

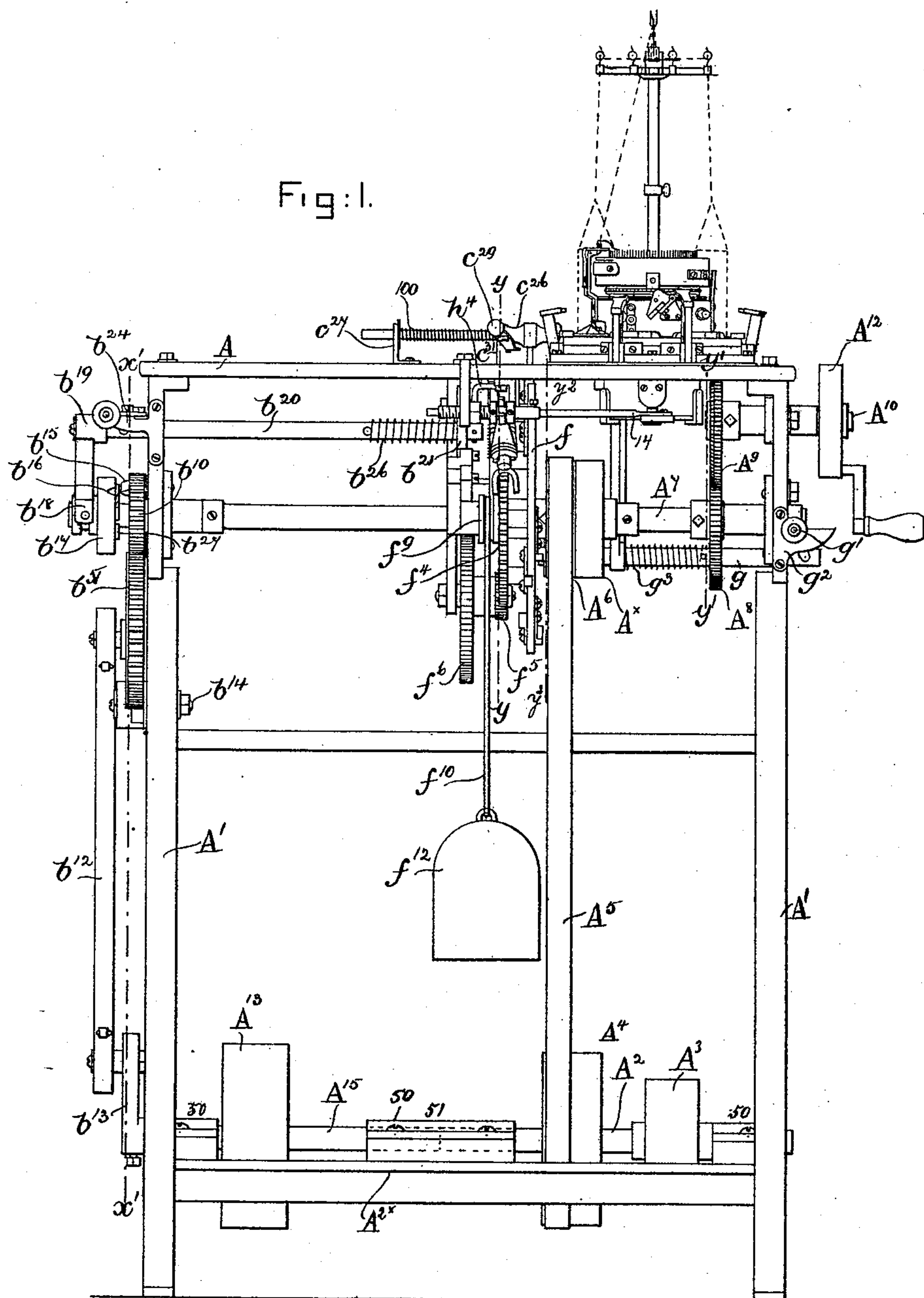
(No Model.)

6 Sheets—Sheet 1.

W. H. & G. D. MAYO.  
CIRCULAR KNITTING MACHINE.

No. 461,357.

Patented Oct. 13, 1891.



Witnesses:  
*Frederic S. Greenleaf*  
*Frederick L. Emery.*

Inventors.  
William H. Mayo,  
George D. Mayo,  
by Lemuel S. Gregory attys

(No Model.)

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Fig: 2.

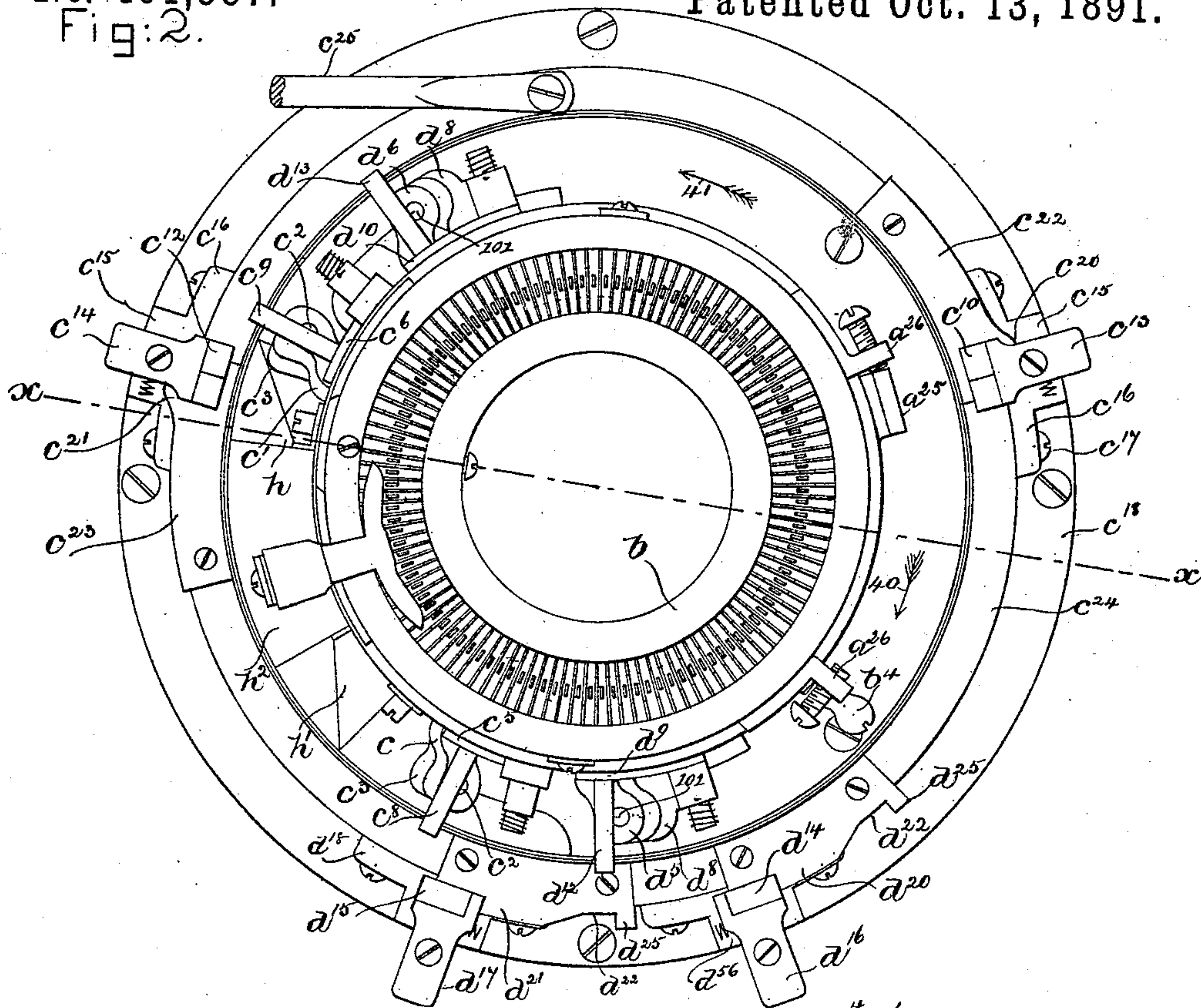
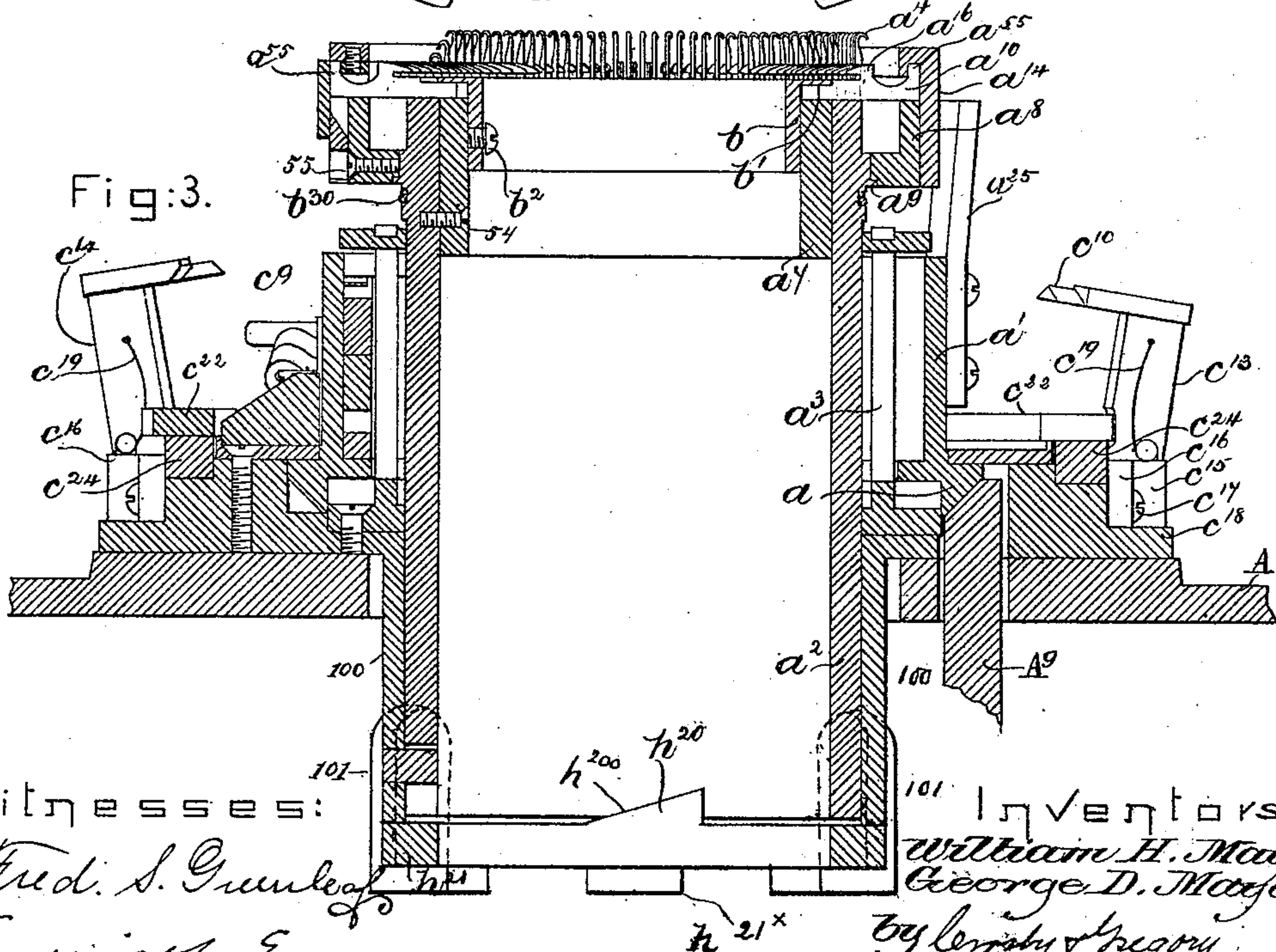


Fig: 3.



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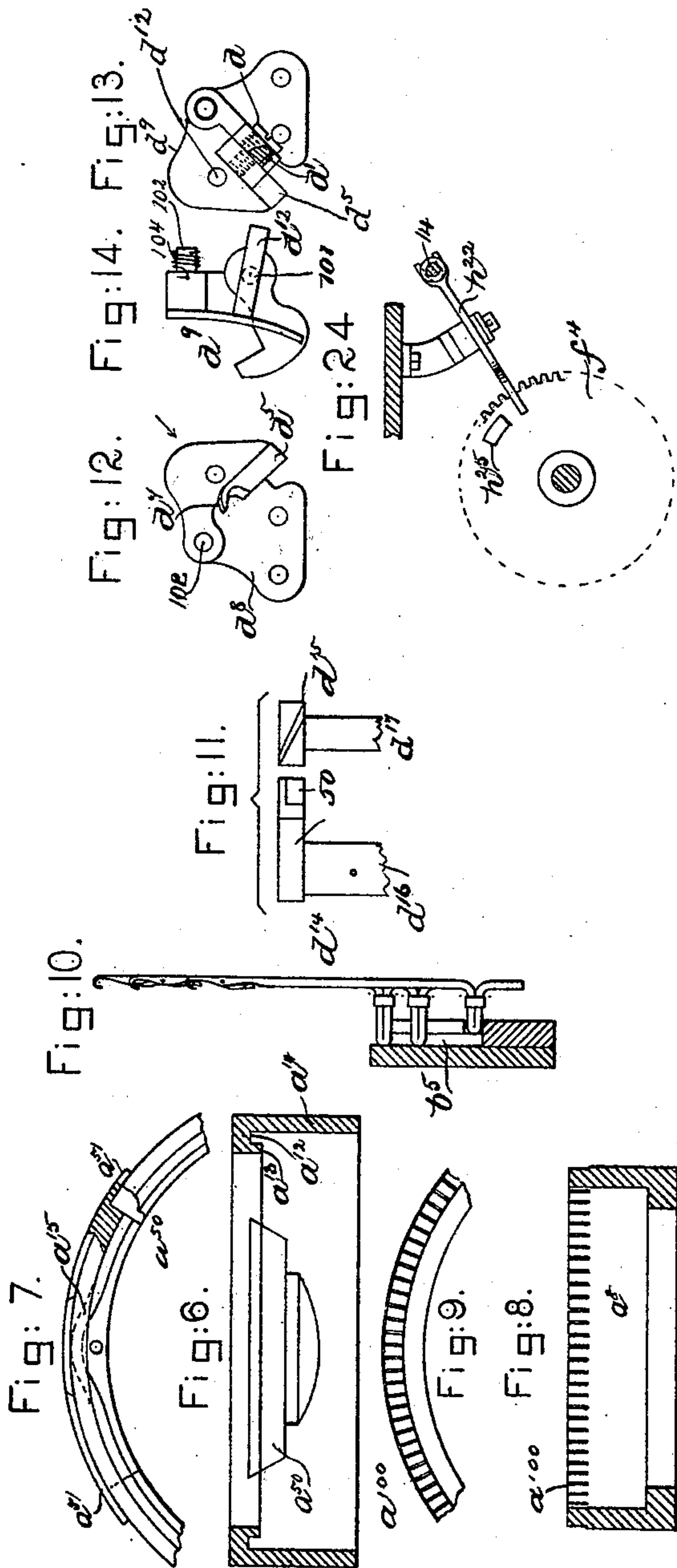
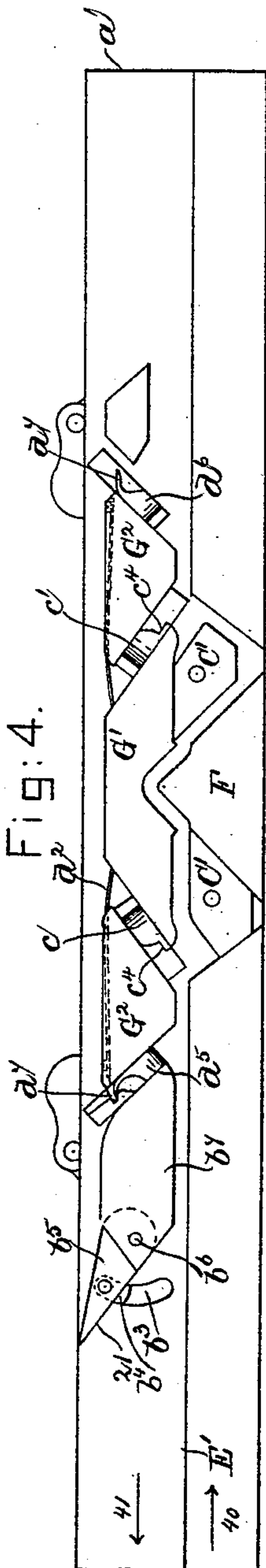
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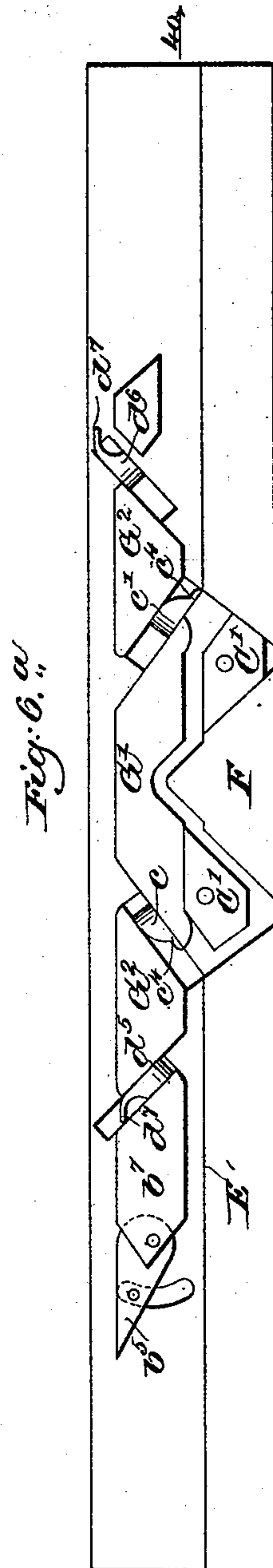
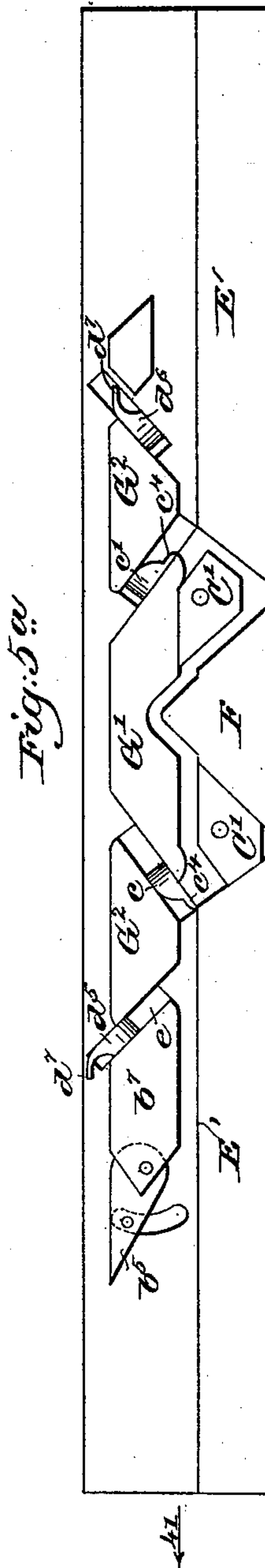
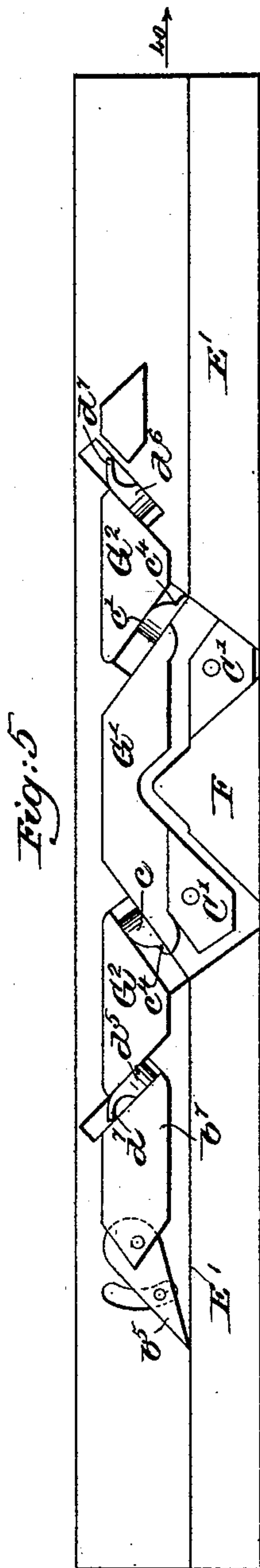
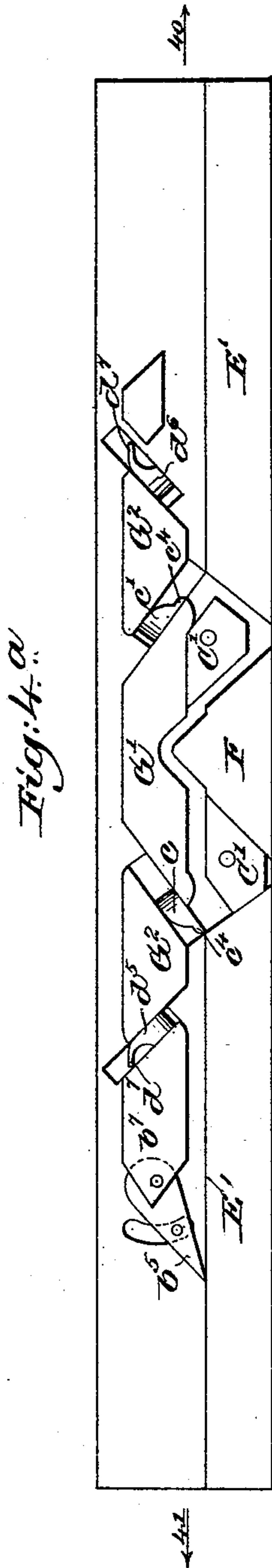
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6 Sheets—Sheet 4.

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CIRCULAR KNITTING MACHINE.

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(No Model.)

6 Sheets—Sheet 5.

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CIRCULAR KNITTING MACHINE.

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Fig:16.

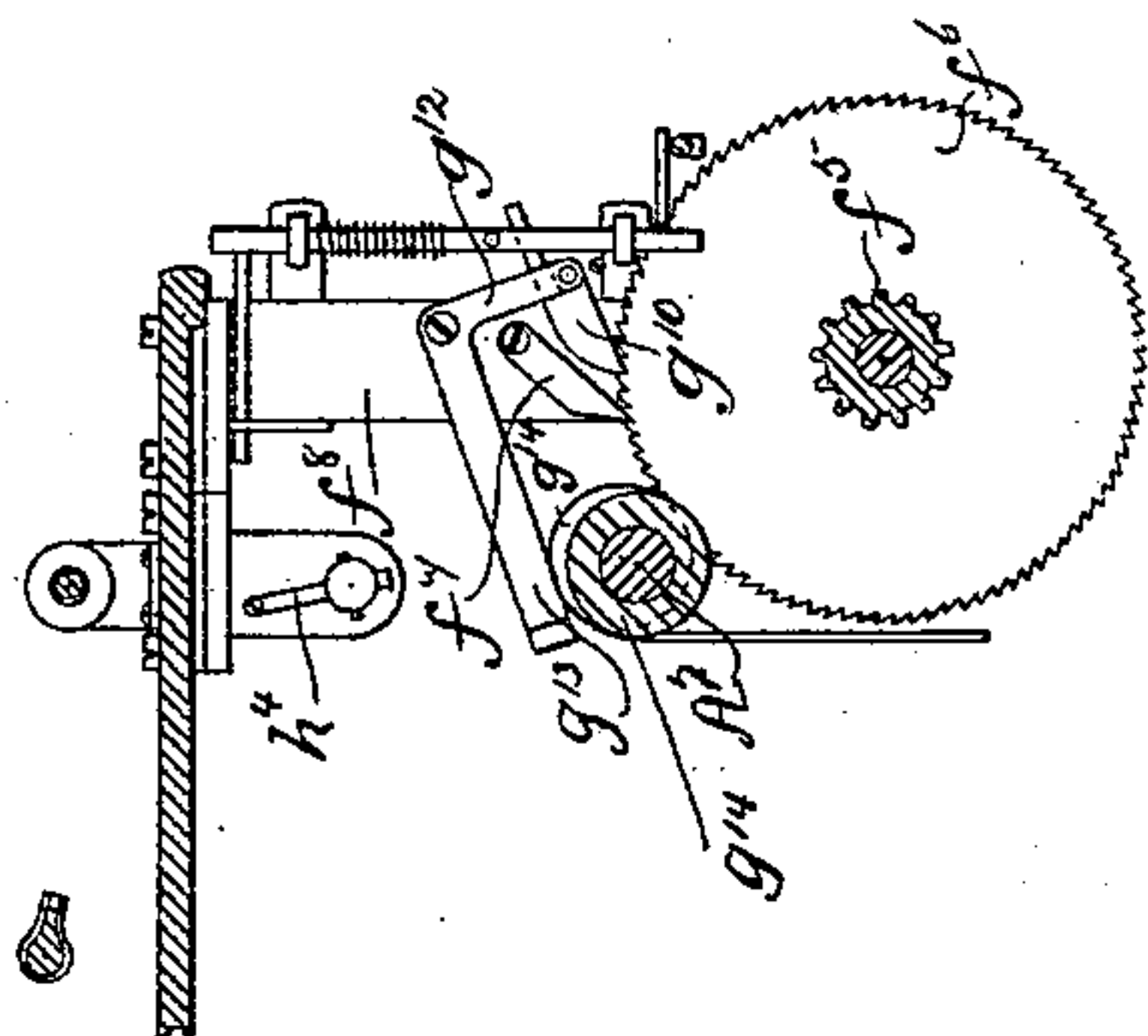


Fig:15.

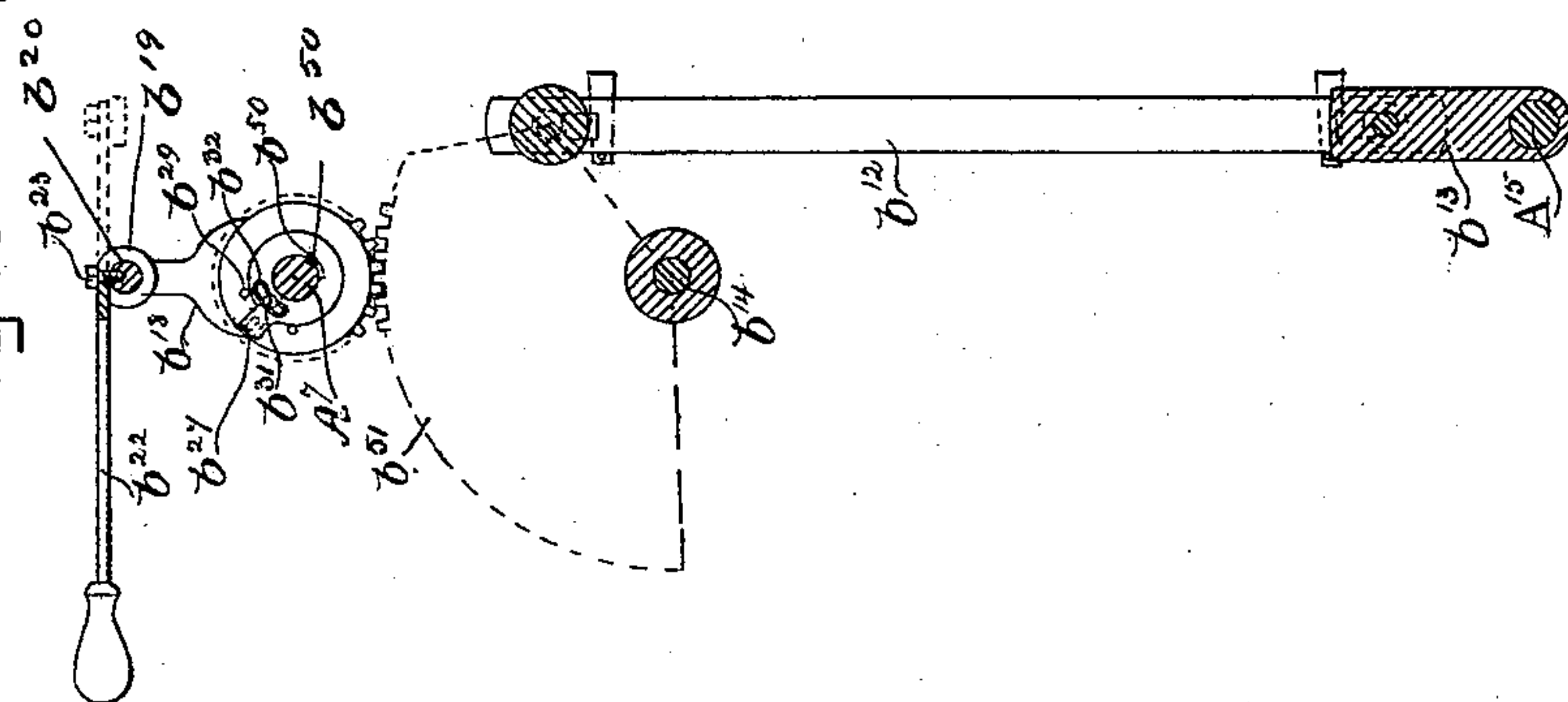


Fig:18.

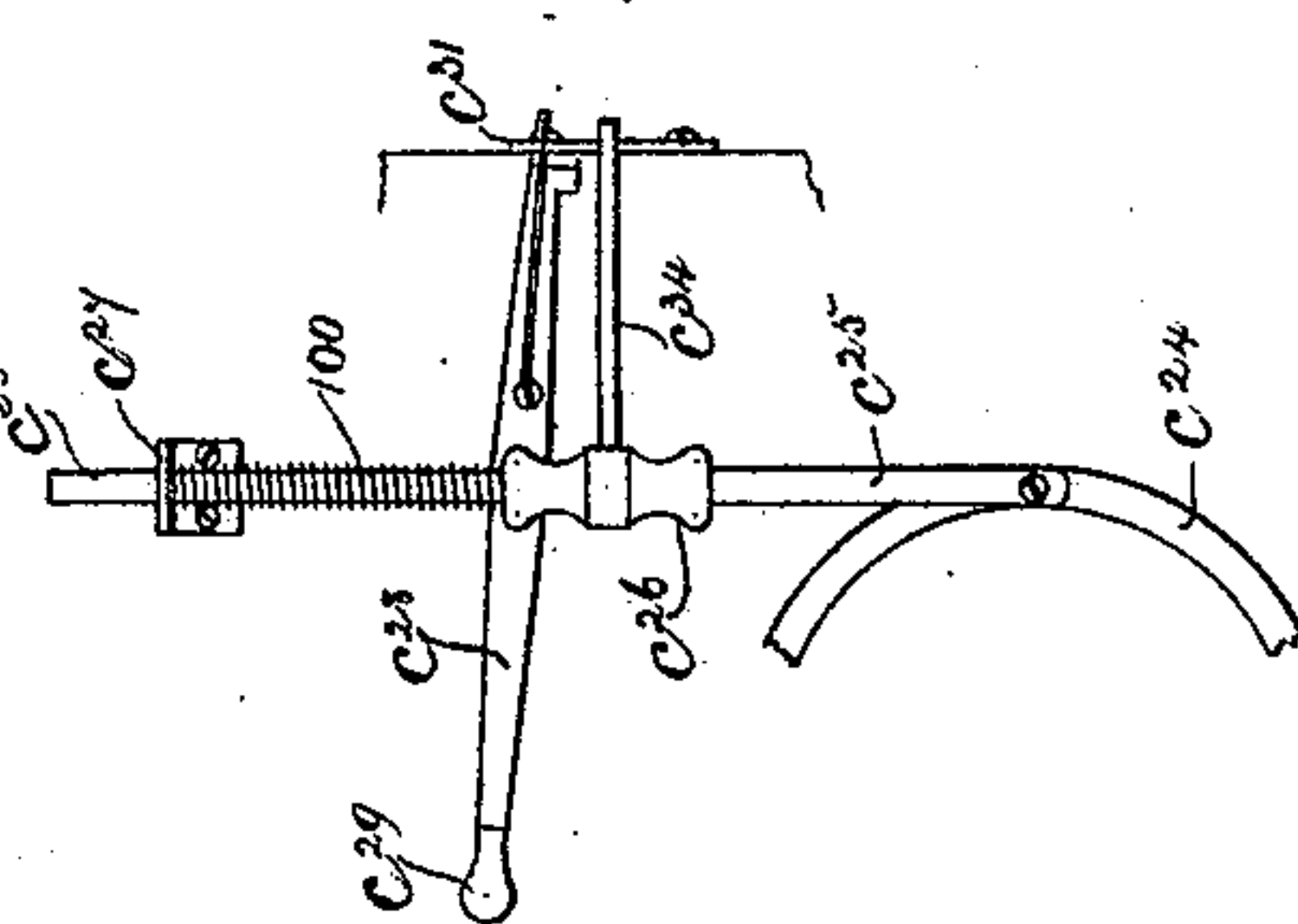


Fig:20.

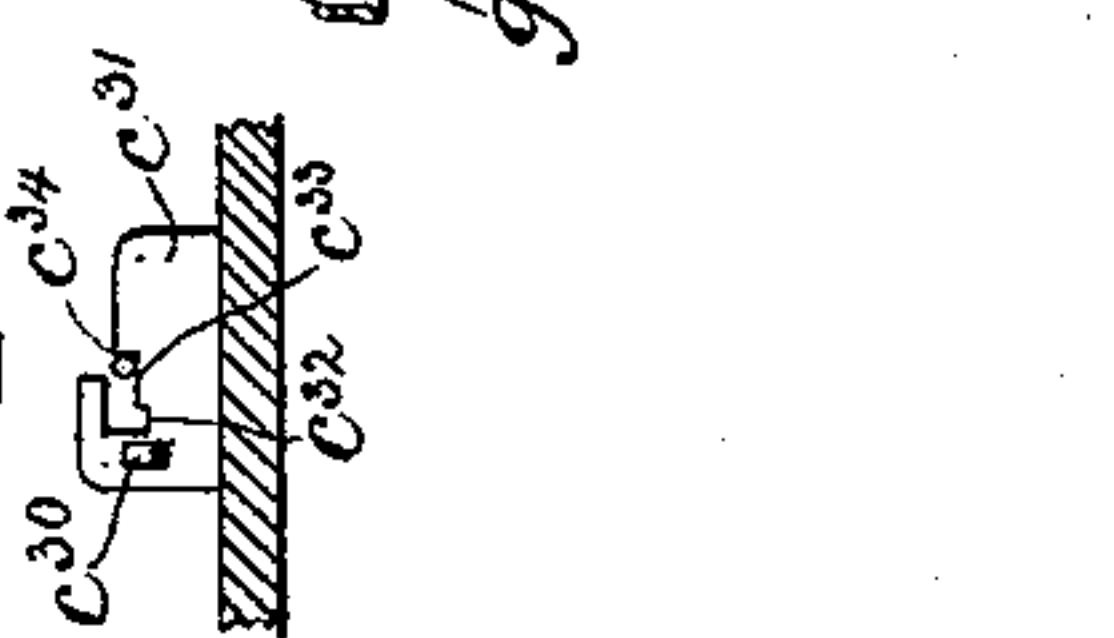


Fig:21.

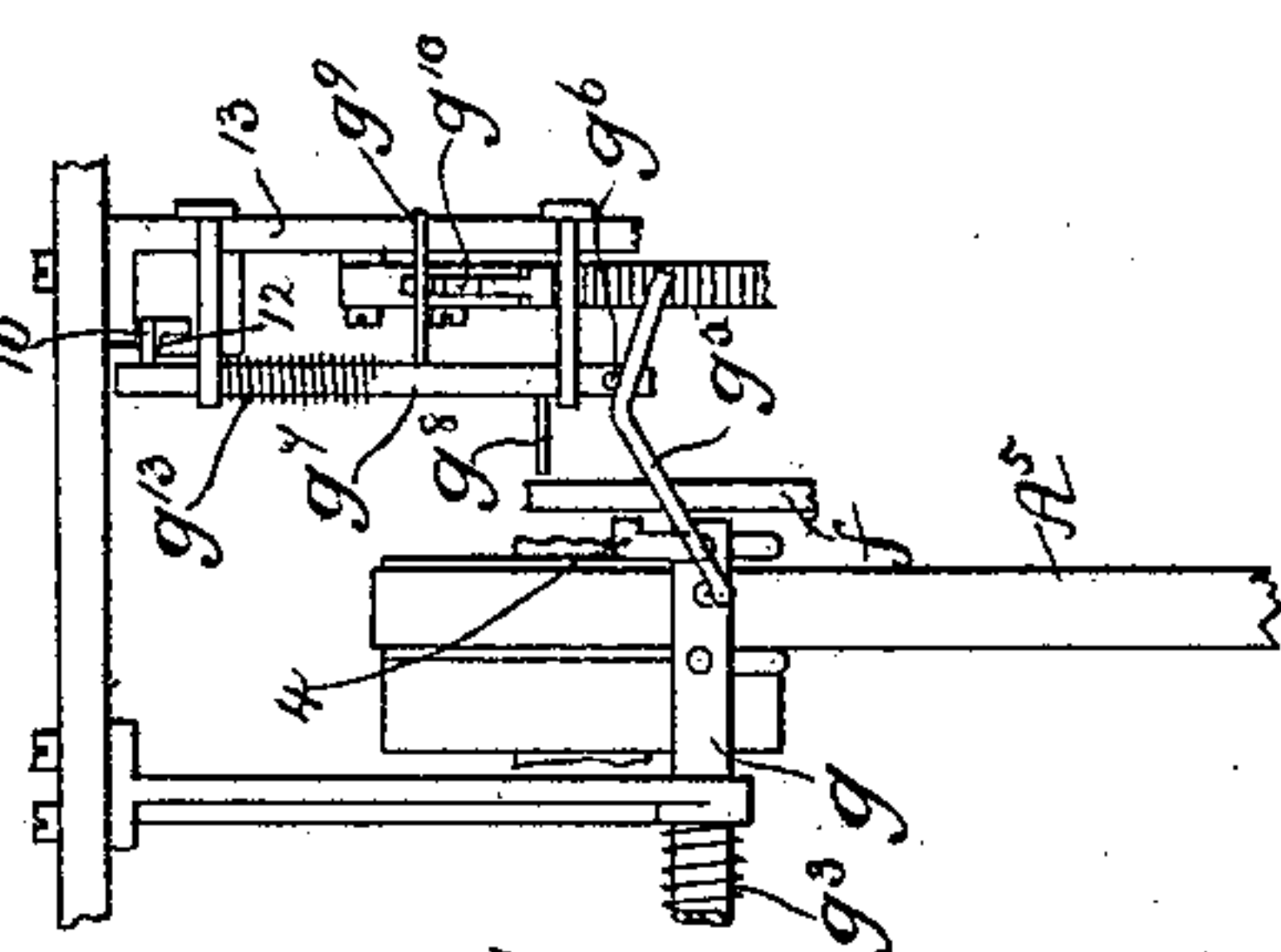


Fig:22.

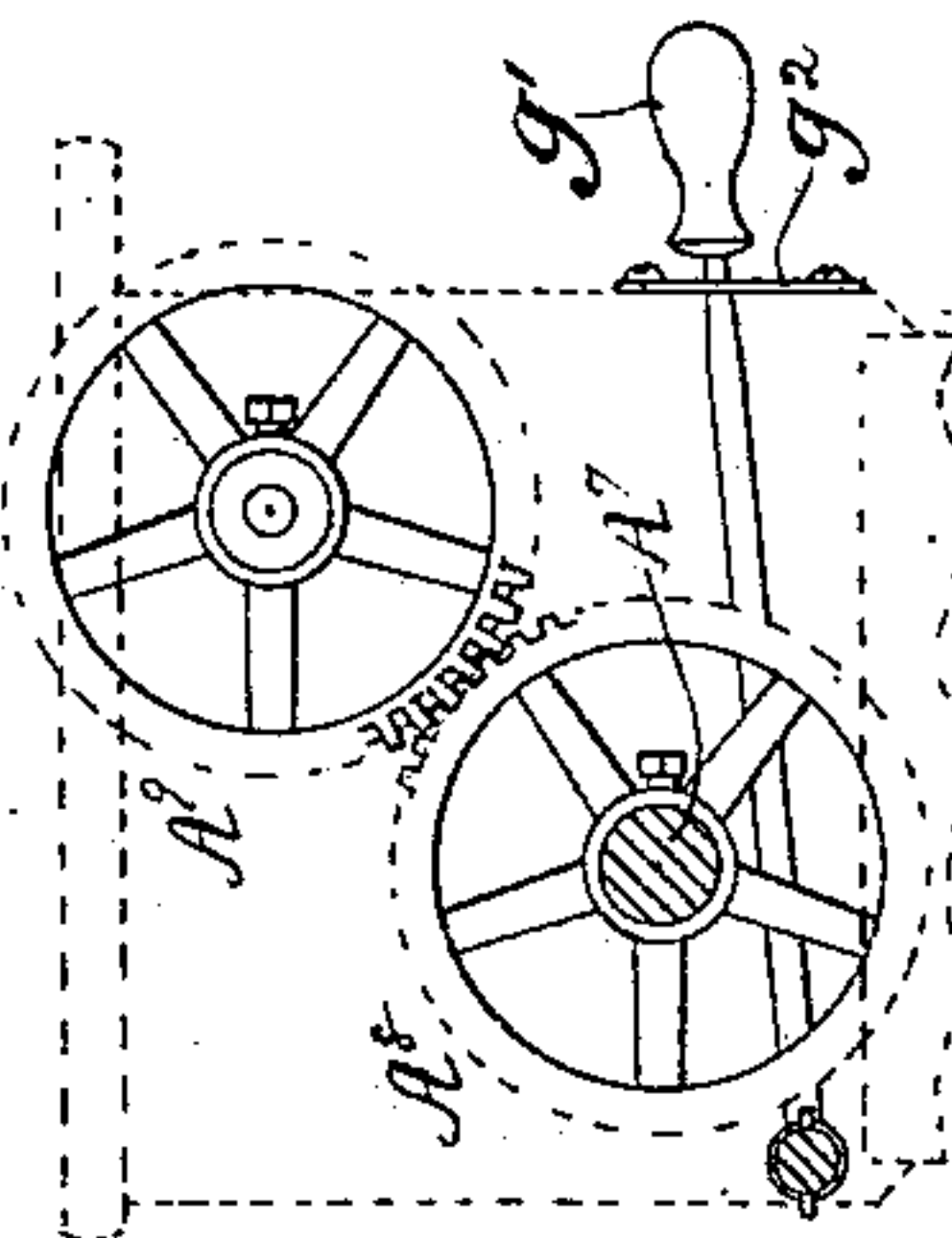


Fig:23



Witnesses

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(No Model.)

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No. 461,357.

Patented Oct. 13, 1891.

Fig 26.

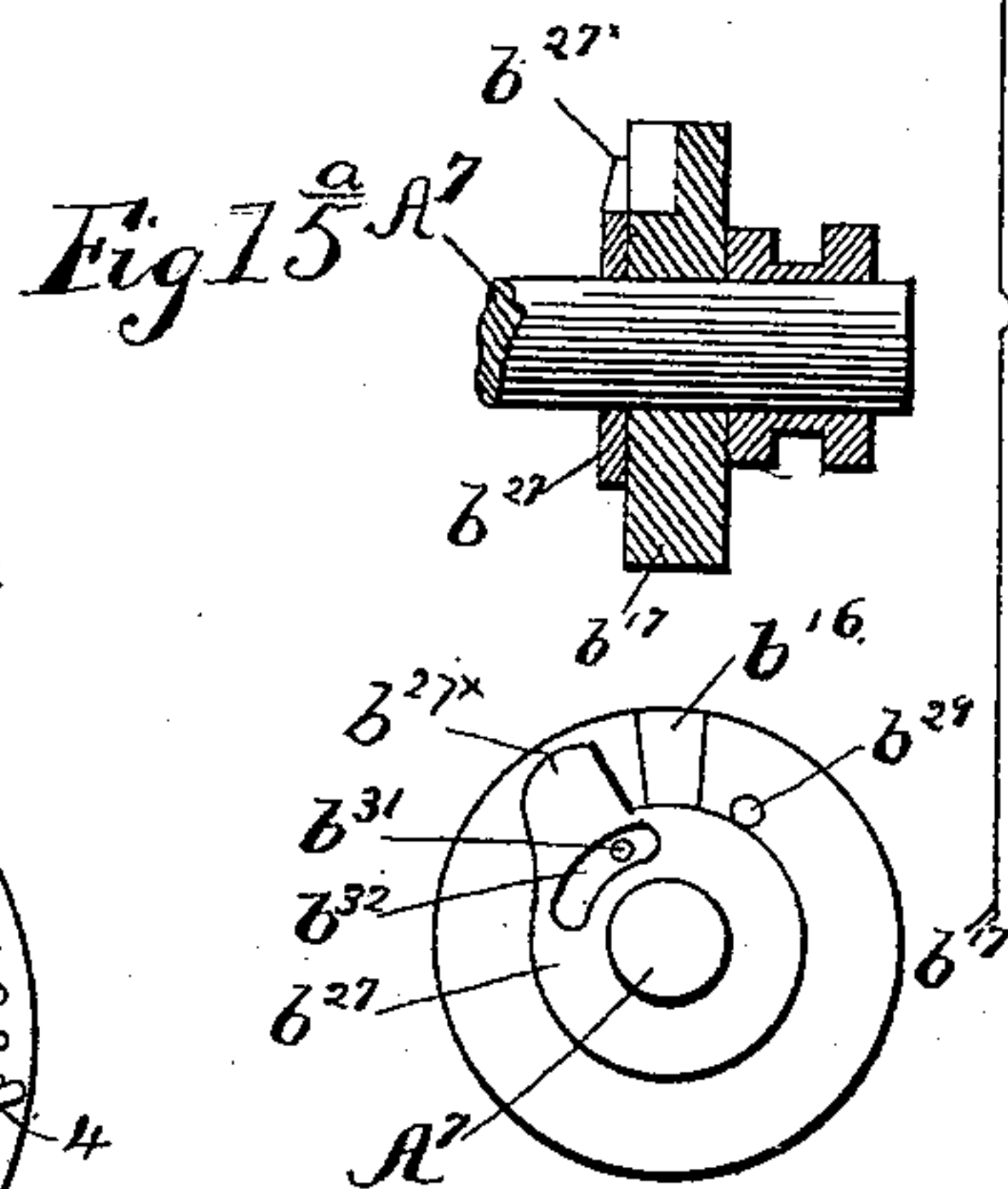
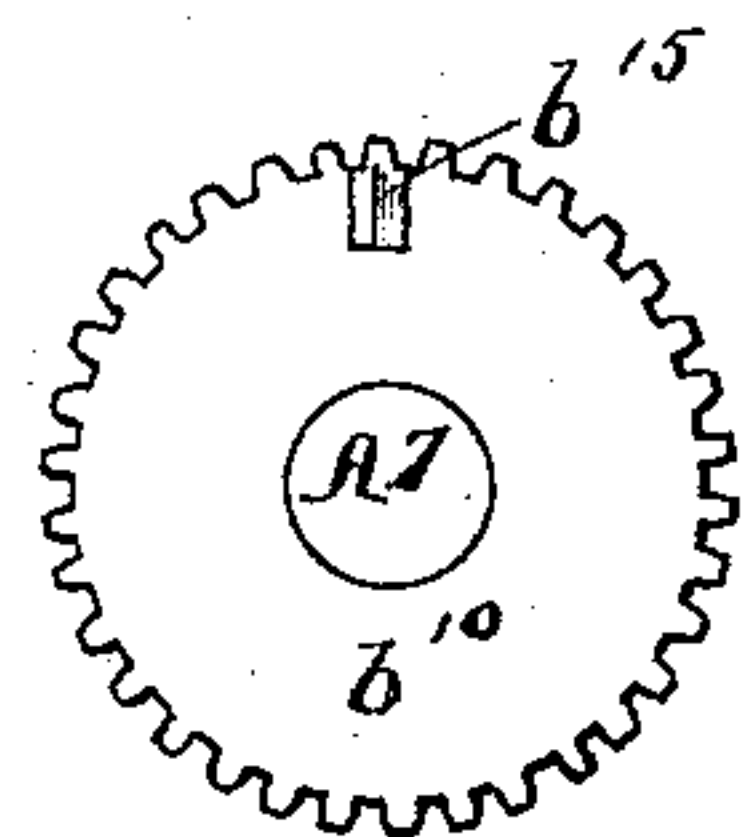
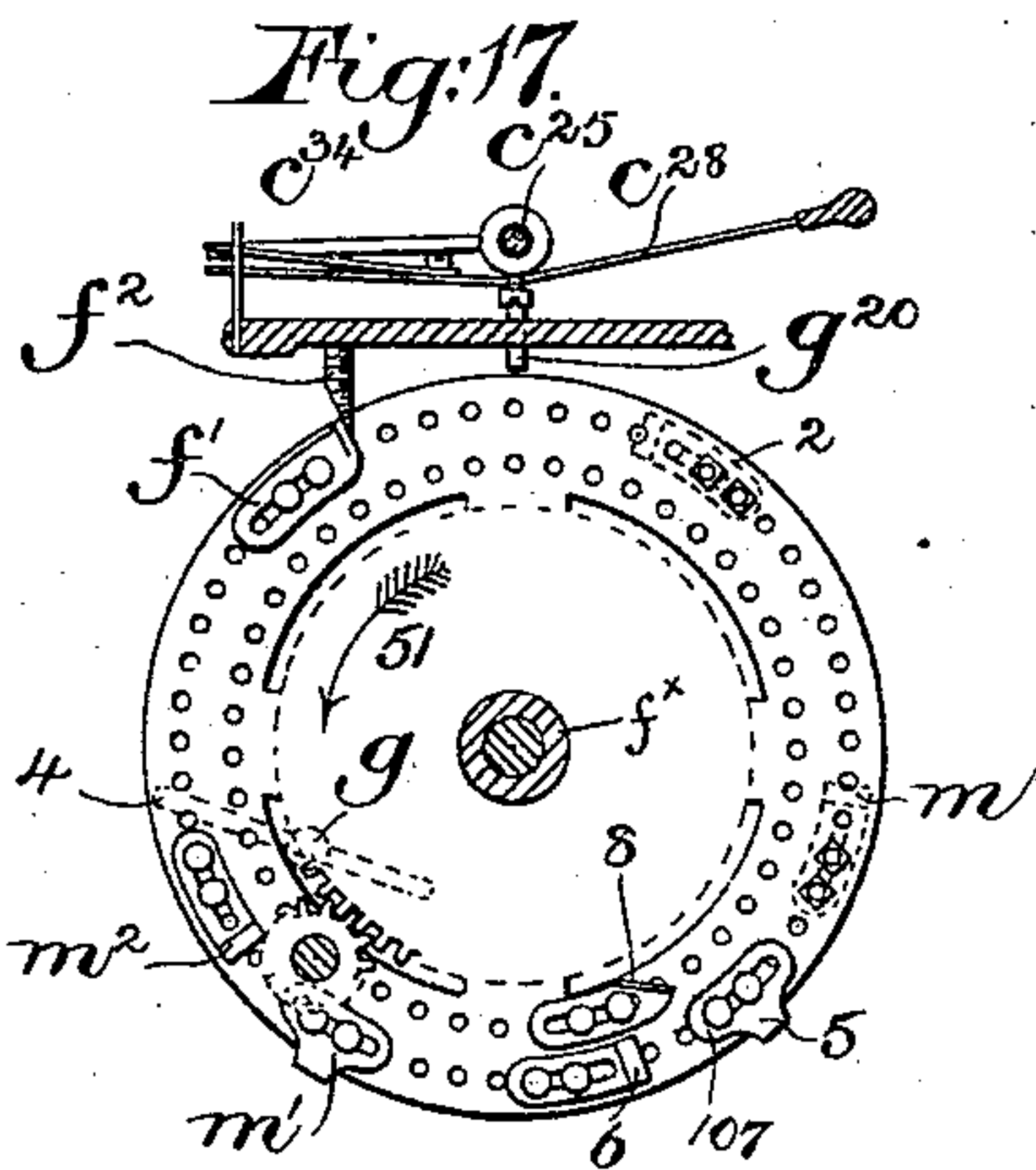
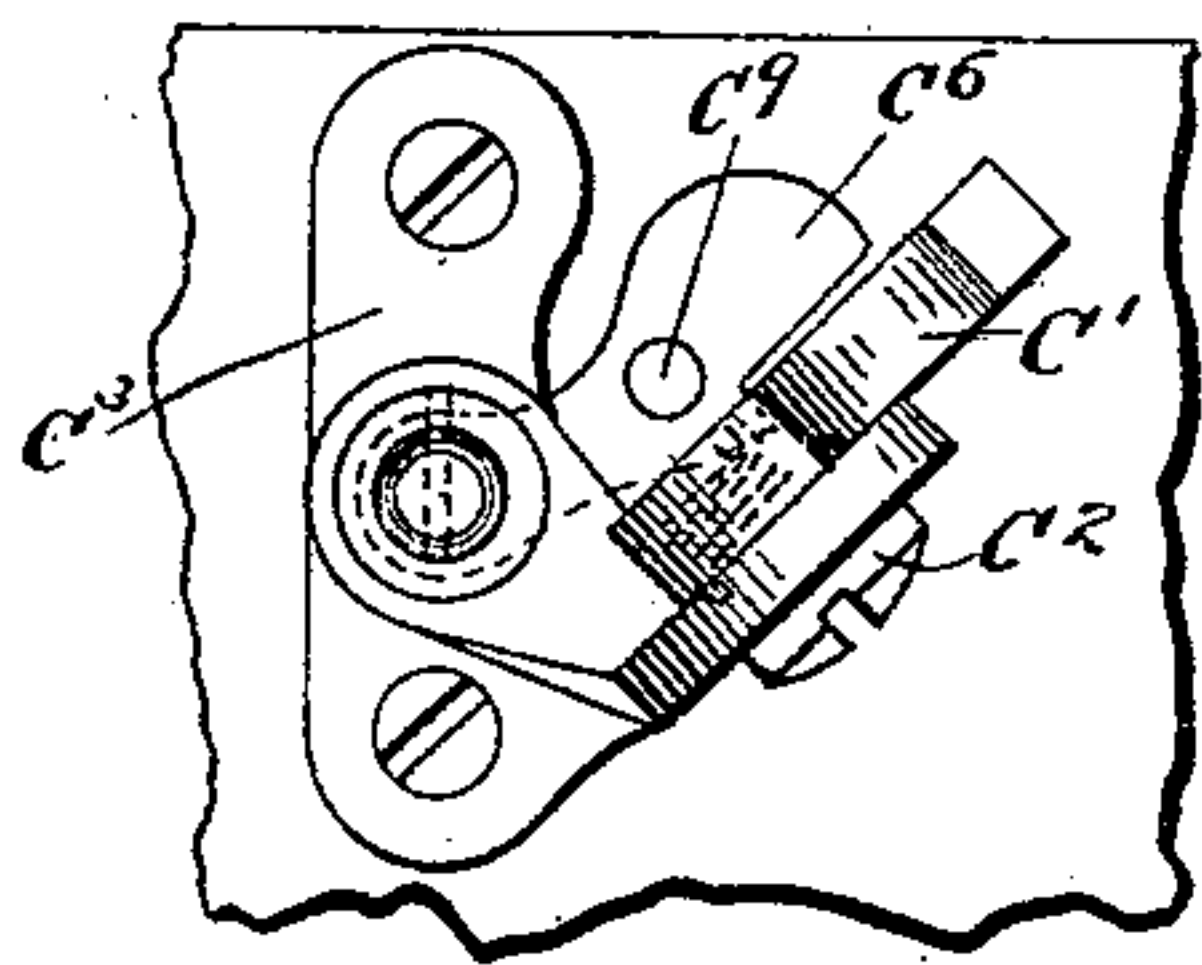
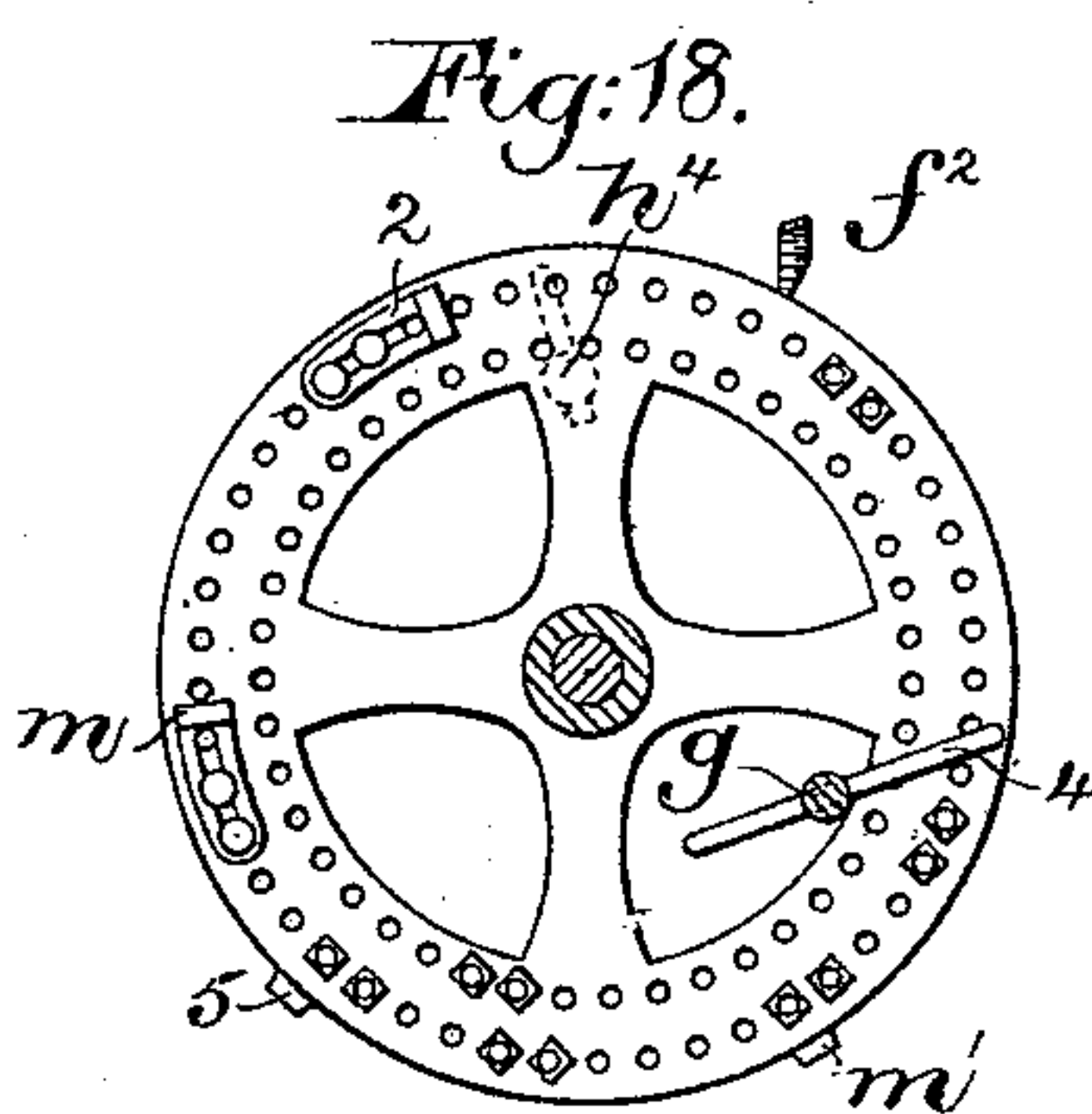
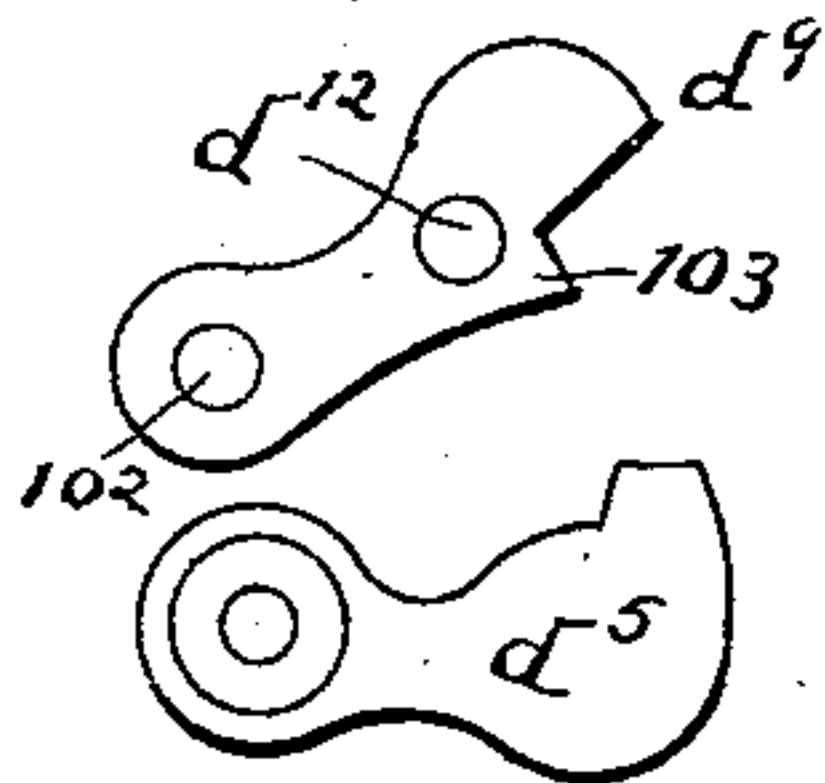


Fig 25



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# UNITED STATES PATENT OFFICE.

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SIGNORS TO THE SULLOWAY MILLS, OF FRANKLIN, NEW HAMPSHIRE.

## CIRCULAR-KNITTING MACHINE.

SPECIFICATION forming part of Letters Patent No. 461,357, dated October 13, 1891.

Application filed October 3, 1888. Serial No. 287,063. (No model.)

*To all whom it may concern:*

Be it known that we, WILLIAM H. MAYO and GEORGE D. MAYO, both of Lynn, in the county of Essex, State of Massachusetts, have  
5 invented an Improvement in Circular-Knitting Machines, of which the following description, in connection with the accompanying drawings, is a specification, like letters and figures on the drawings representing like parts.  
10 This invention relates to that class of knitting-machines which is employed in the production of tubular articles--such, for instance, as socks or stockings--and is provided with means whereby a portion of the needles  
15 may be rendered inoperative, as when after the completion of the leg or foot of a stocking it is desired to knit a heel or toe, and the remaining needles afterward carried one by one out of action at each reciprocation of the  
20 cam-cylinder until the desired number of needles have been acted upon to effect the narrowing of the fabric to the required extent, and whereby the needles thus carried out of operation are returned thereinto one by one  
25 by further reciprocations of the cam-cylinder, and the complementary widening of the fabric thereby accomplished, as well as the return into action of the portion of the needles which were rendered inoperative before the  
30 commencement of the narrowing operation and the knitting of the sock or stocking completed or a new one begun. In Letters Patent of the United States numbered 363,528, which were granted to William H. Mayo, May 24,  
35 1887, is shown and described a machine of this character employing long-heeled and short-heeled needles, in which the long-heeled needles not required in the formation of the heel or toe are rendered inoperative and operative  
40 at the required times, respectively, by elevating and depressing guides or switch-cams, and in which the short-heeled needles employed in the production of such heel or toe are successively carried out of action, one at  
45 a time, at each reciprocation of the cam-cylinder to effect the necessary narrowing of the fabric and afterward brought back one at a time, into action in a reverse order as the reciprocation of such cam-cylinder continues  
50 to correspondingly widen the fabric through the instrumentality of elevating and depress-

ing latches or cams, respectively, which are brought into operation at the proper times by inclined ways on suitable plates co-operating with the elevating and depressing latches. 55

The construction and arrangement of parts thus set forth, while effective in operation and answering the general purposes for which they were intended, require that the plates and their inclined ways which co-operate with  
60 the latches or cams shall be moved into and from operation by hand and that a separate guide or switch-cam for elevating and a separate guide or switch-cam for depressing the long-heeled needles not required in the forma- 65  
tion of a heel or toe shall be employed.

Our present invention has for its object, first, to provide means whereby cam-levers corresponding to the plates and the inclined ways on the said plates shown and described in the  
70 patent referred to may be automatically brought into relation to the latches or cams to effect the operation of the latter at the required times and the stoppage of the machine at predetermined stages of the work accom- 75  
plished; second, to provide means for lowering and raising the needles during the widening-operation, whereby two needles shall be carried into action and one carried out at each reciprocation of the cam-cylinder; third, 80  
to provide means for taking up the work as rapidly as knit which shall be more effective than those heretofore in use, and, fourth, simplifications of parts, whereby the general efficiency of the machine as a whole may be 85  
greatly enhanced.

To these ends the invention consists in certain peculiarities of construction and combination of parts, the nature and distinguishing characteristics of which will be best under- 90  
stood by reference to the accompanying drawings, in which—

Figure 1 is a front elevation of a knitting-machine embodying my invention; Fig. 2, a top view or plan, on an enlarged scale, more 95  
clearly to show the jacks, cam-cylinder, elevating and depressing cams, and levers to operate said cams; Fig. 3, a vertical section on the line *x x*. Fig. 2, the jacks being shown in elevation; Figs. 4, 5, 4<sup>a</sup>, and 5<sup>a</sup>, developed 100  
views of the inside of the cam-cylinder, showing the different positions assumed by the



switch-cam and the elevating and depressing cams during the operation of the machine in the production of a sock or stocking. Fig. 6 is a transverse section of the cam-ring for actuating the jacks; Fig. 6<sup>a</sup>, a developed view of the needle-cam ring, showing the cams  $c^6$  and  $c^7$  in operative position for widening; Fig. 7, a partial under side view of the cam-ring shown in Fig. 6; Fig. 8, a transverse section of the jack-supporting ring; Fig. 9, a partial top view or plan of the same; Fig. 10, a sectional detail more clearly to show the manner of raising the long-heeled needles which are not to be reciprocated in the heel and toe work; Fig. 11, details of one of the cam-levers by which the needle-depressing cams are operated; Fig. 12, a detail of one of the needle-depressing cams, supporting-bracket, and latch, looking at its inner side—that is, from the center of the machine; Fig. 13, an outside view of the same; Fig. 14, an upper edge view of the same, looking in the direction of arrow in Fig. 12; Fig. 15, a sectional detail on the line  $x'x'$ , Fig. 1, looking toward the left, more clearly to show the safety device for controlling the reciprocation of the cam-cylinder; Fig. 15<sup>a</sup>, a detail view showing the parts composing the clutch and safety devices separate from one another; Fig. 16, a section of Fig. 1 on line  $y y$ , looking toward the left; Fig. 17, a section of Fig. 1 on line  $y y$ , looking toward the right to show the pattern-wheel; Fig. 18, a section of Fig. 1 on the line  $y^2 y^2$ , looking toward the left, showing only the pattern-wheel in side elevation; Fig. 19, a detail in plan of the mechanism for automatically operating the cam-levers which actuate the needle lifting and depressing cams; Fig. 20, a partial view of the same, looking toward the left; Fig. 21, a detail of the rear portion of the machine to show the mechanism for automatically operating the belt-shipper; Fig. 22, a sectional detail on line  $y'y'$  of Fig. 1, looking toward the right; Fig. 23, a detail to be referred to; Fig. 24, a detail of the mechanism for automatically adjusting the needle-cylinder vertically to get the proper length of loop; Fig. 25, a detail showing an elevating cam and latch detached; and Fig. 26, a detail showing one of the elevating-cams, its co-operating latch, and the means made use of for mounting them upon the cam-cylinder.

The frame, comprising the bed-plate A, the uprights A', and cross-pieces A<sup>2x</sup>, connecting said uprights, support the working parts of the machine. The uprights A' and boxes 50 51, secured to the cross-piece A<sup>2x</sup>, support journal-bearings for main shafts A<sup>2</sup> A<sup>15</sup>, the shaft A<sup>2</sup> being provided, as shown, with a driving-pulley A<sup>3</sup> and second pulley A<sup>4</sup>, the latter being connected by a belt A<sup>5</sup> to the fast pulley A<sup>6</sup> and loose pulley A<sup>x</sup> on a shaft A<sup>7</sup>, supported by the uprights A', the shaft A<sup>15</sup> being also provided, as herein shown, with a fast pulley A<sup>13</sup>. The shaft A<sup>7</sup> has mounted on it a gear A<sup>8</sup>, in mesh with a bevel-gear A<sup>9</sup> on a shaft or arbor A<sup>10</sup>,

provided, as shown, with a crank or hand-wheel A<sup>12</sup>, the gear-wheel A<sup>9</sup> meshing with bevel-teeth  $a$  (see Fig. 3) on the cam-cylinder 70  $a'$ , substantially as in the patent referred to. The needle-cylinder  $a^2$ , the skeleton frame  $a^3$  to guide the heels of the needles  $a^4$ , the cam-cylinder  $a'$ , provided with the annular ledge E', (see Figs. 4 and 5,) the needle-elevating 75 cam F, the vertically-movable wedge-shaped stitch-cams C', the guide-plate G', and guide-plates G<sup>2</sup>—one at each end of the guide-plate G', forming with the inclined ends of the guide-plate G' channels for the passage of the 80 heels of the needles when the latter are acted upon by the needle-lifting cams to be described—are all substantially as in the patent referred to. The upper end of the needle-cylinder  $a^2$  (see Fig. 3) is made broader or thicker 85 by the addition to its interior of a ring  $a^7$ , which is connected thereto by a screw 54, a second ring  $a^8$  surrounding the upper end of the cylinder and resting on ledge  $a^9$  thereof, being attached to the cylinder by a screw 90 55. The upper ends of the said cylinder and rings, suitably grooved, as at  $a^{100}$ , Fig. 8, form a support for the jacks  $a^{10}$ , as shown best in Fig. 3, said jacks being short horizontally-sliding jacks. Each jack  $a^{10}$  at its rear end is 95 made straight and provided with an upwardly-extended projection  $a^{55}$  to enter an annular groove or channel  $a^{12}$ , (shown best in Fig. 6,) formed, as shown, by the overhanging lip  $a^{13}$  of a ring  $a^{14}$ . The ring  $a^{14}$  is provided, as shown, 100 with a circumferential slot or opening, into which is fitted a piece  $a^{50}$ , provided with a cam-shaped groove or channel  $a^{15}$ , which forms a part of the groove  $a^{12}$  when the piece  $a^{50}$  is secured in place by screws (not shown) inserted 105 through threaded openings in the extended ends  $a^{51}$  of the back of the piece  $a^{50}$ , (see Fig. 7,) the said cam-shaped groove acting to withdraw the fingers  $a^{16}$  of the jacks (see Fig. 3) out of the path of movement of the needles when a 110 stitch is being formed. It will be noticed that the jacks  $a^{10}$  are short in length and do not extend beyond the projection  $a^{55}$ , but that the said projection forms an upward continuation of the rear end of the jack, thus obtaining an increased surface at the rear end of the jack, against which the ring  $a^{14}$  acts, and 115 as the said ring acts on the said increased surface the said jack is moved forward in a straight path without side-twisting—that is, 120 the said jack is moved forward by a direct thrust—thereby diminishing the wear and strain upon the jacks which would be the case if the jacks had butts or projections between their ends as heretofore. The ring  $a^{14}$  125 rests directly upon and is supported by the ring  $a^8$ , and is operated from the cam-cylinder  $a'$  through the instrumentality of an arm  $a^{25}$ , fixedly secured to the latter and engaging with suitable stops  $a^{26}$ , projecting outwardly from 130 the former, as shown in Figs. 2 and 3.

The jacks  $a^{10}$ , which take the stitches as they are formed and push them back from the needles, thus taking up the work as fast as it is



knit, are prevented from being raised by the work when the cylinder-needles are in operation by a ring  $b$ , provided with a flange  $b'$ , which rests upon the front or inner ends of said jacks, as clearly shown in Fig. 3, the inner ends of the jacks reciprocating between the flange  $b'$  and the top of the ring  $a'$ , the ring  $b$  being secured to the ring  $a'$ , as shown, by set-screw  $b^2$ . (See Fig. 3.)

The cam-cylinder is provided, as shown in Figs. 4 and 5, with a curved slot  $b^3$ , through which is extended a thumb-piece  $b^4$ , (see Fig. 2,) secured to a switch-cam  $b^5$ , pivoted, as at  $b^6$ , to the cam-cylinder and to a guide-piece  $b^7$ , the said cam performing the double office of elevating and depressing the long-heeled needles. For instance, when in the formation of a heel or toe of a sock or stocking it is desired gradually to narrow the fabric the cam  $b^5$  will be turned down into the position shown in Figs. 5 and 10, so that during the rotation of the cam-cylinder the long-heeled needles not to be used in the production of heels and toes, preferably about one-half of all the needles, are caused to travel up to and on the upper face or edge 20 of the cam  $b^5$ , as shown in Fig. 10, until they are substantially on a line with the top of the guide-plates  $b^7$  and  $G^2$  thus throwing them out of operative position, they being held in said inoperative position by the work or by a spring-band  $b^{30}$  on the needle-cylinder. (See Fig. 3.) After the narrowing has been finished, as will be described, the long-heeled needles may be lowered into their normal position, with their heels resting on the ledge  $E'$ , by elevating the cam  $b^5$  into its normal position, (shown in Fig. 4,) the long heels of the needles in the rotation of the cam-cylinder riding down the under face or edge 21 of the cam  $b^5$ . With the long-heeled needles elevated and the cam  $b^5$  in the position shown in Fig. 5, the said cam not being thick enough to act on the short-heeled needles, as clearly shown in Fig. 10, the cam-cylinder is reciprocated by the oscillation of the shaft  $A^7$ , having loosely mounted upon it a pinion  $b^{10}$ , in mesh with a segmental gear  $b^{51}$ , mounted on a stud  $b^{14}$  of the frame  $A'$ , as shown in Fig. 1, by link  $b^{12}$  to a crank  $b^{13}$  on the shaft  $A^{15}$ . The pinion  $b^{10}$  is provided, as shown, with a stud or projection  $b^{15}$ , adapted to enter a recess or socket  $b^{16}$  in a disk  $b^{17}$ , mounted on the shaft  $A^7$  by a key  $b^{50}$ , (see Fig. 15,) the said disk being moved longitudinally, as herein shown, to engage the socket  $b^{16}$  with the stud  $b^{15}$  by the forked arm  $b^{18}$  of a hub  $b^{19}$ , fast on a rod  $b^{20}$ , supported in bearings in the upright  $A'$  and in a lug  $b^{21}$ , depending from the bed-plate  $A$ . The rod  $b^{20}$  is moved longitudinally by a lever  $b^{22}$ , (see Fig. 15,) pivoted to the frame of the machine and connected to said rod, as by a screw  $b^{23}$ , extended through a slot in said lever, the latter engaging a notched projection or casting  $b^{24}$ , secured to the frame of the machine (see Fig. 1) to retain the disk  $b^{17}$  in engagement with the pinion  $b^{10}$ , the rod  $b^{20}$ ,

when the lever  $b^{22}$  is disengaged from the casting  $b^{24}$ , being moved longitudinally to disengage the disk from the pinion, as shown, by the spring  $b^{26}$  and stop the reciprocation of the machine.

To prevent the cam-cylinder from starting its reciprocating motion in the wrong direction, a safety device is provided, it consisting, as herein shown, of a collar  $b^{27}$  on the shaft  $A^7$  and provided with an arm or lug  $b^{27x}$ , (see Figs. 15 and 15<sup>a</sup>,) resting against the stud  $b^{29}$  and covering the socket when the shaft  $A^7$  is running in the wrong direction, but which is struck by the stud  $b^{15}$  on the pinion  $b^{10}$  and moved to uncover the socket when the shaft is rotating in the right direction, the movement of the lug or arm away from the socket being limited, as shown in Figs. 15 and 15<sup>a</sup>, by a pin  $b^{31}$ , extended in a slot  $b^{32}$  in the collar  $b^{27}$ .

When it is desired to narrow the work, the long-heeled needles are first raised and rendered inoperative, which is accomplished by depressing the switch-cam  $b^5$ , as shown in Fig. 5, and starting the reciprocation of the cam-ring, and the short-heeled needles are then raised one by one at each reciprocation of the cam-cylinder until a sufficient number of the short-heeled needles have been raised to allow to be knit the narrowest course in the formation of a heel or toe.

The short-heeled needles are raised one by one at each reciprocation of the cam-cylinder by needle-elevating cams  $c c'$ , pivoted, as at  $c^2$ , to a casting or lug  $c^3$ , fastened to the outside of the cam-cylinder. (See Figs. 2 and 26.) Each cam  $c c'$  is extended inwardly through a slot in the cam-cylinder and at its inner end is provided with a hook or finger  $c^4$ , (see Figs. 4 and 5,) which engages the heel of a needle and raises it up out of operative position—that is, out of the path of the stitch-cams  $C' C'$ —as will be described.

In the normal working of the machine and when the long-heeled needles are being raised and lowered the fingers or hooks  $c^4$  of the elevating-cams  $c c'$  are withdrawn, so as not to engage the heels of the short-heeled needles, as shown in Fig. 4, the said cams  $c c'$  being locked in this position by latches  $c^5 c^6$ , respectively, (see Figs. 2 and 26,) the said latches being pivoted to the cam-cylinder and provided with arms or posts  $c^8 c^9$ , extended, as shown, substantially at right angles to the cam-cylinder. At each reciprocation of the cam-cylinder the latches  $c^5 c^6$  are disengaged from the cams  $c c'$  by cams  $c^{10} c^{12}$ , (herein shown as forming part of levers  $c^{13} c^{14}$ ,) pivoted to a stationary part of the machine—as, for instance, the bed-plate—they being each herein shown pivoted in ears  $c^{15}$  (see Figs. 2 and 3) of a casting  $c^{16}$ , secured, as by screws  $c^{17}$ , to a ring  $c^{18}$ , secured to the bed-plate  $A$ , the said levers each having secured to them, as herein shown, one end of the springs  $c^{19}$ , having their outer ends fastened to the casting  $c^{16}$ .



When the machine is producing circular work, as in the formation of the leg of a stocking or sock, the cam-levers  $c^{13} c^{14}$  are kept out of the path of movement of the posts  $c^8 c^9$  by  
 5 cams  $c^{20} c^{21}$ , (herein shown as forming part of plates  $c^{22} c^{23}$ ,) secured to a ring  $c^{24}$ , loose on the ring  $c^{18}$ ; but when it is desired to narrow, as in the formation of a heel or toe, the ring  
 10  $c^{24}$  will be given a partial rotation, as in the direction indicated by arrow 40, Fig. 2, to move the cams  $c^{20} c^{21}$  beyond or out of engagement with the levers  $c^{13} c^{14}$ , thus permitting the springs  $c^{19}$  to move the said levers forward to place the cams  $c^{10} c^{12}$  in the path of move-  
 15 ment of the posts  $c^8 c^9$ . The ring  $c^{24}$  has connected to it a rod  $c^{25}$ , herein shown as provided with a hub  $c^{26}$ , (see Figs. 1, 17, and 19,) the said rod sliding in bearings in an upright lug  $c^{27}$ , secured to the bed-plate. The hub  $c^{26}$   
 20 has pivoted to its underside, as herein shown, a lever  $c^{28}$ , provided with a handle  $c^{29}$  and having its inner end extended through a slot  $c^{30}$  in plate  $c^{31}$ , secured to the bed-plate, the plate  $c^{31}$  having a series of notches  $c^{32} c^{33}$ , in  
 25 which rests a rod  $c^{34}$ , (see Fig. 20,) secured, as shown, to the hub  $c^{26}$ . The rod  $c^{34}$  between the lug  $c^{27}$  and hub  $c^{26}$  is encircled by a spring 100, whose normal tendency is to move the ring  $c^{24}$  in the direction of arrow 40 in Fig. 2, but which  
 30 movement is controlled or regulated by the position of the rod  $c^{34}$  in the plate  $c^{31}$ .

When the machine is producing circular work, the rod  $c^{34}$  is in engagement with the notch  $c^{32}$ ; but when it is desired to narrow,  
 35 the lever  $c^{28}$  will be turned to allow the spring 100 to move the rod  $c^{34}$  into engagement with the notch  $c^{33}$ , as shown in Fig. 20. The operator now moves the switch-cam  $b^5$  into its lower position, (shown in Fig. 4<sup>a</sup>,) and then  
 40 moves the lever  $b^{22}$  to start the reciprocating mechanism, and on the first reciprocation of the cam-ring in the direction of the arrow 41, which in practice will be the first reciprocation in the narrowing operation, the long-  
 45 heeled needles will be raised. Let it be supposed that the ring  $c^{24}$  has been moved in the direction of arrow 40 and that the rod  $c^{34}$  is in engagement with the notch  $c^{33}$ , the levers  $c^{13} c^{14}$  being moved forward to place the cams  
 50  $c^{10} c^{12}$  in the path of movement of the posts  $c^8 c^9$ , and also let it be supposed that the cam-cylinder is moving in the direction of such arrow 40.

At the commencement of the narrowing of  
 55 the work—that is, when the machine is knitting circular work—the cams  $c c'$  are in their uppermost position, or as shown in Fig. 4. As the cam-ring is moved in the direction of arrow 40 the post  $c^8$  rides over the cam  $c^{12}$  and  
 60 disengages the latch  $c^5$  from the cam  $c$ , permitting the cam  $c$  to be turned on its pivot  $c^2$  into the position shown in Fig. 4<sup>a</sup> by a suitable spring encircling said pivot, (see Fig. 26,) thus leaving the hook or finger  $c^4$  of the  
 65 said cam in the path of movement of the heel of a short-heeled needle, so that on the reverse reciprocation or movement of the cam-

cylinder in the direction of arrow 41 opposite to that indicated by arrow 40 the heel of the first short-heeled needle will engage the hook  
 70 or finger  $c^4$  and force the cam  $c$  back into its normal position, as shown in Fig. 4, until the cam has been swung back far enough to release the needle, which at such time rests upon the guide-plate  $G'$ , and on the further  
 75 reciprocation of the cam-ring the needle is forced by the guide-plate above a spring  $d^2$ , closing the passage  $d^3$  between the guide-plates  $G' G^2$ . On the further movement of the cam-ring in the direction of arrow 41 the  
 80 post  $c^8$  passes over and out of contact with the cam  $c^{10}$ , the lever  $c^{13}$  being lower or smaller than the lever  $c^{14}$ , while the post  $c^9$  rides over the cam  $c^{10}$  and trips the latch  $c^6$ , thus permitting the elevating-cam  $c'$  to be in turn  
 85 moved to its lowest position, (shown in Fig. 5,) so that on the reverse rotation of the cam-cylinder in the direction of arrow 40 the end one of the short-heeled needles on the opposite side of the machine will be engaged  
 90 with the hook or finger of the said cam and the said needle elevated. By repeated reciprocations of the cam-cylinder the number of short-heeled needles it is necessary to render inoperative in order to produce the narrowest  
 95 course required may be raised. In the formation of the heel of a sock it is necessary complementarily to widen the fabric after it has been narrowed, which is accomplished in the present case by needle-depressing cams  
 100  $d^5 d^6$ , (see Figs. 4 and 5,) shaped substantially like the elevating-cams  $c c'$ , with the exception that the finger or hook  $d^7$  on each depressing-cam is made long enough to engage the  
 105 heels of two needles, for a purpose to be hereinafter described.

The depressing-cams  $d^5 d^6$  are pivoted at 101 to castings  $d^8$ , secured to the outer side of the cam-cylinder, and the said cams are normally  
 110 locked in their inoperative position (shown in Fig. 4) by latches  $d^9 d^{10}$ , having posts  $d^{12} d^{13}$ , each of said latches being pivoted to the castings  $d^8$ , as at 102, and provided on its under side with a shoulder 103, (see Fig. 25,) against which the cam abuts, the said latch  
 115 being normally thrown forward to engage the cam by the spring 104, encircling the pivot 102. (See Fig. 14.) The posts  $d^{12} d^{13}$  are operated to disengage the latches from their cams by cams  $d^{14} d^{15}$  on levers  $d^{16} d^{17}$ , of the same  
 120 construction as the levers  $c^{13} c^{14}$ , they being pivoted, as shown, to ears  $d^{56}$  of castings  $d^{18}$ , secured to the bed-plate and provided with springs by which the said levers are thrown forward, the said levers being normally held  
 125 out of the path of movement of the said posts, as shown, by cam-plates  $d^{20} d^{21}$ , (see Fig. 2,) provided with recesses or notches  $d^{22}$ , into which the said levers are moved by their springs, the said cam-plates being secured to  
 130 the ring  $c^{24}$ . Let it be supposed that the ring  $c^{24}$  has been moved in the direction of arrow 40 to place the notches  $d^{22}$  opposite the levers  $d^{16} d^{17}$ , and thus bring the cams  $d^{14} d^{15}$ , which,



it will be noticed, incline in opposite directions, into the path of movement of the posts  $d^{12}$   $d^{13}$ , which is accomplished by moving the lever  $c^{28}$  in Fig. 19 so as to disengage the rod  $c^{34}$  from the notch  $c^{33}$  and place it upon the top of plate  $c^{31}$ , the movement of the ring  $c^{24}$  being limited, as shown, by lugs  $d^{25}$  (see Fig. 2) on the cam-plates  $d^{20}$   $d^{21}$ . The lever  $d^{16}$  and post  $d^{13}$ , co-operating therewith, are higher than the lever  $d^{17}$  and post  $d^{12}$ , co-operating with it, so that only one depressing-cam will be placed in operative position at each reciprocation. The posts  $c^8$   $c^9$   $d^{12}$   $d^{13}$ , and the levers  $c^{13}$   $c^{14}$   $d^{16}$   $d^{17}$  are arranged at varying heights, substantially as shown in the patent, No. 363,528, referred to. Let it be supposed that the narrowing is being finished, as in the formation of a heel of a sock, after which the work is to be gradually widened again—as, for instance, to complete the heel. In this case as the cam-ring is moving in the direction of arrow 40 from the position shown in Fig. 2 the post  $d^{12}$  passes under the cam-lever  $d^{17}$ , which is beveled downwardly on its under side, as at 50, (see Fig. 11,) the said lever being turned back on its pivot without effecting the movement of the post  $d^{12}$  and its latch  $d^9$ , the cam-ring being moved in the said direction until the post  $c^8$  rides over the cam  $c^{12}$  to trip the elevating-cam  $c$ . The movement is now reversed by the reciprocating mechanism, above described, and on the reverse movement in the direction of arrow 41 the cam  $c$  elevates a needle, as above described, which becomes the last short-heeled needle on the inner end of the adjacent row of elevated short-heeled needles, and on the further movement of the cam-cylinder in said direction the post  $d^{12}$  rides over the inclined cam  $d^{15}$  and disengages the latch  $d^9$  from the depressing-cam  $d^5$ , permitting the latter to be moved by the spring  $d'$ , encircling its pivot, from the position shown in Fig. 4 to that shown in Fig. 5<sup>a</sup>, so that on the still further rotation of the cam-ring in the direction of arrow 41 the finger or hook  $d^7$  will engage the heels of the two short-heeled needles at the inner end of the opposite row of elevated short-heeled needles and will draw them down the passage or channel  $e$  to their normal position, with their heels resting on the ledge  $E'$ . The cam-ring is rotated in the direction of arrow 41 until the cam  $c'$  is tripped by the cam  $c^{10}$  and depressed to the position shown in Fig. 6<sup>a</sup>, when the motion is reversed and the cam-ring moved in the direction of arrow 40. As the cam-ring is moved in the direction of arrow 40 one of the two short-heeled needles previously depressed by the cam  $d^5$  on the movement of the cam-ring in the direction of arrow 41 is again raised by the elevating-cam  $c'$ . As the cam-ring is moved in the direction of arrow 40 the post  $d^{13}$ , which in the movement of the cam-ring in the direction of arrow 41 passes under the inclined cam  $d^{14}$ , rides over the cam  $d^{14}$ , thereby disengaging the latch  $d^{10}$  from the depressing-cam  $d^6$ , permitting the latter to be

moved from the position shown in Fig. 4 to that shown in Fig. 6<sup>a</sup>, so that on the further movement of the cam-ring in the direction of arrow 40 two of the short-heeled needles on the end of the row of elevated short-heeled needles elevated by the cam  $c$  will be depressed by the cam  $d^6$ . On the reverse movement one of the two needles depressed by the cam  $d^6$  will be again raised by the cam  $c$ , and so on until all the short-heeled needles have been lowered. It will thus be seen that in the widening of the fabric, as in completing the heel or toe of a sock, two needles are depressed on the movement of the cam-ring in one direction and one of the said needles again raised on the movement of the cam-ring in the reverse direction, thereby producing a stronger fabric and one having a better finish at the sides of the heel and toe.

In order that the various changes in the position of different parts of the machine to produce different kinds of work, as above referred to, may be accomplished automatically I have provided the pattern-wheel  $f$  (see Figs. 1, 17, and 18) with cams or projections to control the operation of the different parts.

Referring to Fig. 17, the pattern-wheel  $f$  has secured to it a lug or stop  $f'$ , which rests against a lug  $f^2$  on the bed-plate  $A$  when the machine is in its starting position—that is, when about to produce circular work, as in the formation of the leg of a sock. The pattern-wheel  $f$  is mounted on a loose sleeve  $f^x$  on the shaft  $A^7$ , and, as shown, the said sleeve has mounted on it a gear-wheel  $f^4$ , (see Fig. 1,) in mesh with a pinion  $f^5$ , having mounted on its shaft a ratchet-wheel  $f^6$ , the teeth of which are normally engaged by a pawl  $f^7$ , pivoted to an arm  $f^8$ , secured to the bed-plate  $A$ . (See Fig. 16.) The sleeve  $f^x$ , as herein shown, is extended beyond the gear  $f^4$  and is provided with a groove to form a pulley  $f^9$ , to which is connected one end of a band  $f^{10}$ , having at its opposite end a weight  $f^{12}$ , which acts to restore the pattern-wheel  $f$  to its normal position when a stocking is finished. The driving-belt  $A^5$  is shifted, as herein shown, by a shipper  $g$  of ordinary construction, the said shipper having a handle  $g'$ , which is locked in a notch in a plate  $g^2$  (see Fig. 23) when the belt is shipped to the fast pulley, the shipper-rod being encircled by a spring  $g^3$ , which acts on the shipper to move the belt from the fast to the loose pulley when the handle is disengaged from the notch in the plate  $g^2$ . The shipper-rod  $g$  has secured to it, as shown in Fig. 21, a bent rod  $g^5$ , which acts on a stud  $g^6$  on a rod  $g^7$  to lift the said rod and bring a lug 10 on the upper end of the rod opposite a notch 12 in a plate secured to an arm depending from the bed-plate of the machine, the lug 10 being engaged with the said notch by the spring  $g^{13}$ , encircling the rod  $g^7$ , one end of which is fastened to the rod  $g^7$  and the other end to a stationary part of the machine. The rod  $g^7$  is maintained in its elevated position until the lug 10 is released



from the notch 12, which is accomplished, as herein shown, by a cam 8 on the pattern-wheel  $f$  engaging the rod  $g^8$  and turning the rod  $g^7$ , as will be described.

5 In operation the pattern-wheel occupies the position shown in Fig. 17, with the lug  $f'$  in contact with the stud  $f^2$  at the commencement of the circular work—such, for instance, as the leg of the stocking. The shipper, through  
10 its handle, is operated to shift the belt from the loose to the fast pulley and the cam-cylinder rotated to produce circular work, the needles being down and the stitch-cams operated by the inclined cams  $h$   $h'$  on the segmental plate  
15  $h^2$ , as in the case of the plate D and cams  $d$   $d'$  in the patent above referred to. The pattern-wheel is gradually rotated in the direction of arrow 51 by the cam  $g^{14}$  until a cam or lug 2 on one side of the said pattern-wheel  
20 strikes an arm 4 on the shipper-rod  $g$  and moves it down and rocks the said rod sufficiently to raise the shipper  $g'$  from its latch  $g^2$ , thus permitting the spring  $g^3$  to move the shipper-rod to the left in Fig. 21, so as to shift the belt  $A^5$  to the loose pulley  $A^x$  and there-  
25 by stop the machine. The operator now moves the switch-cam  $b^5$  into its lower position (shown in Fig. 5) and moves the reciprocating lever  $b^{22}$  to start the reciprocating mechanism, which, as above described, is actu-  
30 ated by rotation of the shaft  $A^{15}$ , driven by a belt (not shown) on the fast pulley  $A^{13}$ , operated by a suitable shipper. (Not shown.) When the reciprocating lever  $b^{22}$  is moved,  
35 the arm  $h^4$ , fast on the rod  $b^{20}$  and having an incline on one of its faces, is brought into engagement with the stud or rod  $g^{20}$  and slightly rocks or turns the hub  $c^{26}$ , lifts the rod  $c^{34}$  out of the notch  $c^{32}$ , and permits the spring  
40 100 to move the rod  $c^{34}$  into engagement with the notch  $c^{33}$ , thus bringing the cam-levers  $c^{13}$   $c^{14}$  into position to actuate the elevating-cams  $c$   $c'$ . As the rod  $c^{34}$  engages the notch  $c^{33}$  the stud or rod  $g^{20}$  is moved substantially  
45 in line with the periphery of the pattern-wheel. The machine is now operating to narrow the heel, and when the heel has been sufficiently narrowed the stud  $g^{20}$  is struck by a cam or lug 5, herein shown as forming part  
50 of a plate 107, secured to the side of the pattern-wheel, the said lug projecting over and in line with the periphery of the pattern-wheel, the said stud being struck with sufficient force to slightly rock the rod  $c^{25}$  and  
55 raise the rod  $c^{34}$  out of the notch  $c^{33}$  and place it upon the top or edge of the plate  $c^{31}$ , when the spring 100, encircling the rod  $c^{25}$ , moves the ring  $c^{24}$ , so as to place the cam levers  $d^{16}$   $d^{17}$  in position to act on the depressing-cams  
60  $d^5$   $d^6$ , as above described, to widen the work—viz., to complete the heel. The pattern-wheel continues to revolve in the direction of arrow 51 until the cam 6 on the pattern-wheel strikes the arm  $h^4$  on the end of the rod  $b^{20}$  (see Fig.  
65 1) and slightly turns or rocks the rod  $b^{20}$  to release the reciprocating lever  $b^{22}$  from its latch, thus permitting the disk  $b^{17}$  to be dis-

engaged from the pinion  $b^{10}$ , as herein shown, by the spring  $b^{26}$ , thereby stopping the recip-  
70 rocation of the cam-cylinder, the heel at such time being completed. The slot in the lever  $b^{22}$  permits the rod  $b^{20}$  to be slightly rocked. The lever  $c^{28}$  is now moved back by hand to engage the rod  $c^{34}$  with the notch  $c^{32}$  to restore the ring  $c^{24}$  to its normal position, and there-  
75 by remove the cam-levers from operative position with relation to the needle elevating and depressing cams. The switch-cam  $b^5$  is then elevated and the shipper  $g'$  moved to shift the belt  $A^5$  onto the fast pulley and start  
80 the machine revolving to produce circular work in the formation of the foot of the stocking. In the first revolution of the cam-cylinder the long-heeled needles are depressed by the switch-cam  $b^5$ . When the foot portion is  
85 completed, a cam or lug  $m$  on the pattern-wheel, corresponding to the lug or cam 2, strikes the arm 4 and shifts the belt  $A^5$  from the fast pulley to the loose pulley, as above described, thereby stopping the machine. The switch  $b^5$   
90 is now depressed and the reciprocating lever  $b^{22}$  moved to start the machine in reciprocation to produce narrow work in the formation of the toe, the cam-levers  $c^{13}$   $c^{14}$  being brought into operative position, as above de-  
95 scribed, by the arm  $h^4$ . When the toe is sufficiently narrowed, a lug or cam  $m'$  on the pattern-wheel strikes the stud or rod  $g^{20}$  and disengages the rod  $c^{34}$  from the notch  $c^{33}$ , bringing the levers  $d^{16}$   $d^{17}$  into operative position to  
100 actuate the depressing-cams  $d^5$   $d^6$ , as above described, and complementarily widen the toe. The pattern-wheel continues to revolve until the toe is completed, and when this is effected,  
105 a cam or lug  $m^2$  on the pattern-wheel, corresponding to the lug 6, strikes the arm  $h^4$  and disengages the reciprocating lever  $b^{22}$ , thereby stopping the reciprocation of the machine. The lever  $c^{28}$  is now moved back by hand to  
110 engage the rod  $c^{34}$  with the notch  $c^{32}$  to restore the ring  $c^{24}$  to its normal position and remove the cam-levers from operative position with relation to the needle elevating and depress-  
115 ing cams. The switch-cam  $b^5$  is then elevated and the machine revolved by power or by hand a sufficient number of times to form the desired number of courses to allow for finish-  
120 ing the toe of the stocking, and during the knitting of the courses referred to the cam 8 on the pattern-wheel, having, as shown, an inclined face, strikes the stud  $g^8$  and gives the rod  $g^7$  a partial rotation to disengage a  
125 stud 10 from a notch 12 in a plate secured to the arm 13 depending from the bed-plate A. When the stud 10 is disengaged from the notch 12, the spring  $g^{13}$  forces the rod  $g^7$  down and causes the stud  $g^9$  to disengage the pawls from the ratchet-wheel and permit the weight to restore the pattern-wheel to its normal po-  
130 sition. (Shown in Fig. 17.)

The needle-cylinder, as shown in Fig. 3, has an inclined recess or cam-surface  $h^{200}$ , into which is fitted a cam projection  $h^{20}$  on a ring  $h^{21}$ , loosely mounted in the bed-plate. This



ring  $h^{21}$  of itself is not novel, but is used to raise and lower the needle-cylinder to regulate the length of the loops to be made by the needles, so as to impart more or less fullness to certain parts of the stocking, especially the leg. The ring  $h^{21}$  has connected to it a rod 14, (see Fig. 24,) provided, as shown, with an arm  $h^{22}$ , having forks to embrace, as shown, the gear-wheel  $f^4$  and be acted upon to move the rod and produce reciprocation of the loose ring by cams  $h^{25}$  on both sides of the said wheel, only one being shown, whereby the rod 14 may be reciprocated and the needle-cylinder raised and lowered by means of the cam  $h^{20}$ , and thus the length of stitch may be varied according to the shape to be imparted to the fabric being knit, the machine herein shown being adapted to lengthen the stitches while knitting the calf of the leg.

Referring to Figs. 1 and 3, the bed-plate A supports a curb 100, to which are connected suitable lugs 101, which serve to support the cam-ring  $h^{21}$ , having the cam-surface  $h^{20}$ , the said ring having a projection  $h^{21x}$ , to which is jointed the rod 14.

We have herein shown but a single head automatically controlled in its operation by a pattern-wheel; but we do not desire to limit our invention to a single head, as it is evident any desired or convenient number may be geared to the shaft  $A^7$  and be governed by a single pattern-wheel. It is also evident that the position of the lugs or cams on the pattern-wheel may be changed to produce any desired length or size of stocking.

Having thus described our invention, what we claim as new, and desire to secure by Letters Patent of the United States, is—

1. In a knitting-machine, the needle-cylinder and reciprocating jacks supported thereby, combined with a cam-ring  $a^{14}$  to act directly against the outer ends of and actuate the said jacks, whereby a direct thrust is obtained, substantially as described.

2. In a knitting-machine, the needle-cylinder and jacks supported thereby, combined with a cam-ring  $a^{14}$  to act on the ends of the said jacks, whereby a direct thrust is obtained, and with a ring  $b$ , provided with a flange overlapping the inner ends of the jacks, substantially as described.

3. In a knitting-machine, the needle-cylinder and needles carried thereby, a cam-cylinder provided with stitch-cams and needle elevating and depressing cams, and latches to lock said elevating and depressing cams out of operation when carried into that position by the needles themselves as such needles are respectively raised and lowered thereby to be retired from and returned into action, combined with cam-levers to co-operate with said latches and with a ring having cams to co-operate with said cam-levers, substantially as described.

4. In a knitting-machine, the needle-cylinder and the needles carried thereby, combined with a cam-cylinder provided with stitch-cams

and needle elevating and depressing cams having fingers or hooks, the fingers of the elevating-cams engaging but a single needle and the fingers of the depressing-cams being of such length as to engage two needles, latches to normally hold the said elevating and depressing cams in inoperative position, and devices through which the cam-cylinder may be reciprocated, whereby in the operation of the machine two needles may be returned into action at each reciprocation of the cam-cylinder and one of said needles carried out of action at the next reciprocation thereof in the opposite direction, and so on, to effect the widening of the fabric, substantially as and for the purpose specified.

5. In a knitting-machine, a needle-cylinder, a cam-cylinder, and a reciprocating mechanism for said cam-cylinder, it consisting, essentially, of a shaft provided with means whereby it may be rotated and a crank, a segmental gear and pinion in mesh therewith and provided with a stud, and a rod connecting such crank and segmental gear, whereby an oscillatory motion may be communicated to the latter from the former, a disk having a socket to co-operate with said stud, and means to move said disk longitudinally of its axis, combined with a safety device for said reciprocating mechanism, it consisting of a collar having a lug or arm to cover said socket, substantially as described.

6. In a knitting-machine, a needle-cylinder and needles carried thereby, and cam-cylinder provided with a slot, combined with a needle-operating cam pivoted outside the said cam-cylinder and extended through the said slot to operate upon the said needles and be operated thereby, substantially as described.

7. In a knitting-machine, a needle-cylinder and needles carried thereby, a cam-cylinder and cams for retiring from and bringing into operation, respectively, the successive needles during the narrowing and widening operations, and latches for holding the said cams out of action, combined with cam-levers for co-operating with said cams to return them into action at the required time and with means, substantially as described, to automatically operate said cam-levers to bring them into coactive relation to said cams, substantially as and for the purpose specified.

8. In a knitting-machine, the needle-cylinder and needles carried thereby, a cam-cylinder provided with stitch-cams and needle elevating and depressing cams, and latches to lock said elevating and depressing cams when carried out of action, respectively, by the needles as such needles are retired from and returned into action during the narrowing and widening operation, combined with cam-levers to co-operate with said latches and with means, substantially as described, to operate said cam-levers.

9. In a knitting-machine, the needle-cylinder and needles carried thereby, combined with a cam-cylinder provided with stitch-



cams and needle-depressing cams having fingers or hooks constructed to simultaneously engage the butts of two needles and return them into action during the widening operation, a latch for locking each of such depressing-cams out of operation when carried there by the needles themselves, cam-levers for co-operating with said latches to release the depressing-cams to allow them to return into operation, and cams and a pattern mechanism for operating such cam-levers, as and for the purpose specified.

10. The combination, with the cam-levers  $c^{13}$   $c^{14}$   $d^{16}$   $d^{17}$  and a pattern-surface, of the cams for operating said cam-levers and supporting devices therefor, the spring-actuated rod  $c^{25}$ , having the arm or rod  $c^{34}$ , rigidly secured thereto, the plate  $c^{31}$ , having the notches  $c^{32}$   $c^{33}$ , the shipper  $c^{28}$ , and the stud or projection  $g^{20}$ , substantially as described.

11. In a knitting-machine, the needle-cylinder grooved for the reception of jacks, a series of jacks, a surrounding ring correspondingly grooved for the reception of jacks, and a cam-ring, as  $a^{14}$ , to act upon and move the said jacks, combined with an independent ring  $b$ , overlapping the inner ends of the jacks, the hooks or portions of the jacks engaging the yarn being at the proper space thereof between their ends, substantially as described.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

WILLIAM H. MAYO.  
GEORGE D. MAYO.

Witnesses:

GEO. E. SPRAGUE,  
FREDD O. THOMPSON.