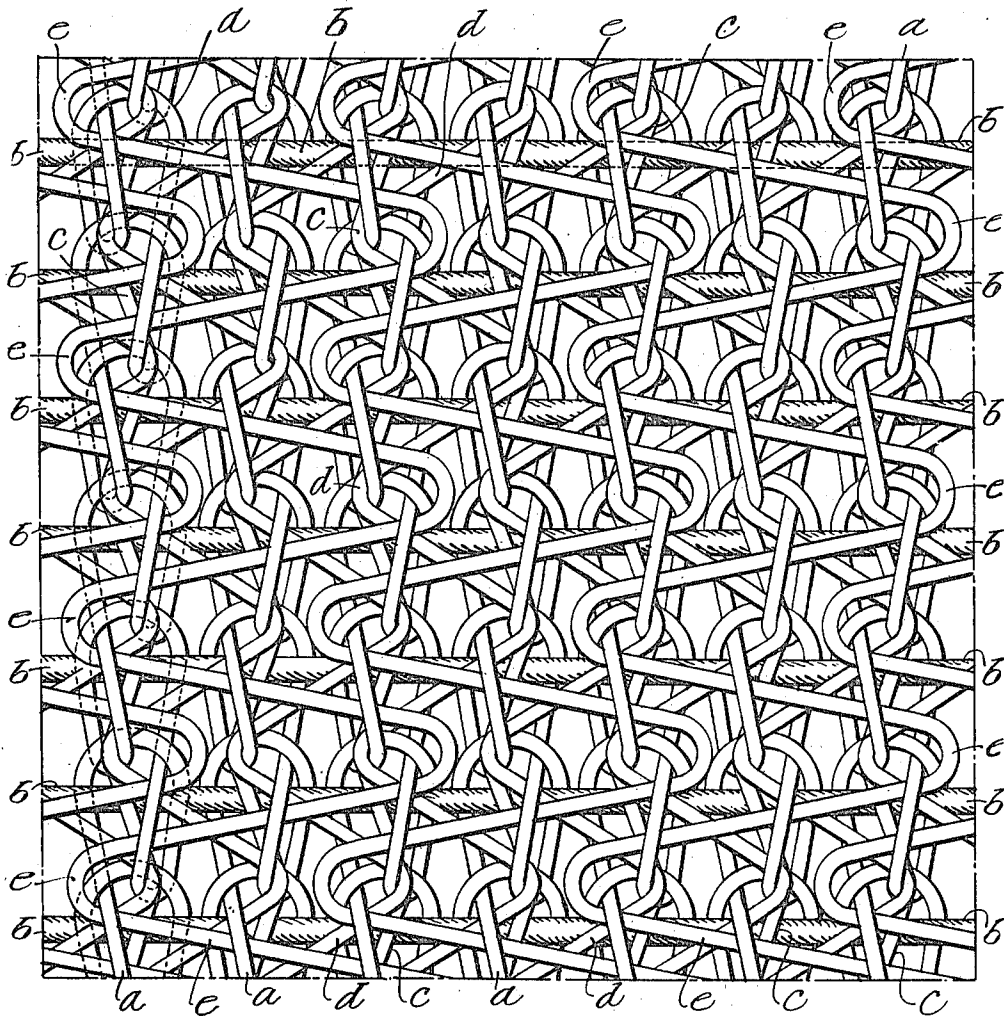
I. SPRINGTHORPE

KNITTING MACHINE

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Fig. 53.



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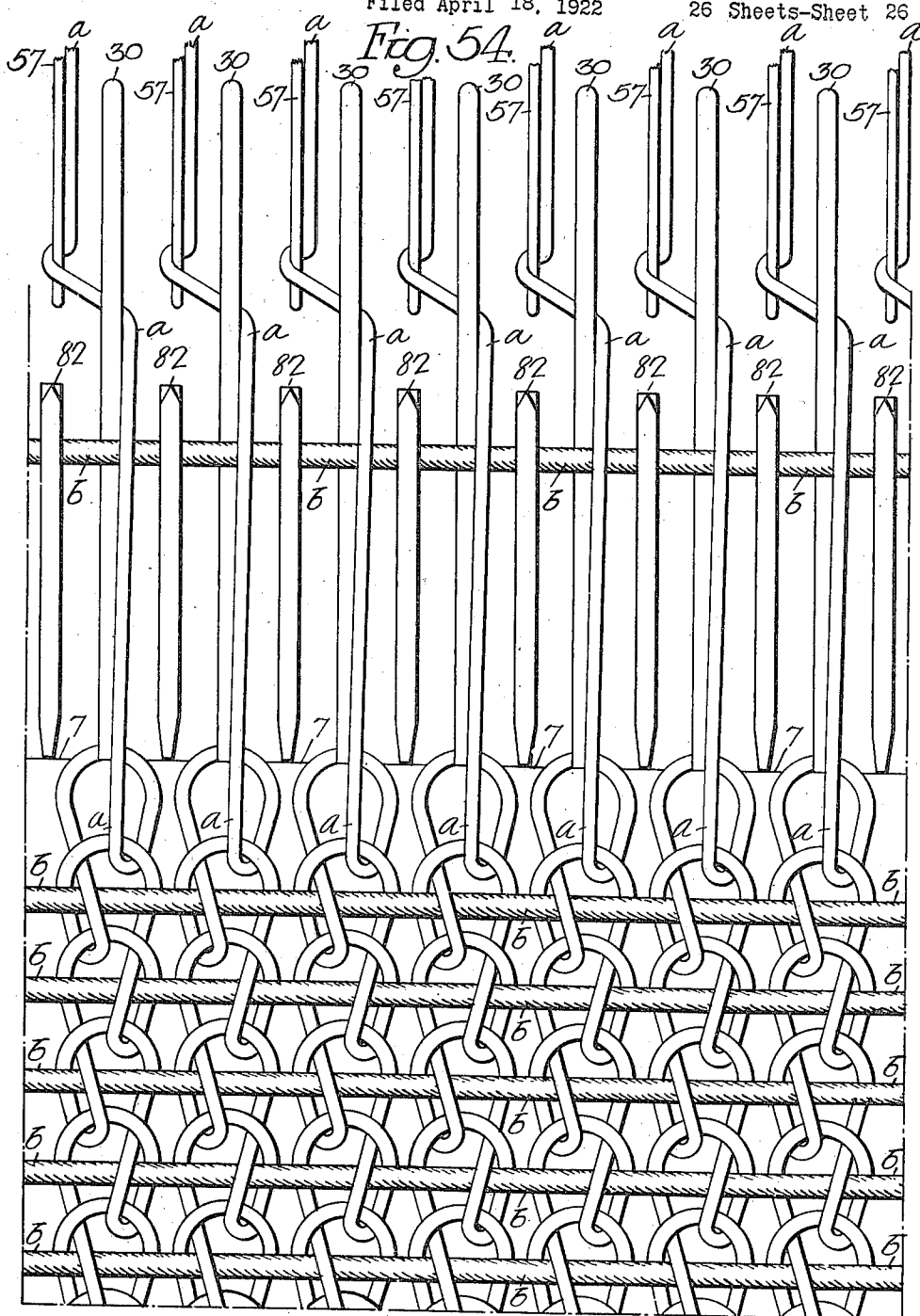
1,661,055

I. SPRINGTHORPE

KNITTING MACHINE

Filed April 18, 1922

26 Sheets-Sheet 26



Inventor—
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Patented Feb. 28, 1928.

1,661,055

UNITED STATES PATENT OFFICE.

ISAAC SPRINGTHORPE, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR, BY MESNE ASSIGNMENTS, TO CONTINENTAL MILLS, INC., OF PHILADELPHIA, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA.

KNITTING MACHINE.

Application filed April 18, 1922. Serial No. 554,464.

My invention relates to certain improvements in straight knitting machines.

One object of my invention is to construct a knitting machine of the above type on which a fabric can be knitted in which there is no substantial stretch.

A further object of the invention is to construct a machine on which a fabric can be knitted having a foundation composed of knitted chains or a net, and in which individual weft threads extend from selvage to selvage of the fabric.

A still further object of the invention is to construct a machine in which two or more continuous weft threads are introduced into the machine simultaneously and one weft thread is selected from the series and introduced into each course, or into a predetermined course, as the fabric is being knitted.

Another object of the invention is to make a knitted fabric having continuous warp threads and having binding and filler threads which may form the design.

In the accompanying drawings:

Fig. 1 is an end elevation of the right hand end of my improved straight knitting machine.

Figs. 2, 2^a and 2^b constitute a front elevation of the machine.

Fig. 3 is an end elevation of the left hand end of the machine.

Fig. 4 is a transverse sectional view of the machine, taken on the line 4—4, Fig. 2.

Fig. 4^a is a detached perspective view, enlarged, showing the thread bars.

Fig. 5 is an enlarged end view of certain portions of the operating mechanism employed in inserting the weft threads into the fabric.

Figs. 5^a and 5^b are details of parts of mechanism shown in Fig. 5.

Fig. 6 is a side elevation of the mechanism shown in Fig. 5.

Fig. 7 is a longitudinal sectional elevation taken on the line 7—7, Fig. 5.

Fig. 8 is a transverse sectional view taken on the line 8—8, Fig. 7, showing the thread laying shuttle.

Fig. 9 is a longitudinal sectional view taken on the line 9—9, Fig. 8, showing the mechanism for actuating the shuttle.

Fig. 9^a is a perspective view of the shuttle.

Fig. 10 is a sectional view taken on the line 10—10, Fig. 9.

Fig. 10^a is a perspective view of the slotted arm on the shuttle chain.

Fig. 11 is a transverse sectional view taken on the line 11—11, Fig. 9, showing the doffing mechanism and its operating parts.

Figs. 12, 13, and 14 are detail views of the different ratchet wheels employed in the operation of introducing the weft threads into the fabric.

Figs. 15, 15^a constitute a side elevation of the needle bar and its shogging mechanism.

Fig. 16 is a plan view of the mechanism shown in Fig. 15.

Fig. 17 is a sectional view on the line 17—17, Fig. 15^a.

Fig. 18 is a sectional view on the line 18—18, Fig. 15^a.

Fig. 19 is a sectional view on the line 19—19, Fig. 15^a.

Fig. 20 is a face view of the mechanism shown in Fig. 17 and illustrating the supporting mechanism of the work plate.

Figs. 21 and 22 are views illustrating details of the chain carrying mechanism of the thread laying shuttle.

Figs. 23, 24, 25, 26 and 27 are detached views of the operating cams.

Fig. 28 is a diagrammatic, longitudinal, sectional view showing the method of placing the weft threads on the thread carriers.

Figs. 29 to 42, inclusive, are diagrammatic views showing the different steps in the process of laying the thread in the carriers.

Figs. 43 to 48, inclusive, are diagrammatic views illustrating the method of taking the threads from the carrier and placing them in the fabric at the point of knitting.

Figs. 49, 50 and 51 are diagrammatic views illustrating the method of placing the threads and tying them in the fabric.

Fig. 52 is a view showing the simplest form of mechanism in which a fabric is formed, having a background of knitted chains and bound together by continuous weft threads.

Fig. 53 is a diagrammatic view of a fabric produced on the machine illustrated in Figs. 1 to 51 inclusive, and

Fig. 54 is a diagrammatic view of a simple fabric, which may be produced on the machine shown in the main figures by cut-

ting out certain elements, and which can be produced on the machine shown in Fig. 52.

Referring in the first instance to Figs. 1 to 4 inclusive, which are the general views of the machine, 1 is the right hand end frame, and 1^a is the left hand end frame. These frames are connected together by transverse beams 2, 3, 4, 5 and 138. The beam 2 supports the needle bar 6, the work plate 7, a point bar 8, and their operating shafts 9 and 10. The beam 3 supports the plot bar 11 and its operating shafts 12 and 13. The beam 4 carries the looping bar 14 and its operating shaft 15. The beam 5 supports the shuttle track 16, the chain 17 for moving the shuttle 18 and supports the thread bars 19 and the doffers 20 and 20^a.

The carriers 21 and 21^a are supported by the end frames 1 and 1^a and the end frame 20 also supports the shogging mechanism for the needle bar.

Referring in the second instance to Fig. 54, which is the view of the simplest form of fabric, *a* are individual warp chains and *b* are the continuous weft threads, which extend the full width of the fabric from one selvage to the other. When the fabric is finished, the individual chains are held together by the weft threads and these weft threads prevent lateral stretching of the fabric.

This fabric can be made on the machine illustrated in Figs. 1 to 51, or on the simplest form of machine shown in Fig. 52.

The fabric shown in Fig. 53 consists of the individual warp chains *a* and the continuous weft threads *b*, in addition to the binding threads *d* for binding each pair of individual warp chains, the longitudinal warp threads *c* which prevent longitudinal stretching of the fabric, and the filler or design threads *e*.

Referring to Figs. 2, 2^a, 2^b, 4, 17 and 20, 7 is the work plate extending substantially the full width of the machine. This plate is supported on a fixed bar 22. On this bar 22, are hinge butts 24, which are free to turn on the bar and are adjustably secured to the work plate 7. On the work plate is a plate 25 having a threaded lug 26 and extending through this lug is an adjusting screw 27, which rests against the hinge butt 24. The hinge butt is slotted for the passage of a clamp screw 28. This work plate can be turned on the bar 22 when there is no fabric in the machine so as to expose the needle bar 6, and to allow access to the needles for cleansing and for straightening the needles when necessary.

Extending parallel with the fixed bar 22 is another bar 23. These two bars are supported at the ends by the end frames and at intervals by brackets 29 on the main cross bar 2.

The needle bar 6 is angular in cross section

as shown in Fig. 4, and the needles 30 are secured to the upright section of the bar in the ordinary manner.

On the bars 22 and 23 are carriages 31. Each carriage has a vertical bearing 32 through which extends a steadying pin 33, secured to the needle bar 6. This construction holds the bar 6 laterally but allows it to have a vertical motion, and the carriages and the needle bar are free to move longitudinally.

Depending from the needle bar 6 is a series of U shaped brackets 34, which are slotted to receive a bolt 35. On the bolt, between the arms of the bracket, is a sleeve 36. By this construction the bolt and sleeve can be adjusted on the bracket.

The shaft 9 is a rock shaft and has its bearings in boxes 37 on the beam 2 and on the main frame, and secured to this shaft are arms 38 yoked at the outer ends to engage the boxes 39 on the sleeves 36. As the shaft is rocked the needle bar 6 is raised and lowered.

The needle bar has a limited longitudinal movement as well as a vertical movement. This longitudinal movement shogs the needles, when they are up and down, to form the loops of the individual chains.

At one end of the machine is a slide 40 adapted to the rods 22 and 23, Figs. 15 and 16. This slide has a bearing plate 41 against which is pressed a bearing plate 42 on the needle bar 6 by a spring 43 secured at one end to a post 44 on the needle bar and at the other end to one of the brackets 29, as shown in Fig. 15^a.

On the slide 40 is a roller 45 which is in the path of a pattern chain 46 which passes around a drum 47 on a shaft 48 adapted to bearings 49 on a bracket 50 secured to the end frame 1. The chain 46 passes over guides 51 and 52 on the bracket, as shown in Fig. 15. The links of the chain can be designed to shog the needle bar in any manner desired. In the present instance, the chain has alternate high and low links for making a plain fabric in which there are independent knitted chains. In some instances, a pattern wheel may be used in the place of the chain when the machine is designed to knit a fabric with plain or netted foundation.

Mounted in bearings 53 on the under side of the beam 4 is a rock shaft 15 having arms 54, which are preferably made in two parts, one part being adjustably mounted on the other part, as shown in Fig. 4. The looper bar 14 is pivoted to the lower ends of the arms 54 and projecting from the back of the bar is a series of rigid arms 55 which are pivoted to links 56 attached by pivots at their upper ends to brackets on the beam 4.

This construction tends to steady the loop-

er bar and causes it to move to and from the needles in a horizontal plane. On the looper bar are a series of loopers 57 having eyes for the threads *a* which pass through a guide plate 58. There are as many loopers as there are needles and the action of the loopers is to carry threads *a* through the spaces between the needles and, as the needles are shogged, they cross the threads to form a loop, and the loopers are withdrawn through the spaces on the opposite sides of the needles from which they entered.

The thread bar 19 is made in the present instance of a series of perforated plates 59, Figs. 4 and 4^a. The threads *c*, *d* and *e*, extend on one side of the plate 59 and through the perforations to the opposite side. There may be a number of plates for the filler or design threads *e* according to the particular design of the fabric being knitted. All the threads pass through a guide screen 60 stretched from one end frame to the other, see Figs. 2, 2^a and 2^b and Fig. 4. These threads are controlled by suitable jacquard mechanism, or chain drum, not shown, as this mechanism forms no part of the present improvement.

61, 62 and 63 are feed rollers for the knitted fabric after it passes from the needles over the work plate 7. These rollers are geared together at one end of the machine. The lower roller has at the opposite end a gear wheel 64, which meshes with a pinion on a shaft 65 on which is a ratchet wheel 66.

On the shaft 9 is an arm 69, which is connected to one arm of a lever 70 by a link 71. The lever is pivoted to the end frame 1^a at 72. Pivoted to the lever are pawls 73 and 74, which engage the ratchet wheel 66 and move said wheel and the connected parts, including the rollers, as the machine operates.

The point bar 8 carries a series of points 75, which are assembled in sections in the ordinary manner. These points 75 pass between the needles and remain in position as the needle bar descends casting the loops in the ordinary manner. Projecting from the point bar 8 is a series of arms 76 to which are attached the arms 77 and 78 by adjustable pivots 79 and 80, respectively. The arms 77 are secured to a rock shaft 10 adapted to bearings 81 on the beam 2, and the arms 78 are mounted on the rod 23. As the shaft 10 is rocked, the points enter the spaces between the needles and are withdrawn in time with the other mechanisms of the machine.

The plot bar 11 has a series of flat, notched teeth 82, which pass into the space between the needles. The teeth are assembled in sections and the sections are firmly secured to the plot bar, as shown in Figs. 4 and 11,

by bolts, or other fastening, and can be readily removed when necessary.

The notches formed in the teeth 82, of the plot bar 11, receive a selected weft thread *b* from the doffers 20, 20^a, which had been previously picked from the carriers, and places this thread in proper position at the point of knitting. The teeth of the plot bar 11 also act as a comb, their points entering between and combing downward the threads *c*, *d* and *e*, which have been relatively crossed by the action of the plates 59 constituting the thread bar 19, so that the loops or stitches formed by the threads *a* may be formed around all of the threads *b*, *c* and *d* to secure them in the fabric being knitted.

The hooks 83 of the teeth form the notches, and they pick the thread from the doffer. The plot bar 11 has a transverse motion and a vertical motion. Extending rearwardly from the plot bar are pins 84, which slide in horizontal bearings 85 in castings 86, which have vertical bearings 87, which slide on vertical guide posts 88 secured to the beam 3. A vertical movement is given to the casting by arms 89 on the rock shaft 12 through links 90, and a horizontal movement is given to the plot bar 11 by an arm 91 on a rock shaft 13 through links 92, Fig. 4.

The doffers 20, 20^a, one at each end of the machine, are constructed and operated as follows:

Secured to the beam 5 are brackets 93, and pivoted to the ends of the brackets at 94 are doffer levers 95. One arm of each lever is moved and a doffer is adjustably clamped to the arm, as shown in Figs. 9 and 11. Each doffer is hooked at the outer end so as to select a thread from the thread carriers.

The other arm of each lever 95 has an adjustable roller 96, which is engaged by a lifting plate 97 on a spindle 98 adjustably mounted on a square bar 99 adjustably secured to the plot bar 11, Fig. 11. When the plot bar is retracted so that the plate 97 is under the roller and a vertical movement is given to the plot bar, the plate 97 will push the roller and will turn the doffer lever on its pivot, moving the hooked end of the doffer into the path of the notched teeth of the plot bar. Each doffer is offset at 100 so as to allow the thread, engaged by the teeth of the plot bar, to pass the doffers and their levers. As the plot bar moves forward, the roller 96 is released and the doffer returns to its normal position. Arms 101 on the pivots 94 come in contact with stop screws 102 in the frame of the machine.

In order to place the weft threads in the knitted fabric without interfering with the speed of the machine, I provide means for drawing in a number of threads at a time.

These threads extend from one side of the machine to the other when in place on the carrier, and the doffers select one thread after another of the series as the knitting progresses.

At one end of the machine is a carrier 21 and at the other end is a carrier 21^a. Each carrier is made, as shown in Figs. 7 and 11, of three disks. Two of the disks 103 are notched at 103^a and the central disk 104 is less in diameter than the other disks, as shown.

This construction provides notches for the weft threads and the projections between notches form pegs around which the threads are passed by the shuttle 18. A guard finger 105, secured to the beam 5, in the present instance, extends into the annular groove in each carrier. This finger holds the threads in the carrier with the exception of the one selected by the doffers.

The carrier disks are mounted on a short shaft 106 adapted to a bearing 107, adjustably secured to the end frame by bolts 108. Secured to the shaft 106 is a stop wheel 109 having a series of notches in a portion of its periphery. This wheel has an extended hub 110, on which are secured two ratchet wheels 111 and 112. The ratchet wheel 111 has twelve teeth and an extended untoothed surface 113 at its periphery. The wheel 112 has a single tooth 114, and a more extended untoothed surface 115.

The shuttle 18, for placing the weft threads on the carriers 21, 21^a, at either end of the machine, is moved back and forth across the full width of the machine along its supporting rail 16 by the chain 17. This chain 17 passes around, and is supported at its ends by sprocket wheels 169 and 170, and intermediate of its ends by brackets 171 provided with guides 172. These brackets are mounted on the beam 5 (Figs. 4, 21 and 22).

In the present instance, the sprocket wheel 169 is the driven wheel and is mounted on an adjustable stud 173 on a bracket 174 on the end frame 1. The sprocket wheel 169 is secured to the hub of a gear wheel 175, which meshes with a gear wheel 176 on a cross shaft 177. On one end of this shaft is a bevel gear wheel 178, which meshes with a pinion 179 on a vertical shaft 180 mounted in bearings 181 on the frame 1. At the lower end of the shaft 180 is a bevel wheel 182, which meshes with a bevel wheel 183 secured to the main shaft 135.

On one of the links of the chain 17 is an arm 184, shown in Figs. 10 and 10^a. This arm is slotted at 185 to receive a sliding block 186, pivotally mounted on a pin 187 projecting from the back of the shuttle 18. The chain imparts a movement to the shuttle through this connection and the slot allows the block freedom of movement when the arm is passing around the sprocket

wheels at either end of the machine. Thus, while the chain has a continuous movement in one direction, the shuttle is reciprocated.

The shuttle 18 is made, as clearly shown in Figs. 8, 9 and 9^a, and has body portion 188 having ribs adapted to upper and lower longitudinal slots in the rail 16.

Depending from the body portion 188 is an arm 189 having a segmental extension 190 provided with a series of tubes 191 through which the threads pass that are located on the carriers by the shuttle. The arm 189 is slotted at 192 to allow the threads to pass to their respective tubes from their bobbins, which are located at any convenient point, and which are not shown in the present instance.

The tubes 191 of the shuttle are so spaced apart that they enter the spaces between the pegs of the carriers as shown in Fig. 8, and the threads are taken from one carrier to the other (six threads in the present instance) by the shuttle.

The carriers are moved intermittently, a notch at a time, to allow the doffers to remove a single thread and place it in position to be taken by the plot bar to the knitting point. The machine is so designed that six threads can be carried by the shuttle on one movement across the machine and placed in position on the carriers. Thus, while the shuttle is moving slowly across the machine and back, the doffers can move quickly to select one thread at a time without reducing the speed of the knitting machine.

Referring to Figs. 5 and 7, the plot bar 11 has an angle bracket 116, which is connected by a link 117 to an arm 118 on a segmental gear 119, pivoted at 120 on a bracket mounted on the main frame. The connections are made so that the parts can be adjusted, if desired.

The segmental gear meshes with a pinion 121 loosely mounted on the shaft 106 (Fig. 7). Secured to the hub of this pinion 121 is a ring 122 having an arm 123 with an elongated slot 124 therein (Fig. 5^a). Mounted in the slot is the pivot pin 125 for a pawl 126. This pawl engages the single toothed wheel 112. This mechanism turns the thread carrier 120 degrees to straighten the threads and locate them in position to be engaged by the doffers. It will be understood that this mechanism is duplicated at the opposite end of the machine. Both thread carriers 21 and 21^a are controlled by the plot bar 11 through the links 117, segments 119, gears 121, pawls 126, and wheels 112 on the shafts 106; also from the bar 11 through the arms 128, pawls 131, and wheels 111, fixed on the shafts 106.

On the plot bar 11, close to the bracket 116, is a plate 127 having a rounded projection, which comes in contact with an arm 128 on a lever 129 pivoted at 130 to an ex-

tension of the bearing 107. On the short arm of the lever is pivoted a pawl 131, which engages the teeth of the ratchet wheel 111. Their parts are adjustable. As the 5 plot bar 11 moves rearward, the projection strikes the arm 128 and moves the wheel 111 one tooth, turning the carrier 21 to bring a new thread into the path of the doffers. The carrier at the opposite end of the machine is moved by its mechanism one tooth 10 at a time in unison with the first mentioned carrier.

On an arm 132 on the bearing 107 (Fig. 5^b) is pivoted a detent pawl 133, which has 15 a pin 134, V-shaped at the end to engage the stop wheel 109 and hold the carrier in position after movement, so that the threads will always be held parallel with the bank of needles.

135 is the main shaft of the machine and is mounted in a bearing 136 on each end frame and there is a bearing 137 midway of the ends which is supported by a longitudinal beam 138 which, with the other beams, 25 ties the two end frames together.

On this main shaft are the cams which actuate the several mechanisms hereinbefore described. The shaft 135 is provided with one or more hand wheels 139 so that the 30 mechanism for making adjustment and for timing the several parts can be turned by hand.

140 is the needle bar face cam located at the left hand side of the machine, Fig. 2^b, 3 and 26. This cam is secured to the main shaft 135 in the position shown in Fig. 2^b. Loosely mounted on the shaft is a guide 35 block 141 upon which the bar 142 slides. This bar carries a roller 143 at one end, which extends into the groove of the cam 40 140 from which the bar 142 receives its motion. The free end of the bar 142 is pivotally connected to a lever 143 fixed on one end of the rock shaft 9. Through these several 45 parts the needle bar 6 is raised and lowered in proper time with the other cooperating bars during the process of knitting. The rocking shaft 9 also drives the take up rolls 61, 62 and 63, through the mechanism 50 hereinbefore described.

Mounted on the main shaft 135 is a second cam 144, which controls the action of the looping mechanism by which the threads, forming the warp chains, are carried between 55 the needles, the cooperative action of the looping mechanism and the needles forming the individual stitches of which the warp chains are composed. The cam 144 has, in its face, a groove 145 into which a roller 146, carried by the lower end of a vertically moving bar 147, extends. The upper end of the bar 147 is pivotally connected to an arm 148 fixed on one end of the rock shaft 15, while the lower end of said bar straddles the 65 shaft 135 and is guided vertically by a bear-

ing block 149 loosely mounted on the shaft 135. This mechanism gives the looping bar the right movement at the proper time in conjunction with the needle bar 6 to form the stitches of the warp chains. 70

A third cam 150 is mounted on the shaft 135, which controls the point bar 8, whose purpose is to cast the previously formed stitches over the tops of the needles 30. A roller 151, rotatably mounted on the end of 75 one arm 152 of a bell crank lever 153, is pivoted at 154 to the end frame 1^a, and extends into a groove in the face of the cam 150, Fig. 27. The other arm 155 of the bell crank 153 is pivotally connected through 80 a link 156 with a lever 157 fixed on one end of the rock shaft 10. Through these several parts, the point bar 8 is brought under the formed stitches, as the needle bar 6 descends, at the proper time, to cast the said 85 formed stitches over the hooks, of the needles 30, the point bar thereafter being withdrawn, to allow the needles to relocate themselves.

The plot bar 11 is controlled by two cams 90 158 and 159 on the main shaft 135. The cam 158 imparts a vertical movement to the plot bar, and the cam 159 imparts a horizontal movement to said bar. Each of these cams has a cam slot in one face, in the present instance. On the shaft, near the cam 95 158, is a slide block 160 on which slides a bar 161, having a roller 162, extending into the slot of the cam. This bar is pivotally connected at 163 to an arm 164 on one end 100 of the rock shaft 12, and this shaft is connected to the plot bar in the manner previously described. On the shaft 135, near the cam 159, is a guide block 165 on which slides a bar 166 pivoted at 167 to an arm 168 105 on the rock shaft 13, which moves the plot bar to and from the needles.

The pattern chain 46 is driven, in the present instance, from the main shaft 135 as follows: On the shaft 135 is a worm 193 which 110 meshes with a worm wheel 194 on the cross shaft 48 on which the chain drum 47 carrying the pattern chain 46 is fixed.

Fig. 52 illustrates one of the simplest forms of the machine for knitting plain 115 goods as shown in Fig. 54.

The carriers 21 and 21^a are similar to those hereinbefore described. Each segment 119^a, which operates a carrier, has an arm 118^a which is connected by a link 117^a to an 120 arm 195 secured to the rock shaft 13^a, which actuates the plot bar 11^a through the arm 91^a and link 92^a. The plot bar in this instance moves only in a horizontal plane.

The needle bar 6^a is actuated in the same 125 manner as described above, but the doffers are actuated from the needle bar and not by the plot bar.

Secured to the needle bar at each end of the machine is a bracket, having a bar 99^a 130

on which is a spindle 98^a carrying a head 97^a slotted to receive a pin 96^a on the doffer lever 95^a pivoted at 94^a to a bracket on the main frame. The doffers carry the selected weft thread from the carriers to a point in the path of the plot bar, and, as it moves towards the needles, it picks up the thread and places it in position at the knitting point. The other threads are guided in the manner described above.

The operation of this mechanism is as follows:

Referring to Figs. 28 to 42 and Fig. 52, which illustrate the simplest form of machine, and Fig. 54, which illustrates a fabric made of a series of independent chains of loops and weft threads, the threads *a* forming the independent chains of loops are located so that the needle engages the threads and, with the looper and point bar, makes a series of loops. A series of weft threads *b* are drawn across the machine by the shuttle from one carrier to the other and passed around the pegs of the carriers. The doffers remove a weft thread from the carriers and the plot bar takes the thread from the doffers and carries it to the knitting point at the top edge of the work plate.

In order to feed the weft threads one at a time to the doffer, the carriers are moved intermittently $\frac{1}{2}$ of a revolution at a time in the present instance, bringing a weft thread in position during the knitting of a single course. During six of these intermittent movements, the shuttle has traversed across the machine from one carrier to the other and deposited six weft threads on both carriers.

Fig. 28 is a diagrammatic view of a rear elevation showing the shuttle beginning its movement across the machine from the left hand side, carrying with it six weft threads *b* from the carrier. While the shuttle is moving slowly across the machine, Fig. 29 to Fig. 35, the knitting mechanism has made six courses. When the shuttle 18 is in the position shown in Fig. 30, one course has been made. When the shuttle is in the position shown in Fig. 31, the second course has been made, and so on until the shuttle reaches the opposite end of the machine, as in Figs. 35 and 36. It will be noticed that the threads are twisted, and in order to straighten them, the carrier 21^a is turned six points, as shown in Fig. 37. The threads are then straightened and the shuttle is ready to return to the opposite side of the machine, as in Figs. 38 and 39. The shuttle progresses as the six courses are being made, and, when the shuttle reaches the left hand side, as in Fig. 40, the carrier 21 is turned six points to the position shown in Fig. 41, bringing the threads in a parallel position, as in said figure. The shuttle then returns, as in Fig. 42, and the operation is repeated.

Thus, each thread is moved into proper alignment so that the doffers can remove a single thread and place it in position at the knitting point. By this construction, the speed of the machine can be increased, yet the needle mechanism will have sufficient time to form the fabric properly.

By this method the simplest form of fabric can be made, having a weft thread extending from one selvage to the other in each course thereof, or in any predetermined course, or number of courses. By drawing a plurality of weft threads into the machine at one time, the fabric can be made extremely wide—attaining a width of one hundred inches, if desired, at a profitable speed.

The above operation can be carried out on the machine illustrated by the main figures of the drawings as well as that shown in Fig. 52, by simply omitting the extra threads, namely, the floating warp threads *c*, binder threads *d* and design or filler threads *e*, shown in Fig. 53.

Referring to Figs. 4 and 43 to 48, in Fig. 43 the teeth 82 of the plot bar 11 are shown as engaging a weft thread *b* taken by the doffers 20 and 20^a from the carrier 21—21^a and carrying it forward to the back of the threads, *c*, *d* and *e*, while the teeth project through the spaces between the threads as shown in Figs. 44 and 49. Previous to this movement, the bars 59 of the groups 19 of thread bars have been moved by the Jacquard mechanism in the ordinary manner. The plot bar then descends, combing the threads and laying them in position to be knitted into the knit course as in Figs. 45 and 50. The teeth remain in position and hold the loops down while the needles are raised back of the weft threads *b* and the other threads *c*, *d* and *e* as shown in Fig. 4. Then the loopers 57 are moved rearwardly and pass through the spaces between the threads *c*, *d* and *e* and the needles 30, as shown in Figs. 46 and 51. The threads *a* hold the weft threads *b* and all the other threads in position against the backs of the needles while the plot teeth are withdrawn, as shown in Fig. 47. Then the needle bar is shogged, one space in the present instance, after which the loopers recede, forming loops of the threads *a* around the needles. At the same time, the points 75 of the point bar 8 move forward under the last knit course and support the course while the needle bar descends, the needles passing the point 75, which cast the previously formed course over the needles in the usual manner, as shown in Fig. 48. The carrier remains stationary, as shown in Figs. 43, 44, 45 and 46, while the plot teeth are moving forward and down. As the plot teeth move rearwardly the carrier moves one tooth to position, shown in Fig. 47, placing the next weft thread in the hooks of the doffers. As the plot bar raises, as in Fig. 48,

the doffers descend, carrying the thread across the path of the hooks 83 of the teeth 82 of the plot bar; and, as the bar moves forward to the position shown in Fig. 43, it engages the thread and the above operation is repeated.

The knitted fabric, after it is removed from the machine, is finished by any of the well known processes.

Thus, it will be seen that the weft threads extend from one selvage to another and are tied in at each course and can be combined with additional threads, such as floating warps, binders and design or filler threads, as shown in Fig. 53, to form fabrics of different types and design.

A fabric made in the above manner cannot stretch laterally, and, when floating warps are used, cannot stretch longitudinally.

I claim:

1. The combination in a knitting machine, of a needle bar; needles thereon; means, associated with the needles, for forming loops; carriers; a shuttle for placing one or more threads on the carriers substantially parallel to the needle bank; and means for selecting a thread from the carriers and locating it in position at the knitting point.

2. The combination in a straight knitting machine, of a bank of needles; means, associated with the needles, for forming independent chains of loops; carriers; means for placing the individual threads of a series of weft threads simultaneously on the carriers, substantially parallel to the bank of needles and out of the path of movement of said needles; and means for selecting one thread at a time from the series and placing it in position to be incorporated with the fabric being knitted.

3. The combination in a knitting machine, of a needle bar; needles thereon; means, associated with the needles, for forming a series of independent loops; carriers; a shuttle arranged to travel across the machine and place a series of weft threads on the carriers; and means for engaging one thread at a time and transferring it from the carriers to a position at the needles.

4. The combination in a straight knitting machine, of a series of needles; means, associated with the needles, for forming a series of looped chains; a carrier at each end of the machine; a shuttle; means for traversing the shuttle from one carrier to another to place a series of weft threads on the carrier; and means for selecting a thread from the series and locating it at the knitting point.

5. The combination in a straight knitting machine, of a series of needles; means, associated with the needles, for forming a series of looped chains; carriers for weft threads; a shuttle for placing said threads on the carriers; doffers for selecting a thread from the

carriers; and plot bars arranged to receive the thread from the doffer and locate it in position at the knitting point to be incorporated in the fabric.

6. The combination in a straight knitting machine, of a series of needles; means, associated with the needles, for forming a series of looped chains; a rotatable carrier at each end of the machine; means for intermittently rotating the carriers; a shuttle; means for reciprocating the shuttle from one carrier to the other by which weft threads are placed on the carrier; and means for selecting threads from the carrier and locating them at the knitting point of the machine.

7. The combination in a straight knitting machine, of a series of needles; means, associated with the needles, for forming a series of looped chains; a rotatable carrier at each end of the machine; means for rotating the carriers in unison for a given number of steps and for rotating one carrier independently of the other; means for placing threads on the carrier; and means for removing a thread from the carrier and locating it in position at the needles.

8. The combination in a straight knitting machine, of a series of needles; means, associated with the needles, for forming loops; a rotatable carrier at each end of the machine; a shuttle arranged to reciprocate across the machine and to place weft threads on the carrier; means for rotating the carriers in unison for a given number of steps and then rotating one carrier independently of the other carrier; doffers arranged to remove a thread from the carriers; and a plot bar for transferring the thread from doffers to the needles.

9. The combination in a knitting machine, of a series of needles; means, associated with the needles, for forming loops; means for introducing a weft thread parallel with the needle bank; carriers over which the thread is looped; and means for removing a thread from the carriers and locating it at the knitting point to be incorporated in the knitted fabric.

10. The combination in a straight knitting machine, of a series of needles; looping mechanism; a carrier at each end of the machine; a shuttle for introducing a series of threads and placing them in the carriers; doffers for removing a thread from the carriers; and a plot bar having notched teeth arranged to take a thread from the doffers and locate it at the knitting point to be incorporated in the knitted fabric.

11. The combination in a straight knitting machine, of a series of needles; loopers associated with the needles; means for introducing a series of weft threads; carriers for supporting the threads; doffers for removing a thread from the carrier; a plot bar having spacer teeth shaped to engage a thread sup-

ported by the doffers and to place the thread against the needles as the foundation is being formed; and means for imparting a movement to the plot bar in an irregular path.

12. The combination in a straight knitting machine, of a series of needles; loopers associated with the needles; a carrier at each end of the machine; a shuttle for placing a series of threads on the carriers; means for holding the threads on the carriers with the exception of the one to be selected; and means for selecting a thread and locating it in position at the needles.

13. The combination in a straight knitting machine, of a bank of needles; loopers and a point bar associated with the needles; means for drawing in a series of threads parallel with the needle bank; carriers for supporting the threads; doffers for selecting a thread from the carriers; a plot bar for receiving a thread from the doffers; and means for operating the doffers and plot bar to carry the thread from the doffers and locate it at the needle bank.

14. The combination in a straight knitting machine, of a needle bar; needles therein; a series of loopers associated with the needles to form loops; a carrier at each end of the machine; means for rotating the carriers; an endless chain extending across the machine; a shuttle connected to the chain and arranged to place threads on the carriers; and means for transferring a thread from the carriers to a position at the needles.

15. The combination in a knitting machine, of a series of needles; means, associated with the needles, for forming loops; a track extending across the machine; a shuttle mounted on said track; means for imparting movement to the shuttle, said shuttle having thread guides; a carrier at each end of the machine having pegs around which the threads are placed by the shuttle; and means for selecting a thread from the carrier and locating it at the knitting point.

16. In a straight knitting machine, the combination of a needle bank; means co-operative with the needles of said bank for forming a knitted foundation fabric; thread bars for placing threads across such foundation fabric; a plot bar having a series of spaced thin teeth adapted to receive a weft thread and to enter between the said crossed threads at a point removed from the knitting point of the machine, intermediate said needles and said thread bars; and means for moving said plot bar and its attached teeth into the mass of crossed threads and towards the needles of said needle bank while within the mass of said crossed threads, whereby said crossed threads are combed and said weft thread placed into position at the knitting point of the machine, adjacent the needles thereof, to be incorporated with-

in, the foundation fabric, as said fabric is being formed.

17. A plot bar for introducing a weft thread into a knitted fabric, said plot bar consisting of a body portion having a plurality of thin teeth, each tooth having an undercut notch in its upper edge for receiving a thread, the overhanging portion of a tooth forming a hook, the top and base walls of each notch being substantially parallel inclined downwardly from the top edge of said tooth to direct the thread under a hook.

18. The combination in a knitting machine, of mechanism for forming loops in the process of knitting; a shuttle for carrying a series of weft threads into the machine; a carrier at each end of the machine for supporting the weft threads; a shaft for supporting each carrier; means for turning said shafts; and means for removing a thread from the carriers and locating it in position at the knitting point of the machine.

19. The combination in a knitting machine, of mechanism for forming loops in the process of knitting; a shuttle for carrying weft threads into the machine; a carrier at each end of the machine for separating and supporting the weft threads; a shaft on which each carrier is mounted; two ratchet wheels on said shaft, one wheel having a single tooth and the other wheel having a series of teeth; independent pawls engaging the said ratchet wheels; a plot bar for carrying a selected weft thread to the knitting point; and means actuated by the plot bar for controlling the movement of the pawls.

20. The combination in a knitting machine, of a needle bar; needles thereon; means, associated with the needles, for forming loops; a carrier at each end of the machine; a shuttle for placing weft threads on the carrier; means for transferring a weft thread from the carrier to the knitting point at the needles, each carrier consisting of three disks, the central disk being less in diameter than the outer disks, said outer disks being notched to form pegs around which the weft threads are placed by the shuttle; and a guard secured to a fixed position of the machine and extending into the groove formed by the disks of the carriers to retain certain weft threads on the carriers.

21. The combination in a knitting machine, of needle mechanism for forming loops; a carrier at each end of the machine for supporting weft threads; means for selecting a thread from the carriers and transferring it to the knitting point of the machine; a shuttle for placing a series of weft threads on the carriers; and a rail on which the shuttle is mounted, said shuttle having a series of tubes for the passage of threads to the carriers.

22. The combination in a knitting ma-

chine, of needle mechanism for forming loops; a carrier at each end of the machine for weft threads, each carrier having pegs; means for rotating each carrier; means for selecting a thread from the carriers and transferring it to the knitting point of the machine; a shuttle for placing a series of weft threads on the carrier; a rail on which the shuttle is mounted; and means for moving the shuttle from one carrier to the other, said shuttle having a segmental portion perforated for the passage of weft threads to the carriers.

23. The combination in a knitting machine, of needle mechanism for forming loops; carriers for weft threads; means for placing threads on the carrier, and doffers for removing a thread from the carriers; a plot bar extending across the machine; flat notched teeth on said bar; two rock shafts; an arm on each shaft; links connecting the arms to the plot bar; and means for guiding the bar so that it will travel in a given path to select a weft thread from the doffers and locate it at the knitting point to be incorporated in the fabric.

24. The combination in a knitting machine, of needle mechanism for forming loops; a plot bar having notched teeth for carrying a weft thread to the knitting point to be incorporated in the fabric; a rock shaft having an arm; a link connecting the arm to the plot bar for moving said plot bar to and from the needle mechanism; a second rock shaft having an arm connected by a link to the plot bar for imparting a vertical movement to the plot bar; and means for oscillating said rock shaft.

25. The combination in a straight knitting machine, of a movable needle bar; needles on said bar; means co-operative with said needles for forming a knitted fabric; a normally stationary work plate adjacent said needle bar over which said fabric passes; adjusting means for regulating the position of said work plate with respect to the said needles; and a pivot provided for said work

plate to permit its being removed from the immediate proximity of said needle bar to permit of the inspection, repair and replacement of the needles thereon.

26. The combination in a knitting machine, of a needle bar; needles thereon; means for raising and lowering the needle bar; two bars extending from side to side of the machine; carriages arranged to slide on said bars; steadying pins on the needle bar adapted to bearings in the carriages; and means for moving the needle bar longitudinally.

27. The combination in a knitting machine, of a needle bar; needles thereon; looper mechanism; a carrier for weft threads; means for placing threads on said carrier; a doffer lever at each side of the machine; a doffer on one arm of each lever; a projection on the other arm of each lever; a plot bar; means for moving said plot bar toward and from the needles; a bar at each end of the plot bar; and a lifting plate on each bar arranged to engage the projections on the arms of the doffer levers as the plot bar is raised, causing the doffers to carry a weft thread into the path of the plot bar.

28. The combination in a knitting machine, of a needle bar; needles thereon; a looper bar; loopers thereon arranged to enter the spaces between the needles; a beam above the looper bar; a rock shaft carried by said beam; arms on the rock shaft to which the bar is attached; arms projecting from the looper bar; and links connecting said arms to the beam, said links retaining the loopers in a horizontal position.

29. The combination with a warp knitting machine provided with needles, of carriers arranged behind the needles and operating to support the weft threads in parallel stretches, means for moving the carriers step by step, and means which transfer the stretches of weft threads in succession from the front portions of the carriers into engagement with the said needles.

ISAAC SPRINGTHORPE.