

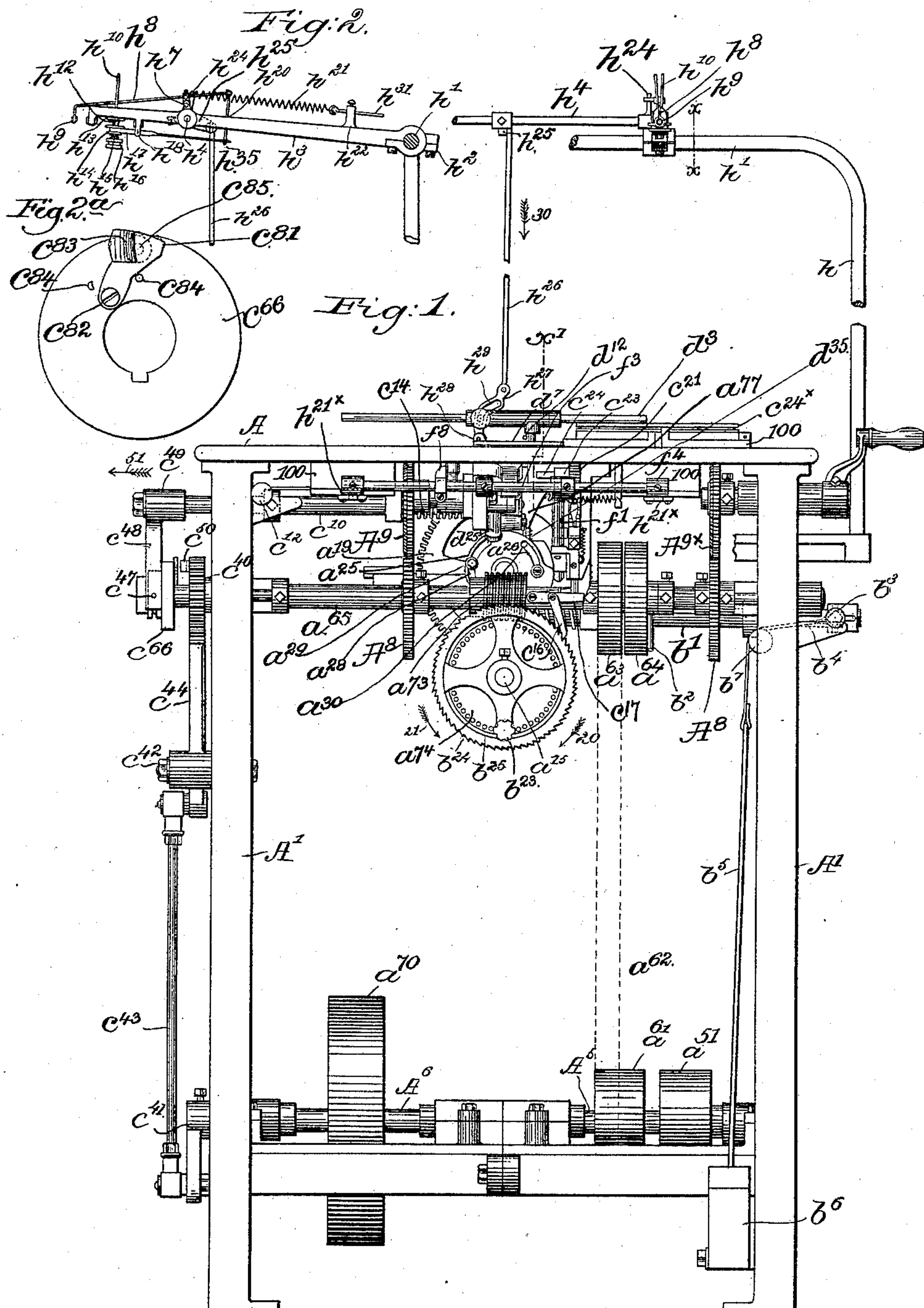
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5 Sheets—Sheet 1.

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

No. 474,671.

Patented May 10, 1892.



Witnesses.
Edward F. Allen.
Oscar F. Hill.

Inventors.
William H. Mayo.
George D. Mayo
by Crosby & Gregory attys.

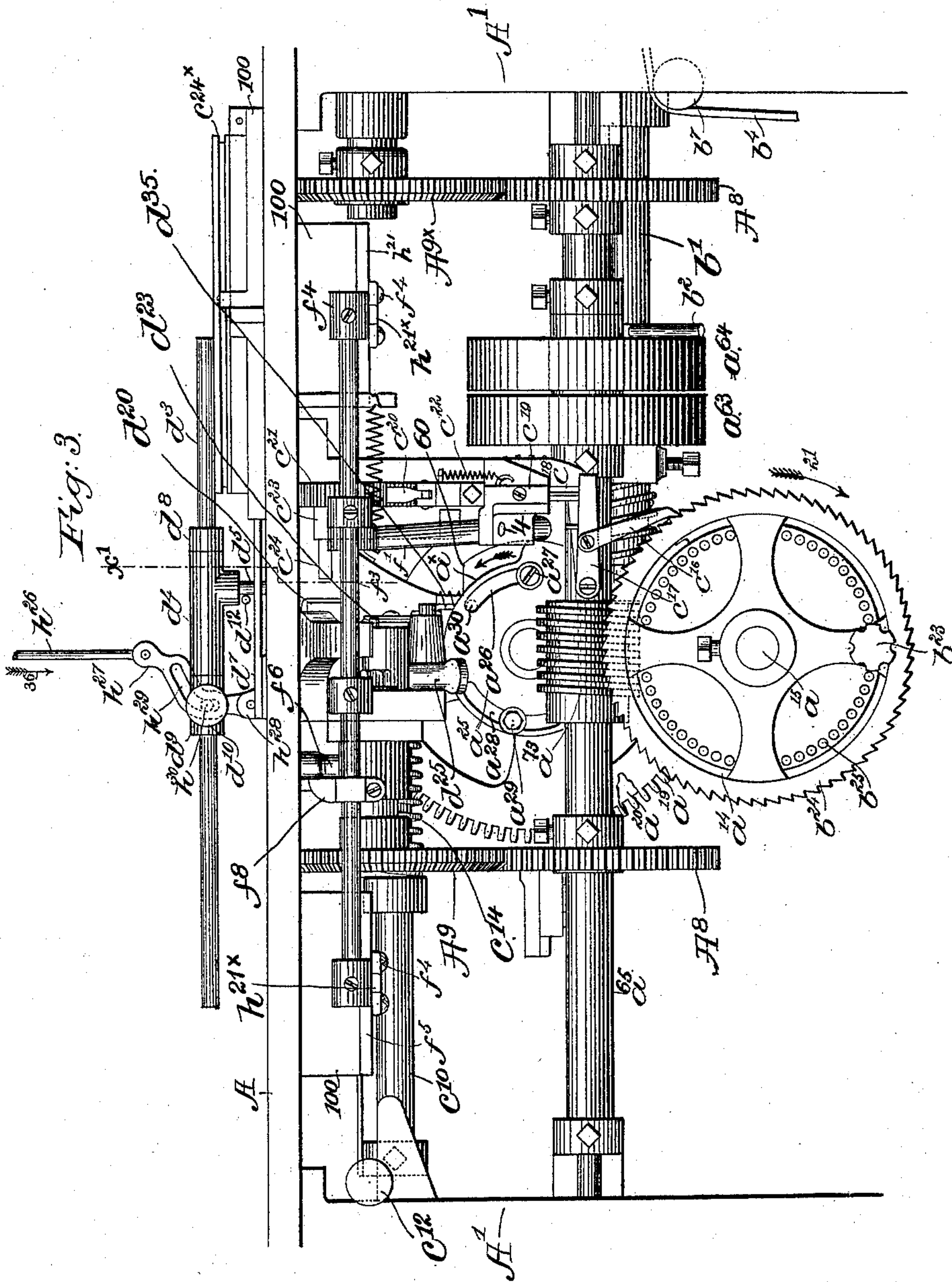
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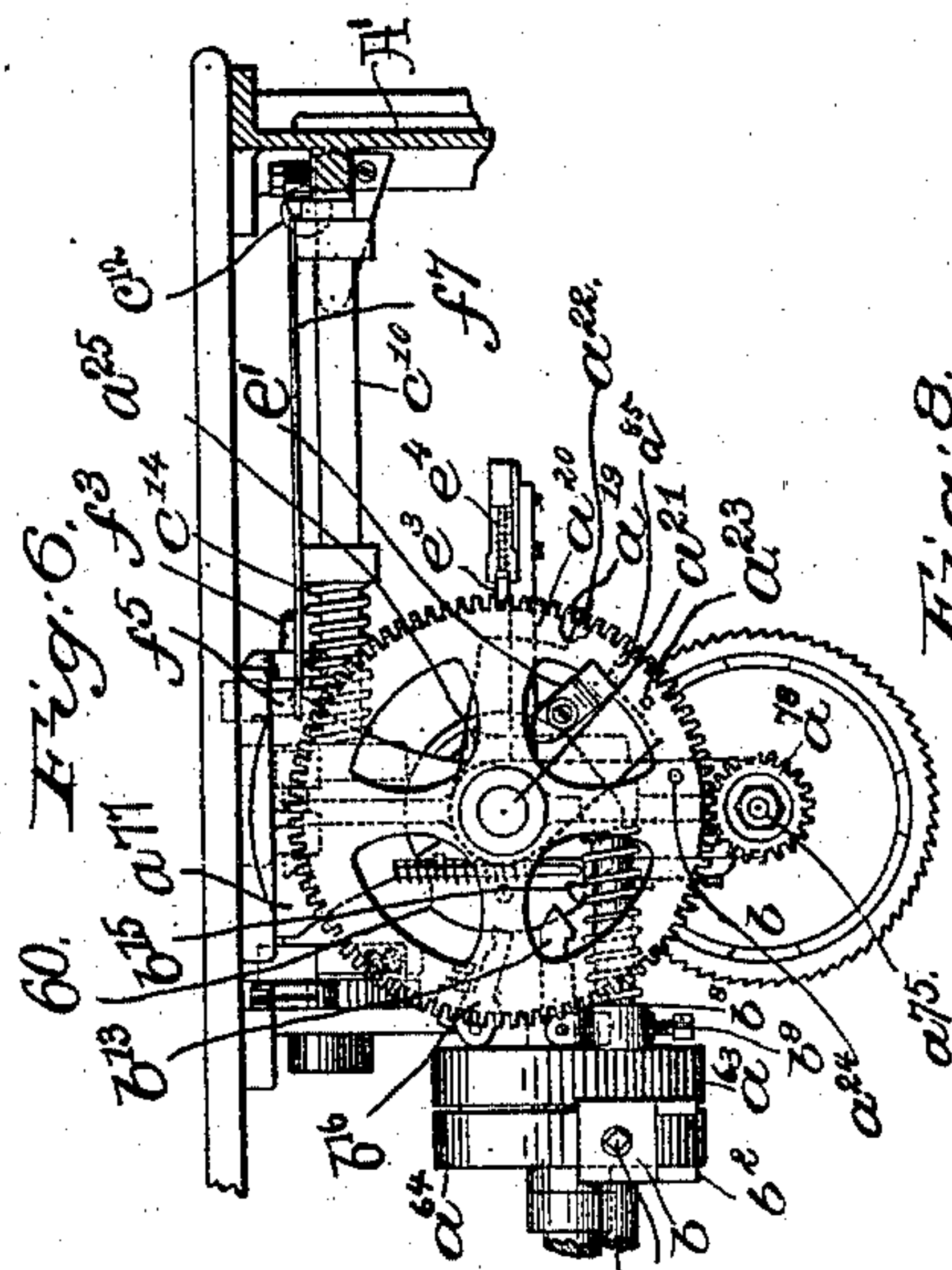


Fig. 6.

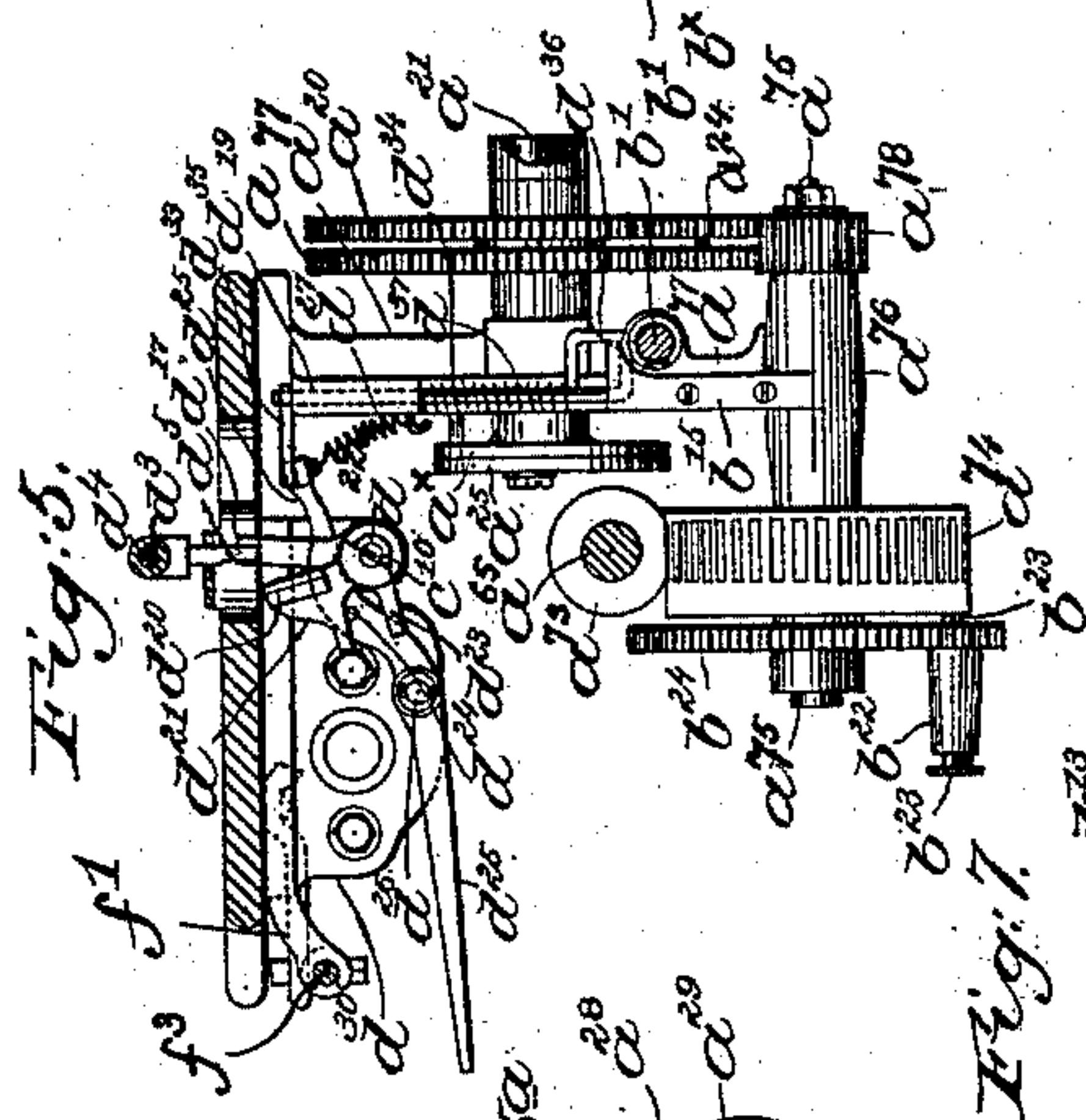
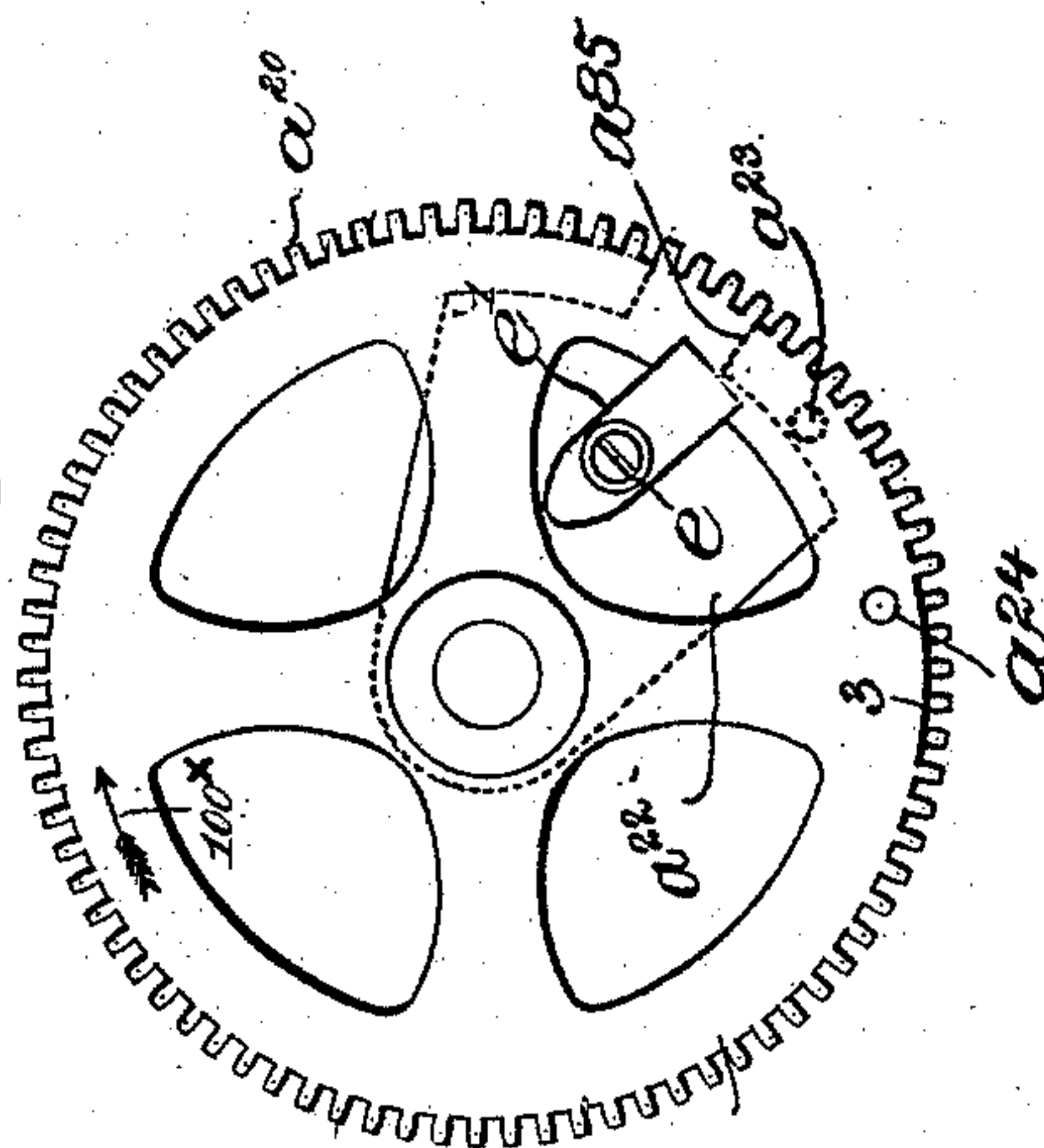
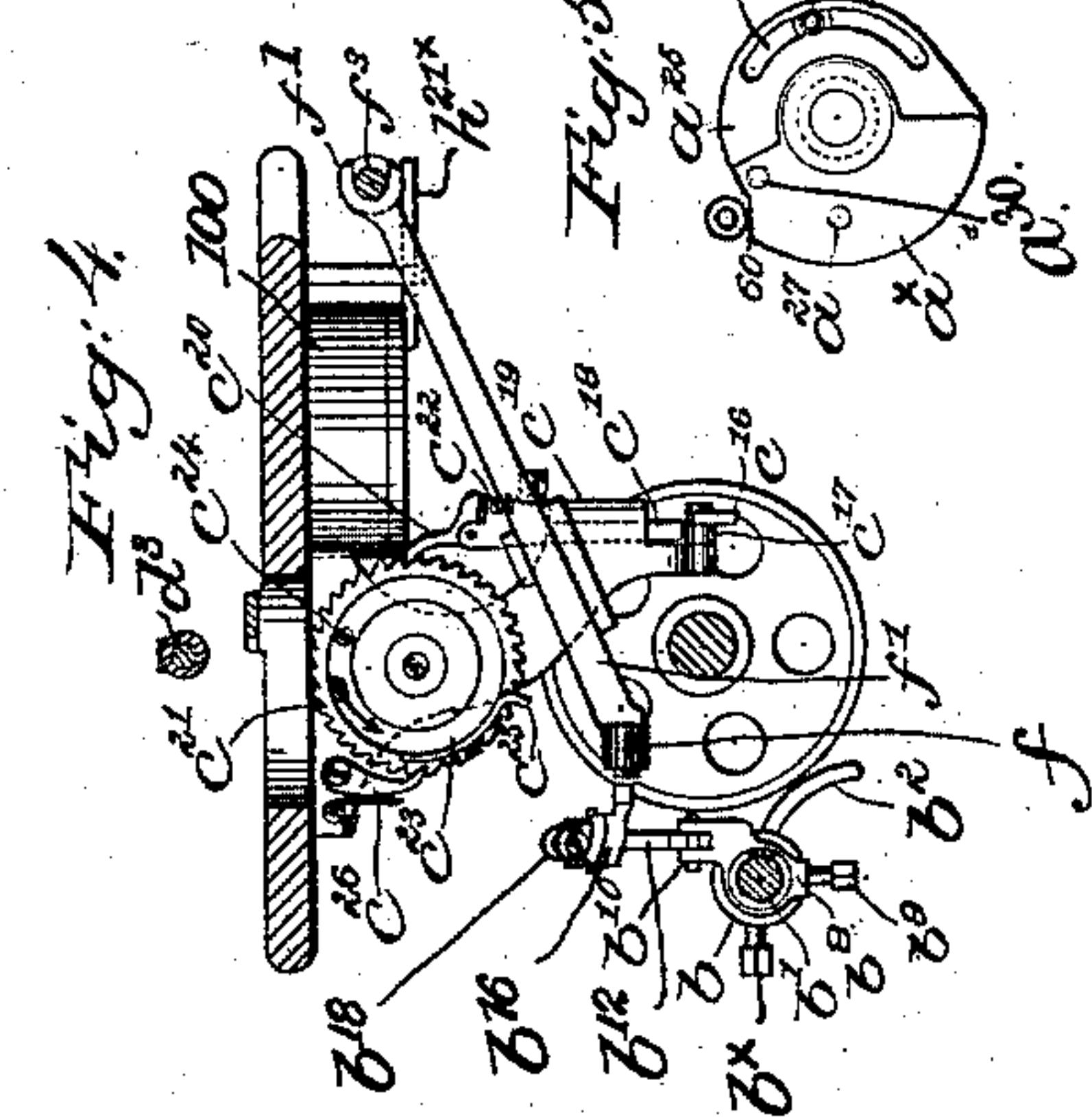


Fig. 7.



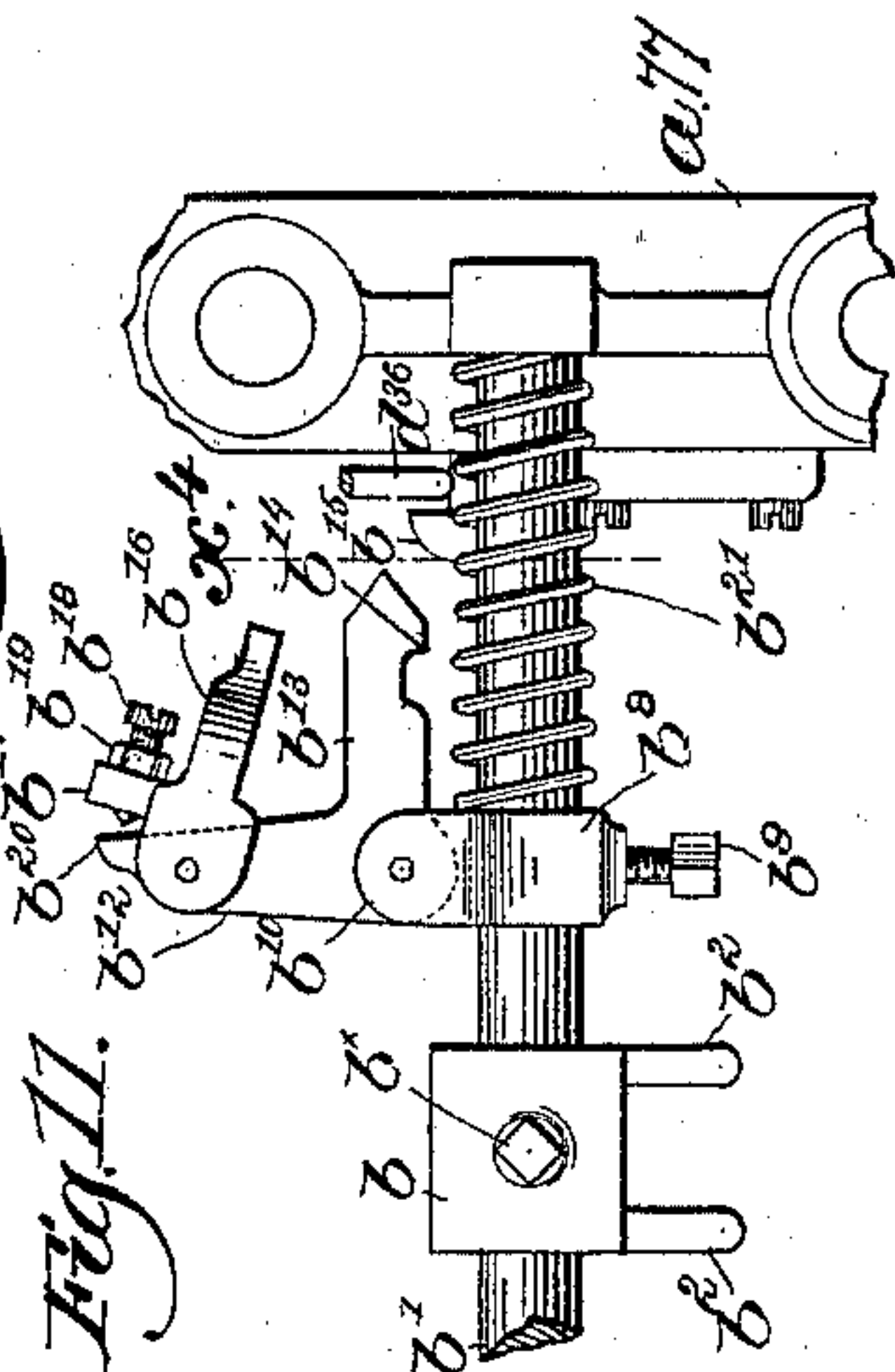
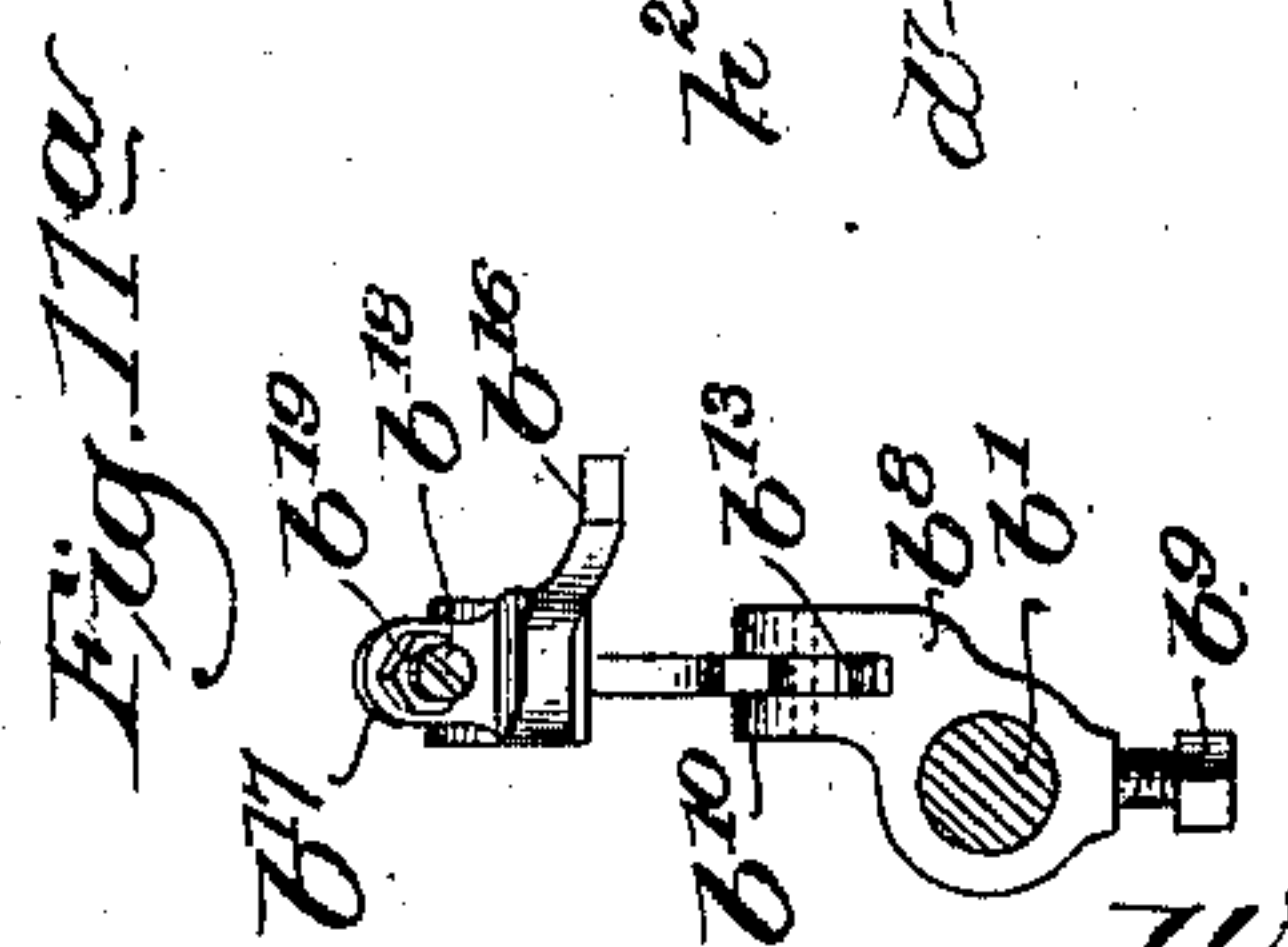
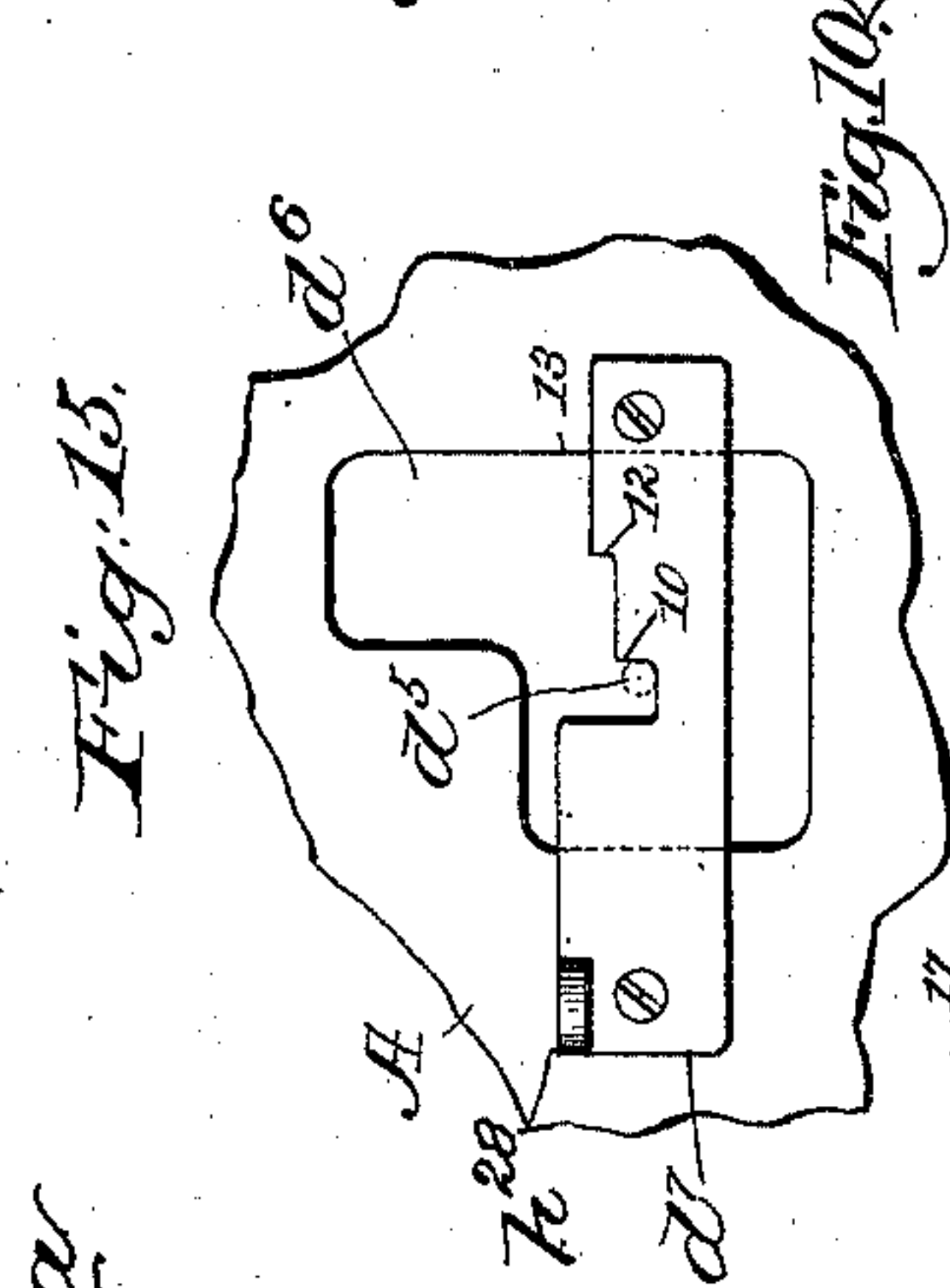
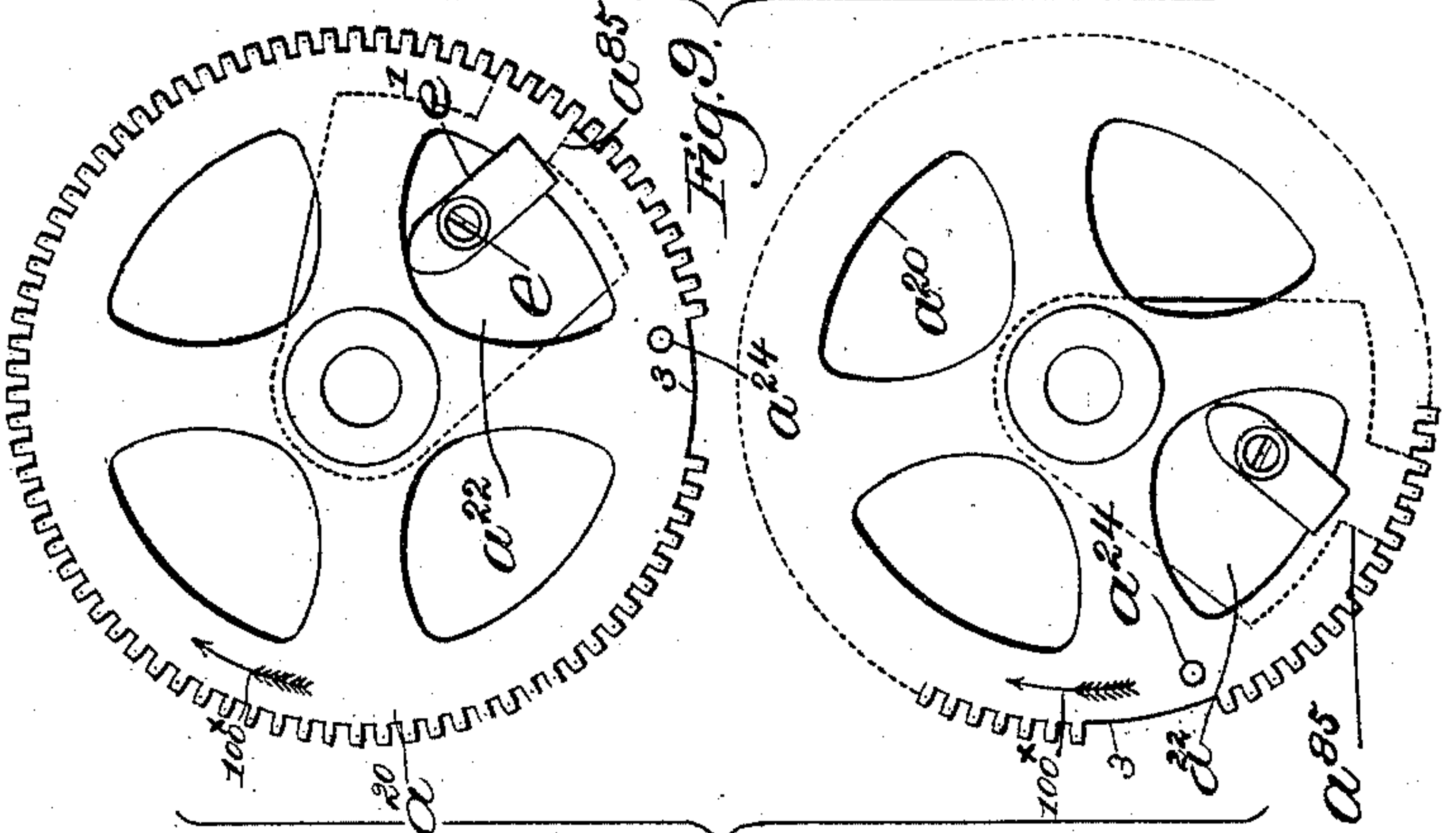
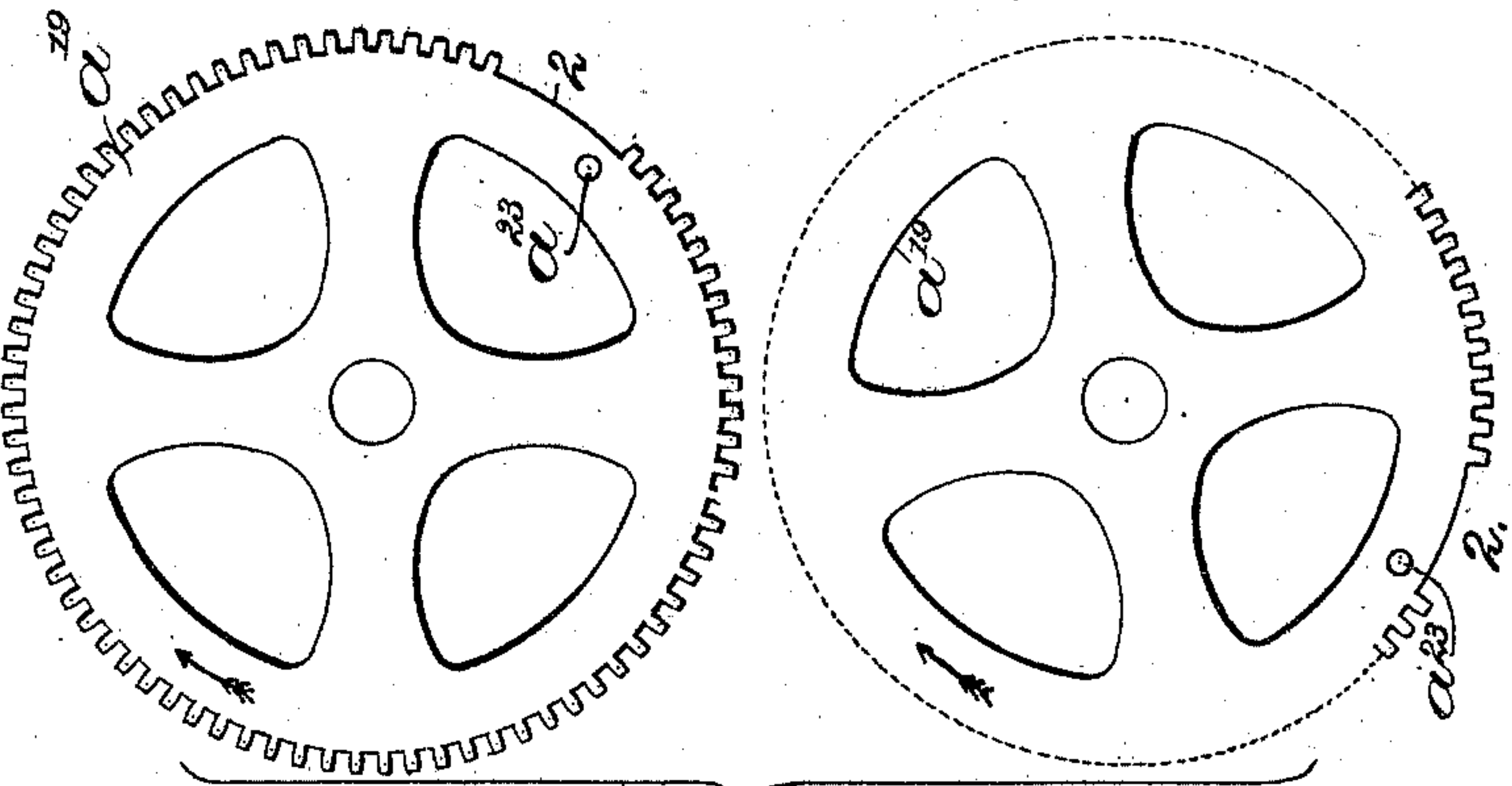
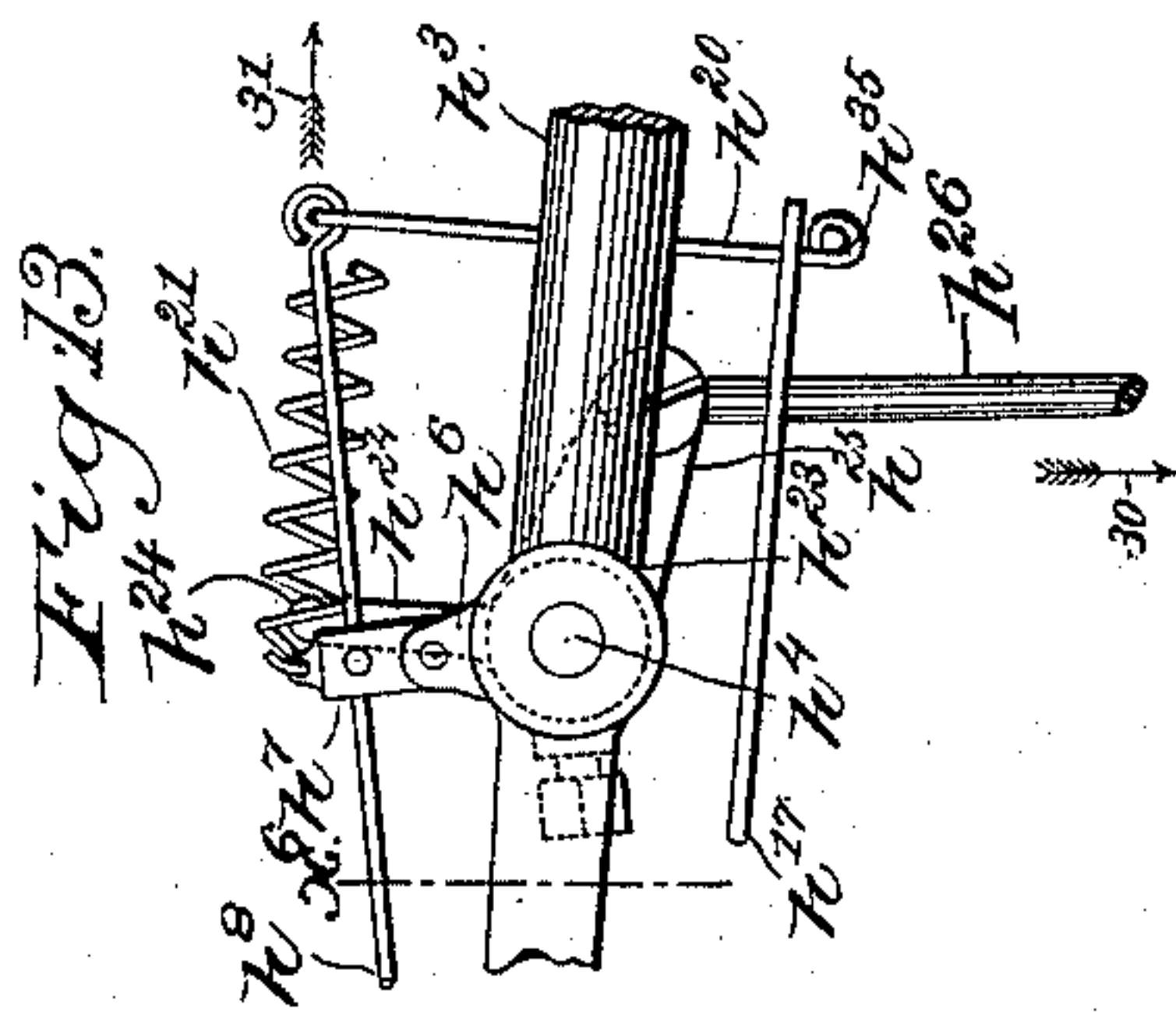
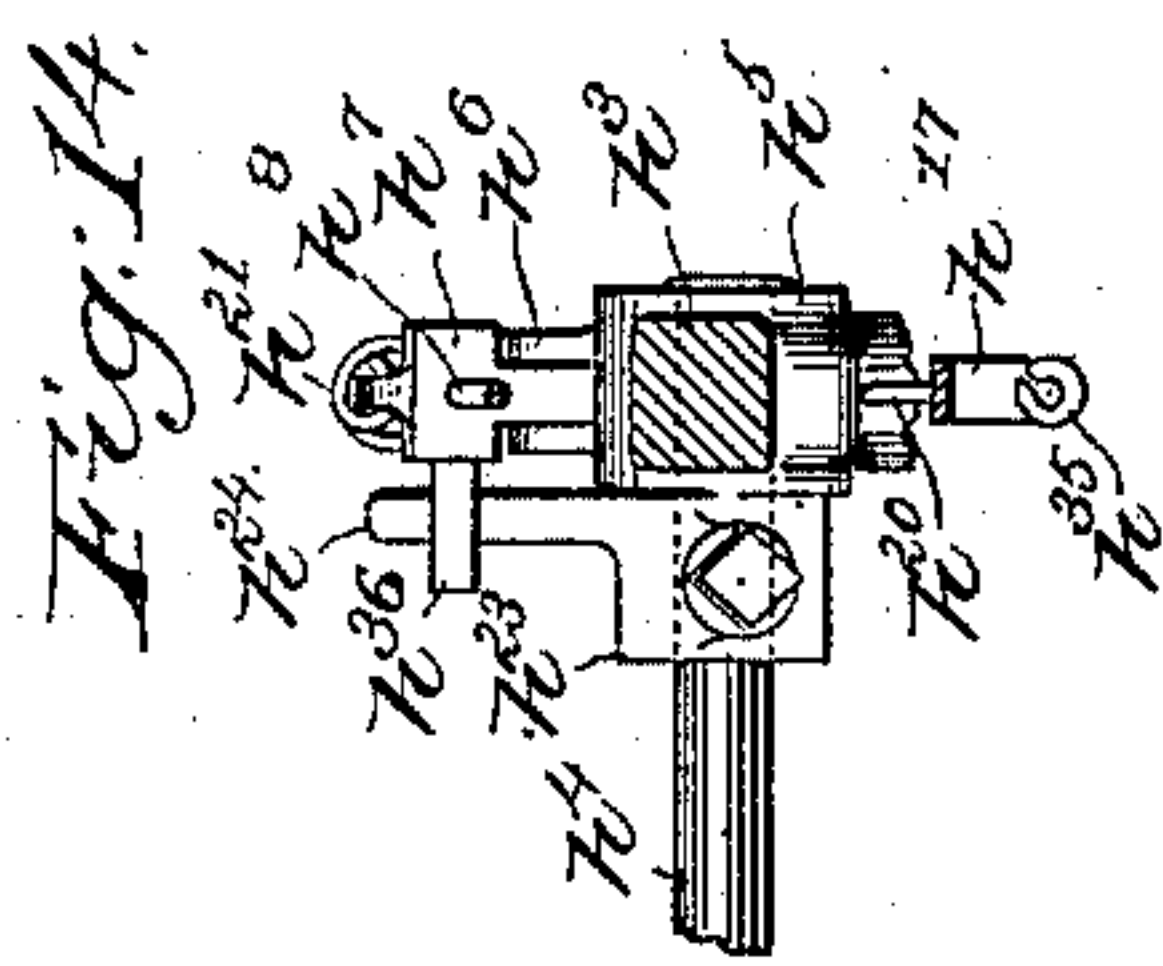
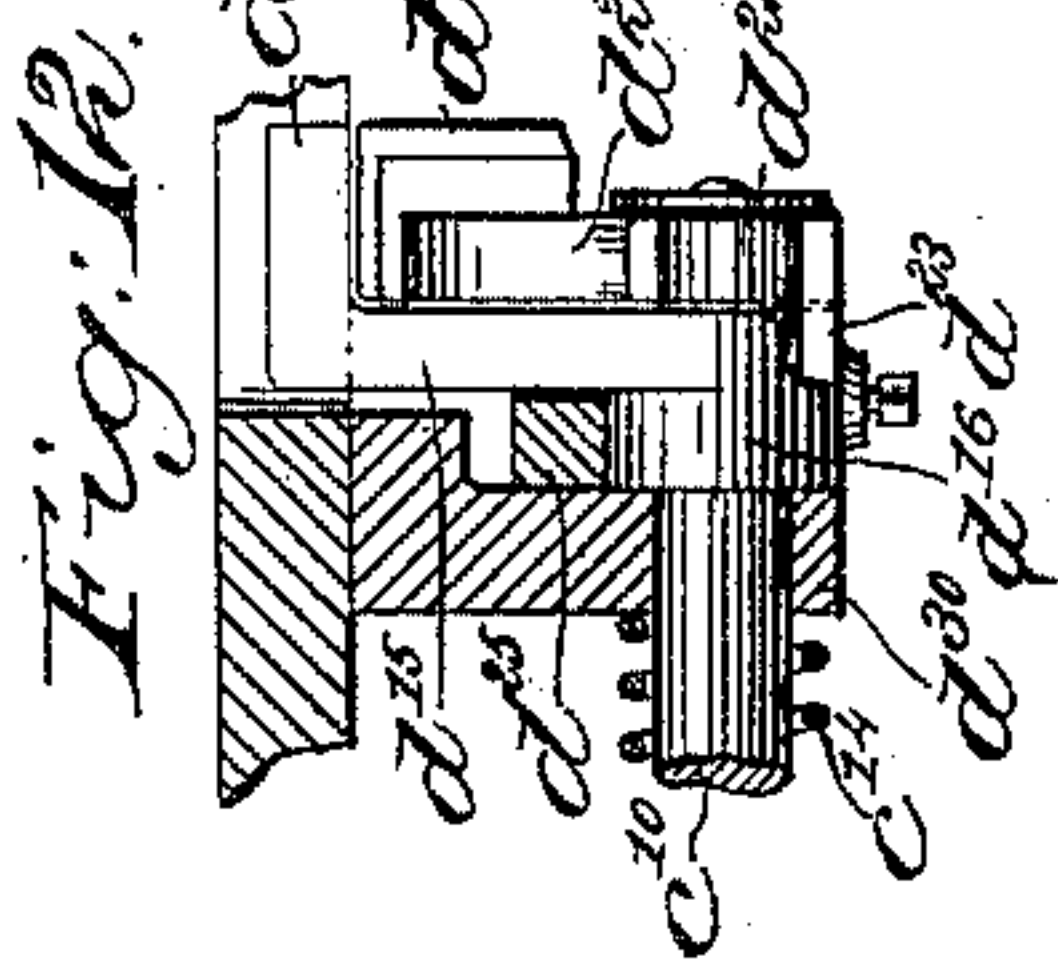
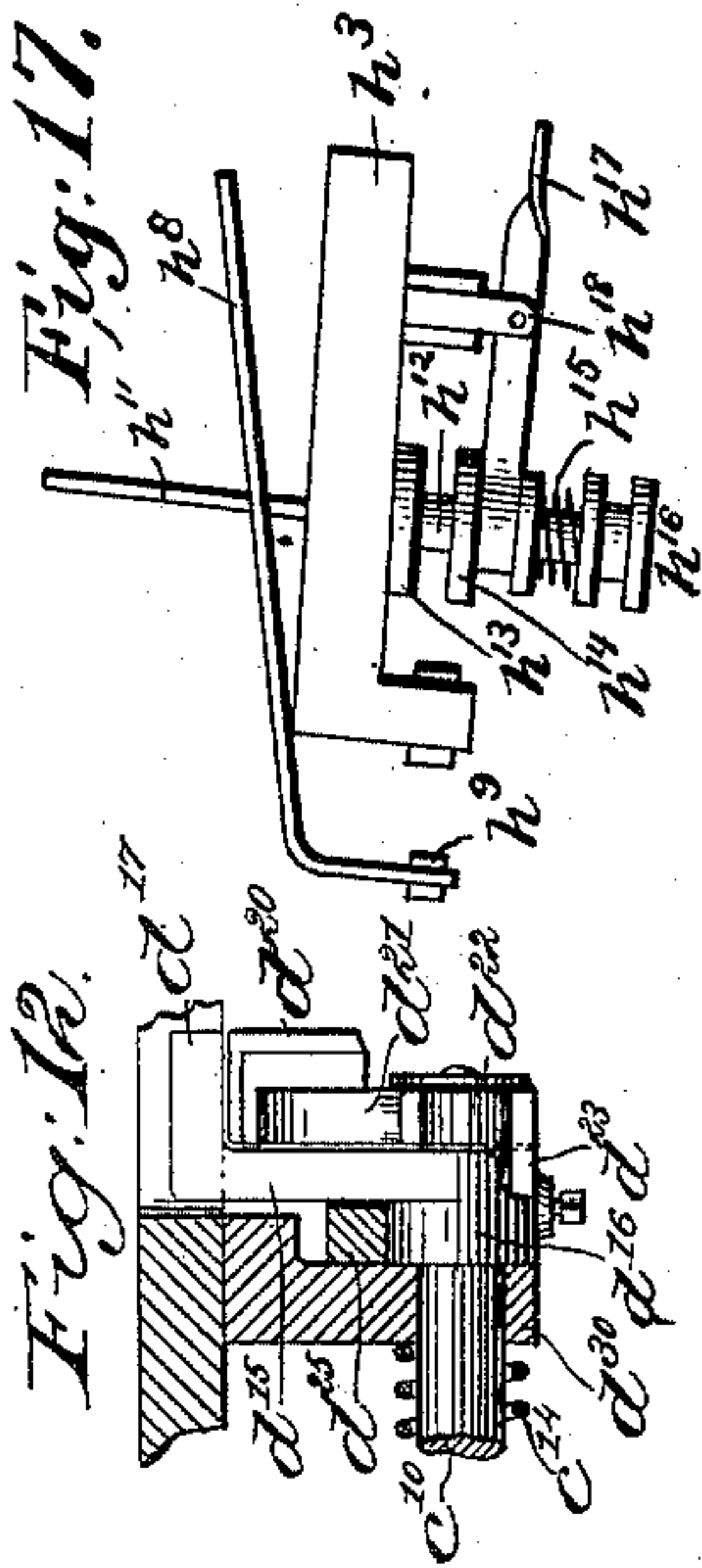
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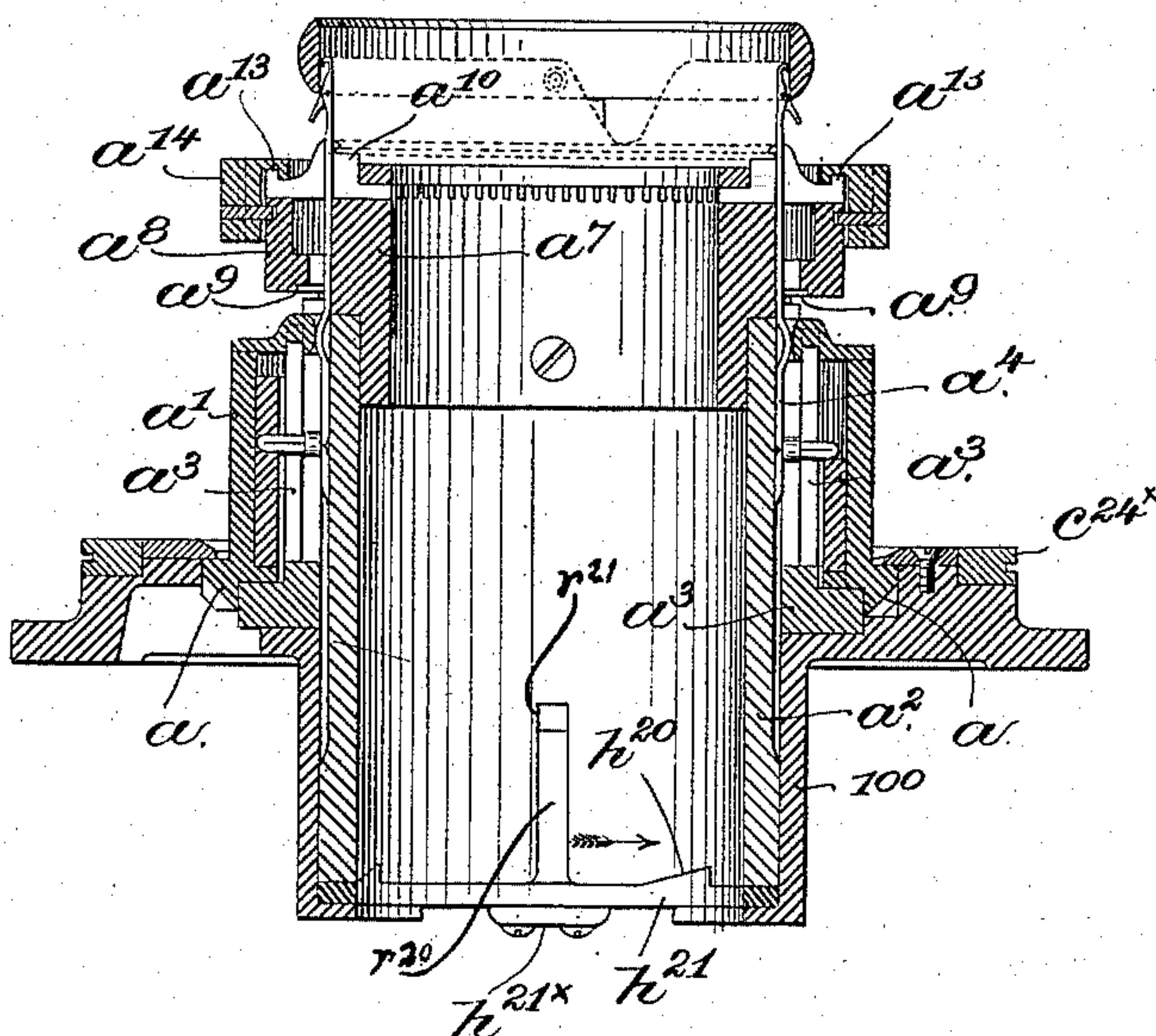
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Fig. 16.



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Edward F. Allen.
Oscar F. Hill

Inventors
William H. Mayo.
George D. Mayo.
by Crosby & Gregory Attys.

UNITED STATES PATENT OFFICE.

WILLIAM H. MAYO AND GEORGE D. MAYO, OF FRANKLIN, NEW HAMPSHIRE.

KNITTING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 474,671, dated May 10, 1892.

Application filed August 29, 1891. Serial No. 404,098. (No model.)

To all whom it may concern:

Be it known that we, WILLIAM H. MAYO and GEORGE D. MAYO, of Franklin, county of Merrimac, State of New Hampshire, have
5 invented an Improvement in Knitting-Machines, of which the following description, in connection with the accompanying drawings, is a specification, like letters and numerals on the drawings representing like parts.

10 This invention relates to knitting-machines, and has for its object to improve the construction of the same.

One feature of our invention consists in a pattern mechanism, as will be described, for
15 automatically controlling the operations of the machine.

Another feature of our invention consists in a novel take-up mechanism, as will be hereinafter described.

20 The invention herein to be described is an improvement on the class of circular-knitting machines shown and described in United States Patent No. 461,357, dated October 13, 1891, said machine being adapted for the production of stockings.

25 In accordance with this our invention we have provided the machine with two independent pattern mechanisms, one for controlling the operation of the parts in the production of tubular knitting, the cam-cylinder
30 being then rotated, and the other controlling the reciprocal movements of the cam-cylinder in narrowing and widening the fabric or stocking for heels and toes. The pattern mechanism for controlling the circular movements
35 of the machine will preferably include mechanism for governing the length of the tubular fabric in the leg and foot and also the length of the stitches.

40 The particular features of our invention will be described in the specification, and pointed out in the claims at the end thereof.

Figure 1 is a front elevation of a knitting-machine embodying our invention, the needle-cylinder, the cam-cylinder, and its co-operating parts being omitted, but said parts
45 are shown separately in Fig. 16; Fig. 2, a sectional detail of the take-up mechanism to be referred to, the section being taken on the line $x x$, Fig. 1, looking toward the left. Fig. 2^a is an inner side view of the clutch part c^{66} ; Fig. 3, a front elevation, on an enlarged scale,

of a portion of the machine shown in Fig. 1 to more clearly show the pattern mechanisms. Fig. 4 is a partial section and elevation on a
55 line indicated by x' in Fig. 1, looking toward the right in said figure. Fig. 5 is a partial section and elevation on the line indicated by x' , but looking toward the left in Fig. 1; Fig. 5^a, a detail to be referred to; Fig. 6, a rear
60 elevation of a portion of the machine shown in Fig. 1 with the wheel a^{20} partially broken out, it showing in elevation that portion of the machine shown in Fig. 5, the view being toward the left in that figure. Fig. 7 is a top
65 or plan view of the top plate of the machine, the needle-cylinder and cam-cylinder being omitted; Fig. 8, a side elevation, on an enlarged scale, of the pattern devices employed for controlling the length of tubular work.
70 Figs. 9 and 10 show enlarged the pattern-wheels a^{19} and a^{20} , only part of the teeth being shown, however, on wheel a^{19} ; Fig. 11, a detail, on an enlarged scale, of a part of the belt-shipper and a locking device therefor.
75 Fig. 11^a, a section in the line x^4 , Fig. 11, looking to the left; Fig. 12, a detail, on an enlarged scale, of a locking device for the clutch-rod c^{10} , which operates the clutch, the position of which determines whether the cam-cylinder
80 shall be rotated or reciprocated; Figs. 13 and 14, details, on an enlarged scale, of the take-up mechanism, Fig. 14 being a section of Fig. 13 in the dotted line x^6 , looking to the left. Fig. 15 is a detail of the plate d^{17} ; Fig. 16, a
85 vertical section taken through part of the machine chiefly to show one of the needles and cam-cylinders removed from Figs. 1, 3, and 7. Fig. 17 is an enlarged detail of part of the take-up.
90

We will first refer to Fig. 16 of the drawings. Said figure shows in vertical section a cylinder-guide having an attached curb 100; a needle-cylinder $a^2 a^7$, the part a^7 having a projecting ledge a^9 ; a ring a^8 , supported on the
95 said ledge; a ring a^{14} , movably mounted upon the ring a^8 , so as to rotate thereon and having a suitable groove to receive the projections a^{13} of the horizontally-sliding jacks a^{10} , adapted to be reciprocated during the rotation of the said ring in grooves made in the upper end of the part a^7 of the needle-cylinder and also in the upper side of the ring a^8 ; the needles a^4 , some of which have long and some
100

of which have short butts; the cam-ring h^{21} , provided with cam projections h^{20} and having an arm h^{21x} , the movement of the said ring adjusting the needle-cylinder vertically to vary the length of the loops made by the needles; the skeleton cylinder a^3 to guide the butts of the needles; the cam-cylinder a' , having at its lower end beveled teeth a and provided with suitable cams to actuate the said needles, both for circular knitting and for heel and toe work, and such parts are and may be all as described in our said patent, so that the said devices need not be herein further described, for the features to be described and claimed in this present invention relate chiefly to the pattern mechanism or devices for controlling the various movements and for automatically moving the ring h^{21} .

The frame-work consists, essentially, of a top plate A, erected upon standards A' A' , suitably connected by cross-girths and having proper bearings for two short shafts A^5 A^6 , each rotated independently of the other, the shaft A^5 having a fast pulley a^{51} and the shaft A^6 a fast pulley a^{70} , by which each may be belted to any proper counter-shaft and be driven. The shaft A^5 has an attached fast pulley a^{61} , which in practice will be belted by a belt a^{62} (shown by dotted lines) with and so as to rotate either a loose pulley a^{64} or a fast pulley a^{63} on a shaft a^{65} , having suitable bearings in the frame-work. The shaft A^6 has at one end a crank c^{41} , which by a link c^{43} , connected with a segmental gear c^{44} , pivoted at c^{42} , continuously oscillates a toothed pinion c^{40} , mounted loosely on the shaft a^{65} , the said pinion having a projecting pin c^{50} , which may be made to enter a hole c^{85} (see dotted lines, Fig. 2^a) in a plate or disk c^{66} , loosely splined upon the said shaft a^{65} , the hub of said disk having an annular groove, which is entered by suitable pins or projections c^{47} of an arm c^{48} , the hub c^{49} of which is fast upon a clutch-rod c^{10} , to be described. The gear c^{40} and the plate c^{66} constitute a clutch, so that whenever the plate c^{66} is moved laterally upon the shaft a^{65} to engage the pin c^{50} of the continuously-oscillating gear c^{40} , then and only then the shaft a^{65} will be oscillated to effect the reciprocating movements of the cam-cylinder, as will be described, and during this time the belt a^{62} will be upon the loose pulley a^{64} , before referred to; but when the circular knitting is being done, as in the production of legs and feet, then the said clutch will be disengaged or in the position shown in Fig. 1, and the belt a^{62} will be on the fast pulley a^{63} , the cam-cylinder then being rotated.

The plate c^{66} has a safety device c^{81} , made as a plate pivoted at c^{82} and provided with a beveled projection c^{83} , the said safety device being adapted to swing between the stops c^{84} . In our machine the engagement of the clutch parts referred to for reciprocal knitting must be made while the gear c^{40} is moving in the direction of rotation of the shaft a^{65} during

rotary knitting, and this is effected by the safety device.

In operation, when the gear c^{40} is to be made the driver for the shaft a^{65} , the shipper-rod c^{10} is actuated to pull the plate c^{66} toward the said gear, and the face of the said plate strikes the pin c^{50} . Now if the gear c^{40} at the time that the plate c^{66} is pushed up against the pin c^{50} is traveling in the same direction as the plate c^{66} , then the pin c^{50} hits against the right-hand end (see Fig. 2^a) of the safety device and swings it over to the left, thus uncovering the hole c^{85} and letting the pin c^{50} enter it; but, on the contrary, should the direction of movement of the gear c^{40} at such time be opposite the direction of rotation of the gear c^{66} , then the said pin c^{50} will strike against the left-hand side of the said safety device where it is beveled and will turn the said safety device to cover the said hole c^{85} , and the pin will ride up the incline of the safety device and pass off the safety device ready to act against the right-hand side of the safety device and turn it back to uncover the hole, as stated, when the gear c^{40} is moved in the opposite direction. The shaft a^{65} has fast upon it two like gears A^8 , which engage the peripheral teeth of and rotate two like bevel-toothed gears A^9 A^{9x} , the said gears by their bevel-teeth each engaging with like teeth a at the lower ends of the cam-cylinders and moving the said cam-cylinders, as required, according to the work to be done.

It will be understood that in the machine herein represented two cam-cylinders and two needle-cylinders and their contained parts will be used, each needle-cylinder being suitably supported in independent openings, as A^{20} A^{21} , in the bed A, (see Fig. 7,) the needle and cam cylinders being, however, omitted from said figure to avoid confusion.

In Figs. 3 and 7 we have shown the guide and curb 100 referred to in position upon the plate A, together with the rings c^{24x} , common to the said patent, where they are designated by like letters; but we have herein omitted from the said ring the cam projections, which in practice will operate the controlling levers or devices for actuating the latches which cooperate with the elevators and depressors (fully described and shown in the said patent) and employed for elevating and depressing in the proper time and order the needles used in narrowing and then in widening, all as provided for in the said patent.

In Fig. 7 of the drawings we have shown two like cam-rings c^{24x} joined together by a connecting-rod d^3 , so that the said rings may be operated in unison, in order that the pattern mechanism to be described may, when it actuates one cam-ring c^{24x} , actuate the other at the same time. The shaft a^{65} has fast on it a worm a^{73} in mesh with a worm-toothed gear a^{74} , (see Fig. 5,) loose on a shaft a^{75} , it having, as represented, bearings in a sleeve or hub a^{76} , secured to or forming part of a

bracket a^{77} , fastened to the frame-work of the machine. The shaft a^{75} constitutes the operating-shaft for the pattern mechanism for controlling the length of circular work and also the length of the stitches, which stitches are varied in the leg to fashion or shape the same. The shaft a^{75} has fast on it a pinion a^{78} .

The pattern mechanism consists in part, essentially, of two gears a^{19} a^{20} , mounted side by side on the shaft a^{21} , the gear a^{19} being fast and the gear a^{20} loose, and a toothed arm a^{22} (see Figs. 8 and 10) located between the said gears. The toothed arm a^{22} is also loose on the shaft, but is secured adjustably, preferably to the loose gear a^{20} , by a suitable clamping device, herein represented as a plate e' and a screw e , the plate e' resting against one side of the said gear and the arm against its other side, the screw enabling the clamp to be held with more or less force upon the said wheel. The gears a^{19} and a^{20} will have their teeth cut away for a short distance, as represented at 2 and 3 in Figs. 9 and 10. The gear a^{19} (see Fig. 9) has a pin a^{23} at its front side next the gear a^{20} , and the gear a^{20} has a pin or projection a^{24} at its rear side next the gear a^{19} . The arm a^{22} , having a shoulder a^{35} , (shown by dotted lines,) is made adjustable on or with relation to the loose gear a^{20} , so as to make the distance between the said shoulder and the pin a^{24} more or less, according to the length required for the leg, the extent of the space between said shoulder and pin determining the time that the fast gear a^{19} , which rotates the pattern-surface a^{25} , may remain at rest, it in practice remaining at rest while the longer stitches of the foot are being knitted. The studs or projections a^{23} a^{24} are of such length and so located as to engage one with the other at the proper times. The shaft a^{21} has fast upon it a cam-plate a^x , (see Figs. 5 and 5^a), to which is adjustably secured a disk a^{25} , the said disk being provided, as represented, with a curved slot a^{26} , (see Figs. 1 and 3,) through which projects a screw a^{27} , by means of which the said disk may be held upon the cam-plate a^x in adjusted position, the plate and disk constituting a pattern-surface. The disk a^{25} has, as represented, a second curved slot a^{28} , in which is adjustably secured a pin or screw a^{29} . The cam-plate a^x has also extended from it in the same direction a stationary pin or stud a^{30} . (See Fig. 5^a and also dotted lines, Fig. 3.)

The studs or pins a^{29} a^{30} constitute releasing devices for the belt-shipper, as will be described, whereby the belt may be shipped from the fast pulley a^{63} to the loose pulley a^{64} . The belt-shipper, as herein shown, consists of a hub b , (see Figs. 4, 6, and 11,) fast on a shipper-rod b' , as by a set-screw b^x , and provided with forked arms b^2 to embrace the driving-belt. The shipper-rod is provided at one end with a shipper-handle b^3 , (see Fig. 1,) the said handle being connected by a strap or cord b^4 to a rod b^5 , secured to a foot-treadle b^6 , the said strap passing, preferably, over a roller b^7 . The ship-

per-rod b' has fast on it by a set-screw b^9 a collar b^8 , (see Fig. 11,) the latter being provided with a lug b^{10} , (see Fig. 4,) in which is pivoted an elbow-shaped lever having two arms b^{12} b^{13} , the arm b^{13} being notched to form a hook or latch b^{14} to engage a lug b^{15} , secured to or forming part of the bracket a^{77} (see Figs. 5 and 11) when the shipper-rod has been moved to place the driving-belt a^{62} on the fast pulley a^{63} . The arm b^{12} has pivoted upon it a dog b^{16} , (see Figs. 11 and 11^a), provided with an ear b^{17} , having a screw b^{18} , provided with a set-nut b^{19} , so that the said screw may be retained in adjusted position, the adjustment of the said screw enabling the machine to be stopped at any part of its revolution. The arm b^{12} has an extension or toe b^{20} , against which the screw b^{18} strikes when the dog is lifted by the pins or projections a^{29} a^{30} , respectively, on the disk a^{25} and cam a^x , as will be described, the said toe thus forming a back-stop for the dog. The downward movement of the dog is limited by a shoulder of the dog striking the arm b^{12} . The shipper-rod b' is surrounded by a spring b^{21} , which normally acts to place the driving-belt a^{62} on the loose pulley whenever the latch b^{14} is disengaged from the projection b^{15} , as will be described. The shaft a^{75} has fast on it a ratchet-wheel b^{24} , (see Figs. 1 and 5,) provided with a sleeve b^{22} (see Fig. 5) to receive a headed pin or rod b^{23} , the inner end of which may be made to enter one of a series of holes b^{25} in the worm-toothed gear a^{74} , before described, thus locking the ratchet-wheel to the said gear. The clutch-rod c^{10} (see Figs. 1, 3, and 12) is surrounded by a spring c^{14} , which normally acts to disengage the two parts c^{40} c^{66} of the clutch used to oscillate the shaft a^{65} during reciprocating knitting. When the shaft a^{65} is being oscillated or rocked backward and forward during reciprocating knitting, the worm a^{73} thereon, by its engagement with the worm-gear a^{74} , oscillates that gear and the ratchet-wheel b^{24} , so that a tooth of the said ratchet-wheel in engagement with a pawl c^{16} raises and lowers a lever c^{17} , which by its action on a rod c^{18} , extended from a suitable guide c^{19} , (see Figs. 3 and 4,) reciprocates the said rod and causes the pawl c^{20} , carried thereby and in engagement with a ratchet-wheel c^{21} , to rotate the said ratchet-wheel intermittently. The pawl c^{20} is kept in engagement with the ratchet-wheel by a spring c^{22} . (See Fig. 4.)

The ratchet-wheel c^{21} has secured to or forming part of it a pattern wheel or disk c^{23} , which in its operation determines the number of courses for the narrowing and widening and when the said narrowing shall cease and the widening commence. The pattern-wheel c^{23} is herein represented as provided with a pin or projection c^{24} (see Fig. 4) and at a point substantially diametrically opposite with a lug or projection c^{25} . The detent c^{26} prevents retrograde motion of the pattern-surface c^{23} . The pin c^{24} operates, as will be described, to disengage the clutch hub or collar

c^{66} from the pinion c^{40} on the shaft a^{65} , and the lug c^{25} determines the stopping of the narrowing and the commencement of the widening.

In the narrowing of the fabric for the formation of a heel or toe only a portion of the needles in the needle-cylinder will be used—viz., the needles having short heels—while the other or long-heeled needles at such time will be lifted or thrown out of action. Herein, as in the patent referred to, it will be understood that in narrowing the needles will be put out of action at the end of each reciprocation of the cam-ring, and after the desired or required number of short-heeled needles have been raised or put out of action and the narrowest course in the heel has been knitted then the short-heeled needles are again put into action in succession in the usual manner by devices controlled by the cam-rings c^{24x} , as provided for in the said patent. The cam-rings c^{24x} common to the said patent are connected by a rod d^3 , provided with a hub d^4 , (see Figs. 3, 5, and 7,) having a pin d^5 , which projects through a hole or opening d^6 in the top plate A, (see Figs. 7 and 15,) said pin being adapted to engage one of a series of notches or shoulders 10 12 of a plate d^7 and a shoulder 13, constituted, as shown, by one side of the opening d^6 , the said plate being secured to the plate A. The hub d^4 is loose on the bar d^3 between the collars d^8 d^9 , fast on said bar, the collar d^9 having, as shown, a handle d^{10} , by which the bar may be moved horizontally or in the direction indicated by the arrow 40, Fig. 7, a spring d^{12} , secured to the plate A by a suitable screw or device d^{13} , acting upon the pin d^5 to move the bar in the opposite direction to keep the said pin in engagement with one or another of the notches or shoulders referred to. When circular work is being done, the pin d^5 engages the notch 10, (see Fig. 15,) and the ring c^{24x} will then be put in such position that it will hold out of operative position the devices which move the latches, as provided for in the said patent, so that at such time the needle elevators and depressors for putting out of action and bringing into action the needles are restrained from operation. When, however, the cam-rings c^{24x} are to be put into position to enable the devices for actuating the latches which control the needle elevating and depressing devices for narrowing and widening to come into operation, then the bar d^3 will be so moved that the pin d^5 will stand against the notch 12. This first movement of the bar d^3 to disengage the pin d^5 from the notch 10 and let it engage the notch 12 and move the cam-ring is effected when the handle d^{10} is moved to effect the engagement of the clutch for oscillating the shaft a^{65} , as at such time the inclined finger d^{17} (see Figs. 5 and 12) of an arm d^{15} , secured to or forming part of the clutch-rod c^{10} , acts on the pin d^5 and rocks the hub d^4 outwardly sufficiently to disengage the said pin from the notch 10 and permit the spring d^{12} , acting on the pin d^5 , to carry the pin against the notch 12, where

the pin remains until the narrowing of the fabric has been completed. When the narrowing is completed, the projection c^{25} , carried by the pattern-wheel c^{23} , moved step by step at each reciprocation in one direction of the shaft A^5 , strikes the pin d^5 and moves it from the notch 12, so that the spring d^{12} again acts to move the bar d^3 until the pin d^5 abuts against the shoulder 13. At this time the cam-rings c^{24x} by their position permit to come into operation the devices which lower in succession the short-heeled needles for widening, all as provided for in the said patent. When the widening of the fabric has been completed for the production of a heel, the reciprocating motion of the shaft a^{65} and of the machine is stopped by means of the stud or pin c^{24} on the pattern-wheel c^{23} striking a lug or finger d^{20} (see Figs. 5 and 12) on an arm d^{21} , secured to or forming part of a sleeve d^{22} , loose on the clutch-rod c^{10} . The pin c^{24} strikes the finger d^{20} and carries the arm d^{21} forward or to the right in Fig. 5 and rocks the sleeve d^{22} on the rod c^{10} until a second arm d^{23} strikes a lug or pin d^{24} on a lever d^{25} , pivoted, as at d^{26} , to the frame-work of the machine and lifts the inner end of said lever from between the hub d^{16} and the bearings d^{30} for the said rod and into the position, Fig. 12, and as soon as this has been done the spring c^{14} on the rod c^{10} forces the latter in the direction of the arrow 51, (see Fig. 1,) effecting the disengagement of the clutch referred to, to thus stop the reciprocating motions of the shaft a^{65} . When the said clutch is disengaged, as described, the lever d^{25} rests on the hub d^{16} , as in Fig. 12; but when the clutch is engaged, then the lever rests between the hub and the bearing d^{30} , and the lever then acts as a locking device to keep the clutch closed. When the lever d^{25} is actuated to release the clutch and stop the oscillatory motion of the shaft a^{65} , knitting is stopped, and at such time the operator, by and through devices fully described in the said patent, will put into position the cam which pulls down into working position all the long-heeled needles which were rendered inoperative for heel-work, and this done, as provided for in the said patent, the operator, by putting his foot upon the treadle b^6 , will slide the shipper-rod to place the belt a^{62} on the fast pulley and start the rotation of the cam-cylinders. The lever d^{25} has an outwardly-extended arm (see Figs. 3 and 5) adapted to be engaged by hand when it is desired to stop the machine, the said lever constituting a controlling device for the shipper-rod b' , as by moving the said lever the latch b^{14} may be disengaged from the lug d^{15} . The inner end of the lever d^{25} , held down normally by a spring d^{27} , supports an arm d^{33} , connected to a rod d^{34} , (see Fig. 5,) which rod is extended down through a guide d^{35} , secured to or forming part of the bracket a^{77} , the lower end of the said rod being provided with a loop or eye d^{36} , through which is extended the pawl or latch b^{14} , (see Fig. 11,) when said pawl en-

gages the lug b^{15} . The rod d^{34} is held down by a spring d^{37} , which normally keeps it in its lower position, with the arm d^{33} on the lever d^{23} and the loop d^{36} clear of the pawl or latch b^{14} . In this way by movement of the arm d^{23} the shipper-rod may be released to allow its spring to shift the belt from the fast to the loose pulley.

The length of circular work knitted by the machine may be controlled by the gears a^{19} a^{20} in the following manner: When the machine is about to commence knitting circular work—as, for instance, the leg of a stocking, the knitting being commenced at the top of the stocking where the loops are the longest—the loose gear a^{20} (see Fig. 10) will have its smooth or toothless portion 3 immediately over the pinion a^{78} , and the teeth of the gear a^{19} , fast on the shaft a^{21} , carrying the pattern a^{25} , will be in mesh with the said pinion. In this condition the shoulder c^{85} of the arm a^{22} (see Figs. 6 and 8) will stand at a short distance back of the pin a^{23} (the said shoulder and pin being, however, shown by dotted lines) of the fast gear a^{19} , and the pin a^{24} of the loose gear stands at some distance ahead of the said pin a^{23} in the direction of rotation of the said gears. Now when the machine is set in operation by shifting the belt from the loose pulley a^{64} to the fast pulley a^{63} to commence circular knitting the pinion a^{78} will start and rotate the gear a^{19} in the direction indicated by the arrow 100^x, Figs. 8 and 10, and in the rotation of the said gear the pin or stud a^{23} , carried by it, will after a time engage the pin or stud a^{24} on the loose gear a^{20} , and the fast gear a^{19} will thereafter carry the loose gear a^{20} with it for a short distance until the smooth or toothless portion 3 of the said loose gear is removable from above and its toothed part is put into engagement with the teeth of the pinion a^{78} . After this both gears are revolved by the pinion a^{78} with the said two pins in contact until in the rotation of the fast gear a^{19} its smooth or toothless portion 2 is brought to its lower side, as in Fig. 6, at which time the rotation of the fast gear, and consequently of the shaft and pattern-disk a^{25} , is stopped and the said parts remain stationary; but the shaft a^{65} still continues to revolve and the machine to knit circular work. While the fast gear a^{19} is thus stationary, the loose gear a^{20} continues to be revolved by the pinion a^{78} until the shoulder a^{85} of the arm a^{22} strikes the pin a^{23} on the fast gear a^{19} , which thus starts the said fast gear and rotates it with the said loose gear until the teeth of the fast gear are again brought into engagement with the pinion a^{78} . Both gears now continue to revolve until the smooth or toothless portion 3 of the loose gear a^{20} is again brought to the lower side opposite the pinion a^{78} , when the rotation of the loose gear is again stopped; but the fast gear a^{19} continues to be revolved for a short distance until the pin a^{30} on the cam-disk a^x engages the arm or dog b^{16} and disengages the latch b^{14} , thus permitting the spring b^{21} to shift the

belt into position on the loose pulley and stop the machine, thus arresting circular knitting for the foot of the stocking, the latter having been completed ready for the knitting of the toe, the roll f at that time resting on the shoulder 60 of the disk a^x , the roll being shown by dotted lines, Fig. 5^a. The arm a^{22} may have one or more teeth, and its teeth, of whatever number, will be set in line with the teeth of the loose gear and the pin a^{23} , carried by the fast gear, will be so set with relation to the teeth of the gears that when the pin a^{23} is struck by the said arm the teeth of the fast and loose gears will be in line or will register, so that they may come each properly into engagement or mesh with the teeth of the pinion a^{78} .

In the formation of a stocking it is necessary to stop the machine and suspend circular knitting at the completion of the leg portion, and this is effected by the adjustable stud or pin a^{29} on the disk a^{25} , it then acting on the arm or dog b^{16} to release the shipper-rod b' , the gears a^{19} and a^{20} at such time occupying an intermediate position, or a position between their starting and finishing positions, the gears being in such relation to the pinion a^{78} that at least one of them will be in engagement with the said pinion and ready to be revolved when the shipper-rod b' is again moved to shift the belt upon the fast pulley a^{63} for the production of circular work. The length of the foot portion of the stocking may be regulated by the adjustment of the pin or stud a^{29} on the pattern disk or wheel a^{25} toward or from the stud a^{30} . Each of the fast and loose gears a^{19} a^{20} will have co-operating with it a like retarding device. (Shown in Fig. 6 as a dog or pawl e^3 , acted upon by a spring e^4 .)

The pattern-cam a^{25} serves the purpose of regulating the length of stitch for the tubular parts of the leg, and in so doing the cam-shaped periphery thereof and of the plate a^x (see Fig. 5^a) act on a roller f (see Fig. 4) at the end of a lever f' , pivoted to the framework of the machine at 4, (see Fig. 3,) the other end of the said lever being forked to embrace a rod f^3 , having at its end a collar f^4 , provided with a suitable projection to enter loosely a hole in the outer end of the arm h^{21x} , fast on the cam-ring h^{21} , before referred to.

In Fig. 16, r^{20} shows a vertical slot in the needle-bed, which slot is entered by a pin r^{21} , (shown as standing in the upper end of the said slot,) said pin being connected with the curb which surrounds and retains the lower end of the needle-bed, said slot and pin acting as a guide for the said bed in its vertical movement. When the roll f rests upon the portion 60 of the cam a^{25} a^x , then the cam projection h^{20} of the cam-ring h^{21} rests upon an inclined portion of the lower end of the needle-cylinder at such a point as to place the top of the cylinder in a more or less elevated position, according to the length of the stitch desired for commencing the stocking, and during

the rotation of the pattern-cam the cam-ring h^{21} will be gradually rotated in the direction of the arrow near it in Fig. 16 to thus enable the needle-cylinder to descend by gravity, thus shortening the stitch and contracting the diameter of the stocking where it is desired to make the leg of less diameter.

When heel and toe work is being done the stitch should be long, as when the leg is commenced, and to insure the long stitches during narrowing and widening we have devised a lever f^5 , which is pivoted at f^6 to the under side of the bed-plate A of the machine, and the inner end of this lever is connected by a link f^7 (see dotted lines, Fig. 7) to the clutch-rod c^{10} , so that when the latter rod is moved it catches the lever f^5 , causing its forked opposite end, resting against the collar f^8 , to move the rod f^3 and turn the cam-ring h^{21} in a direction to raise the needle-cylinder.

The cam-ring h^{21} constitutes what we shall in some instances hereinafter denominate the needle-cylinder "support" or "adjuster."

Sometimes, owing to accident to the yarn, it becomes necessary to stop the machine after the stocking has been started, and then before again starting the machine the pin b^{23} will be withdrawn and the ratchet-wheel b^{24} will be turned back opposite the direction of the arrow 21 until the pattern disk a^{25} is again put into starting position.

We will now refer to the take-up for controlling the slack in the yarn during reciprocating knitting. In Fig. 1, h represents a rod fast to a part of the machine and extended up over the machine at h' . This rod has clamped upon it the rear end of an arm h^3 , provided with bearings for a shaft h^4 , located at right angles to the arm h^3 and near the front side of the machine. The arm h^3 is provided with collars h^6 , having ears, (shown best in Figs. 13 and 14,) and these ears have pivoted between them on a suitable pin a block h^7 , through a hole in which is extended a guide-rod h^8 , the front end of which is extended down in front of the end of the arm h^3 and is provided with an eye h^9 , through which the yarn is passed. The rod referred to lies between two upright arms or pins h^{10} , secured to or rising from the arm h^3 . At the under side of the arm h^3 is a plate h^{13} and below it a disk h^{14} , which is adapted to slide vertically on a pin h^{12} , the disk being acted upon by a spiral spring h^{15} , surrounding said pin and resting against a nut h^{16} , screwed upon the lower end of the pin h^{12} . (See in large detail Fig. 17.) The disk h^{14} is acted upon by a lever h^{17} , pivoted at h^{18} , the rear end of the said lever being connected by a link h^{20} with the rod h^8 . The lever h^{17} has, preferably, a hole at one end, through which the link h^{20} is extended, and the latter below the lever has an enlarged portion or eye h^{35} (see Fig. 14) to act as a stop or rest for that end of the lever h^{17} . The block h^7 (see Figs. 13 and 14) has fast to it one end of a spring h^{21} , the other end of which is connected

(see Fig. 2) to a rod h^{31} , made adjustable in a post h^{22} , carried by the arm h^3 . The shaft h^4 has fast on it a hub h^{23} , having an arm h^{24} , which co-operates with a pin or projection h^{36} on the block h^7 . The shaft h^4 has also fast on it an arm h^{25} , connected by a link h^{26} , (see Figs. 1, 3, and 13,) joined at its lower end to a lever h^{27} , pivoted in turn at its lower end upon an ear h^{28} of the plate d^7 , before described. (See Figs. 3 and 15.) The lever h^{27} has a curved slot h^{29} , into which enters a stud h^{30} , herein represented as forming a part of a collar d^9 , before described. When the link h^{26} is depressed or pulled downward, the arm h^{24} retires from the pin h^{36} of the block h^7 and allows the spring h^{21} to move and raise the outer end h^9 of the rod h^8 to take up the slack in the yarn.

Figs. 1 and 2 show the parts in the position for circular work. When the work is to be varied, the clutch-rod c^{10} is moved by the lever c^{12} , and the stud h^{30} on the collar d^9 travels in the slide h^{29} of the lever h^{27} , turning the latter to depress the link a^{26} and rock the shaft h^4 to turn the arm h^{24} away from the projection h^{36} , thus permitting the rod h^8 to rise and take up the slack in the yarn. As the lever h^{17} is moved to let the rod h^8 rise, the stop or head h^{35} of the link h^{20} is depressed, and so removed from the lever h^{17} , permitting the spring h^{15} to lift the disk h^{14} and clamp the yarn between it and the plate h^{13} , the yarn being held only by the stress due to the spring h^{15} .

We claim—

1. In a circular-knitting machine, the combination, with the shaft a^{65} , having a fast and a loose pulley, a driving-belt in engagement with one of said pulleys, a belt-shipper to move the said belt from one to the other of said pulleys, a locking device for said shipper to maintain the belt on the fast pulley while the said shaft is being rotated for circular work, and a pattern mechanism to automatically release the belt-shipper at a predetermined point or time, of devices to reciprocate the said shaft during heel and toe work, a locking device to co-operate with the devices for reciprocating the said shaft, and a pattern mechanism to automatically release the said locking device to stop the reciprocations of the said shaft at the proper time, substantially as described.

2. A knitting-machine containing the following instrumentalities, viz: a needle-cylinder, a series of needles therein, a cam-ring to act upon the said needle-cylinder, a cam-cylinder having cams to actuate the said needles, a shaft, as a^{65} , and gearing between it and the cam-cylinder, and means to rotate the said shaft and to reciprocate the said shaft at suitable times, and a clutch to determine the periods of rotation and of reciprocation of the said shaft, and consequently the rotation and reciprocation of the cam-cylinder, a clutch-rod, and connecting devices between the said clutch-rod and the said cam-ring,

whereby the engagement of the clutch to effect the reciprocating motion of the said shaft automatically raises the needle-cylinder to lengthen the stitch, substantially as described.

3. In a knitting-machine, the combination, with a shaft a^{65} , provided with a fast pulley and a loose pulley, a driving-belt in engagement with one of said pulleys, a belt-shipper to move the said belt from one to the other of said pulleys, a locking device for said shipper, consisting of a lever pivoted to the shipper bar or rod and having one arm provided with a latch or pawl b^{14} , and a dog b^{16} , pivoted to the other arm of the lever, of a pattern mechanism consisting of a disk a^{25} , provided with a pin or stud a^{29} to act on the dog b^{16} , and gearing to produce rotation of the said disk, substantially as described.

4. In a knitting-machine, the combination of the following instrumentalities, viz: a shaft a^{65} , provided with a worm, a gear in mesh with said worm, a shaft a^{75} , upon which the gear is mounted, a pinion a^{78} , and a pattern-shaft a^{21} , a gear a^{19} , fast on the shaft a^{21} and provided with a smooth or toothless portion and with a pin or stud a^{23} , and a gear a^{20} , loose on the shaft a^{21} and provided with a smooth or toothless portion and having a pin or stud a^{24} to co-operate with the pin or stud a^{23} , and an adjustable arm located between the said gears a^{19} a^{20} , substantially as described.

5. In a knitting-machine, the following instrumentalities, viz: a shaft a^{75} , having a worm-gear thereon, a worm to engage and rotate it, a pinion a^{78} on the said shaft, a shaft a^{21} , a gear thereon in mesh with the pinion a^{78} , a pattern disk or plate a^{25} , mounted on said shaft a^{21} , a pin or stud moved by the said disk to effect the stopping of the machine when circular knitting is to be suspended, a cam secured to the said disk or plate, a stitch-regulating cam-ring to regulate the length of the stitches, and a lever f' in operative connection with the said cam-ring and actuated by the said cam, substantially as described.

6. In a knitting-machine, the combination of the following instrumentalities, viz: a shaft a^{75} , a ratchet-wheel b^{24} , rotated therefrom, a pattern-wheel c^{23} to control the reciprocation of the machine, a pawl and ratchet-wheel c^{21} to rotate said pattern-wheel, a pawl in en-

gagement with the said ratchet-wheel b^{24} , means to oscillate said ratchet-wheel, and intermediate mechanism operated by movement of the latter ratchet-wheel in its oscillation in one direction to actuate the pattern-wheel, substantially as described.

7. In a knitting-machine, the herein-described take-up mechanism, consisting, essentially, of a rod h^8 , provided with a yarn-guide, a block h^7 , to which the said rod is secured, a sleeve provided with an arm h^{24} to act on the said block and force the said rod h^8 downward, as when circular knitting is being done, a spring to move the said block h^7 in a direction opposite to that in which it is moved by the said arm h^{24} , a clamp to hold the yarn during reciprocating knitting, a lever upon which the said clamp is mounted, and a rod h^{20} , connecting the said take-up and the clamp-carrying lever and adapted to operate substantially as described.

8. In a knitting-machine, the herein-described take-up mechanism, consisting, essentially, of a rod h^8 , provided with a yarn-guide, a block h^7 , to which the said rod is secured, a sleeve provided with an arm h^{24} , a rock-shaft to which it is fastened, said arm acting on the said block and forcing the rod h^8 downward for circular knitting, a second arm h^{25} , fast on said rock-shaft, a slotted lever h^{27} , combined with a link connecting said slotted lever with the said arm h^{25} , a pin or stud extended into the slot of the said lever, a bar d^3 , carrying said pin, and a pattern-surface to release the said bar at the proper time, whereby the movement of the said bar in one direction, as when the machine is started for reciprocating knitting, moves the said lever h^{27} to release the rod h^8 and effect the clamping of the thread on its way to the arm h^3 , the combination being and operating 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:

NAPOLEON B. HALE,
JAMES E. BARNARD.