(No Model.)

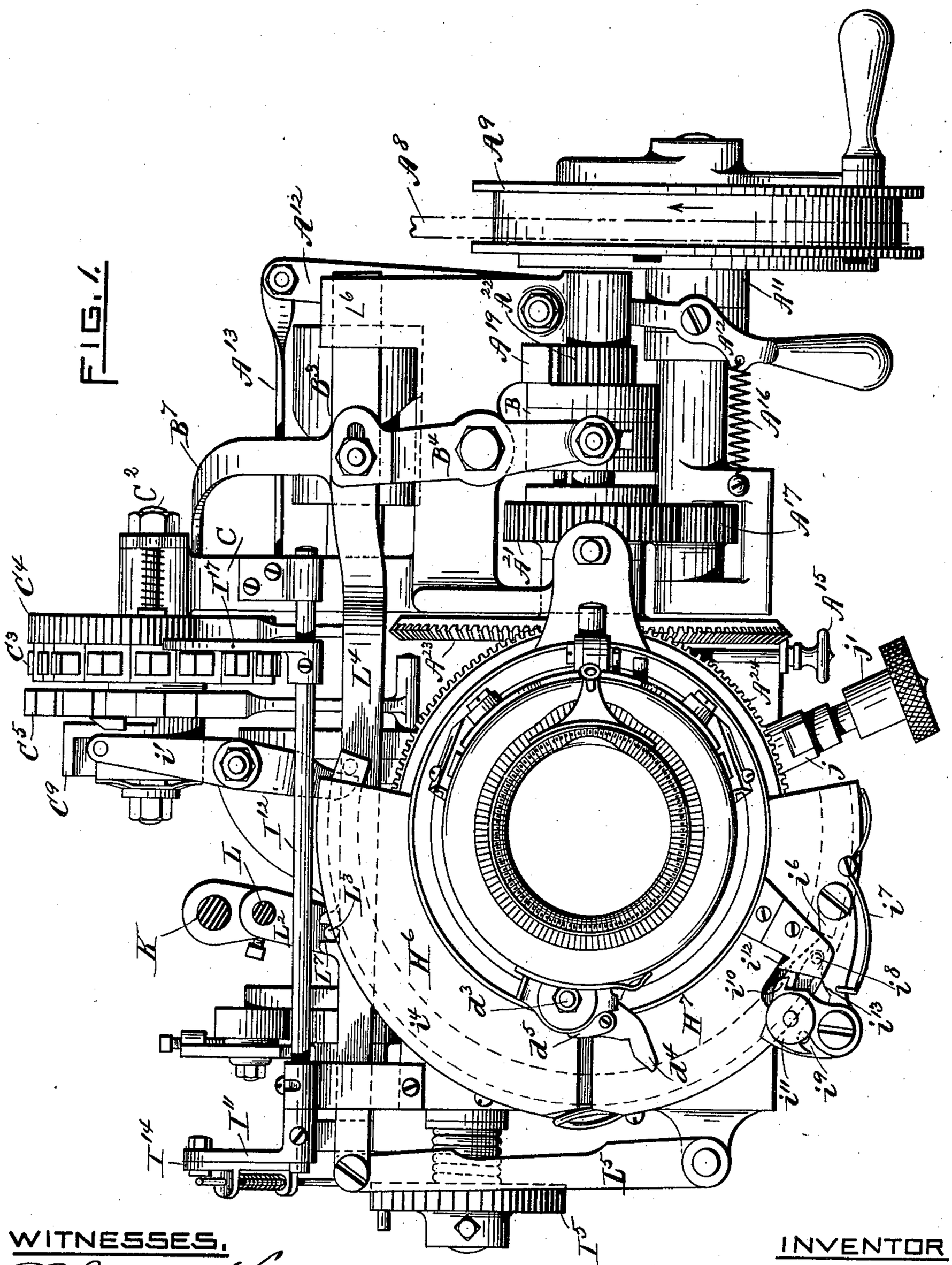
16 Sheets—Sheet 1.

J. E. ROWE.

KNITTING MACHINE.

No. 570,059. Patented Oct. 27, 1896.

FIG. 1.



WITNESSES.

Charles Hannigan.

Ira L. Fish

INVENTOR

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By Wilmarth H. Thurston

Atty.

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(No Model.) 16 Sheets—Sheet 2.

J. E. ROWE.

KNITTING MACHINE.

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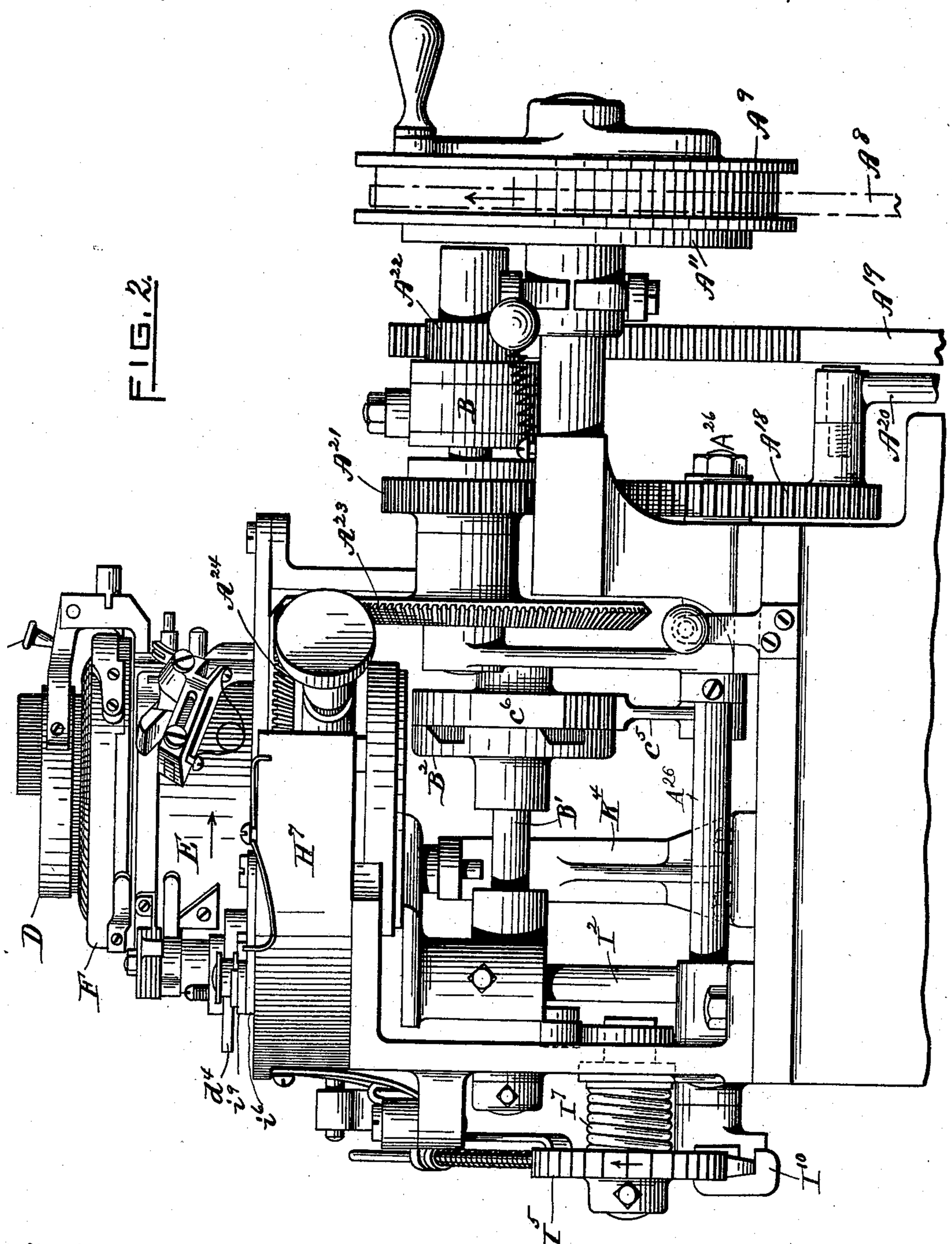
FIG. 2.



WITNESSES.

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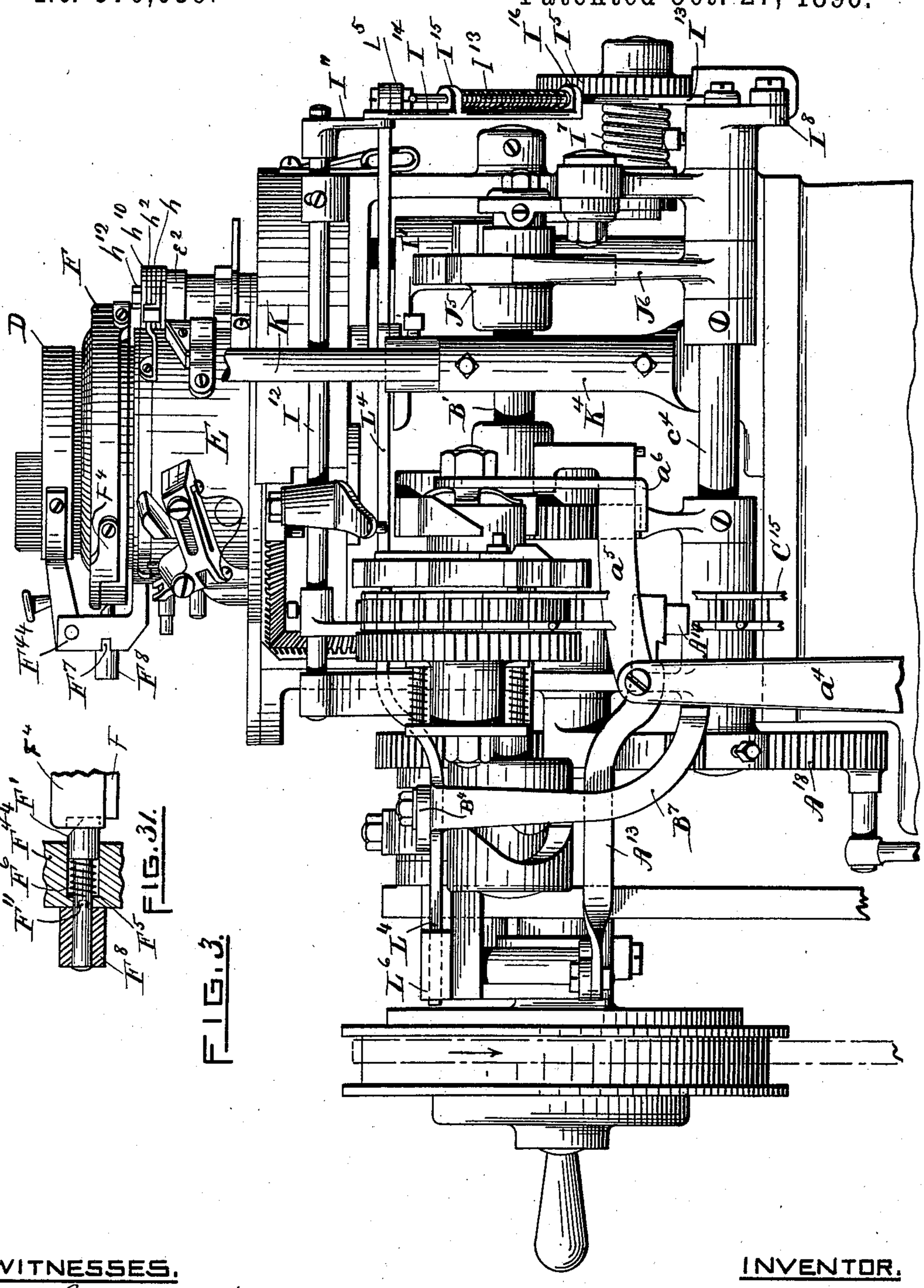

FIG. 3.

FIG. 3A.

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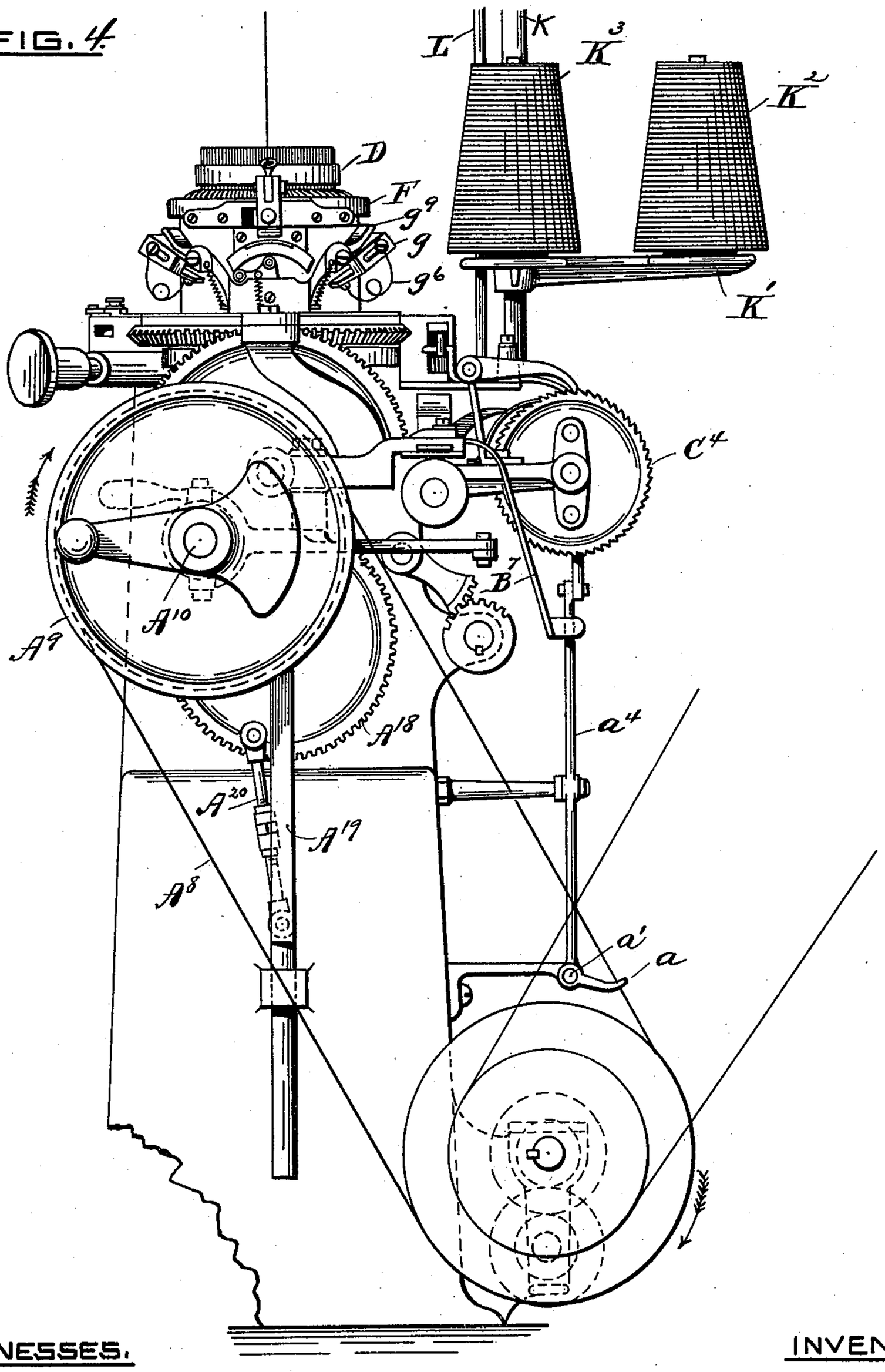
FIG. 4.



WITNESSES.

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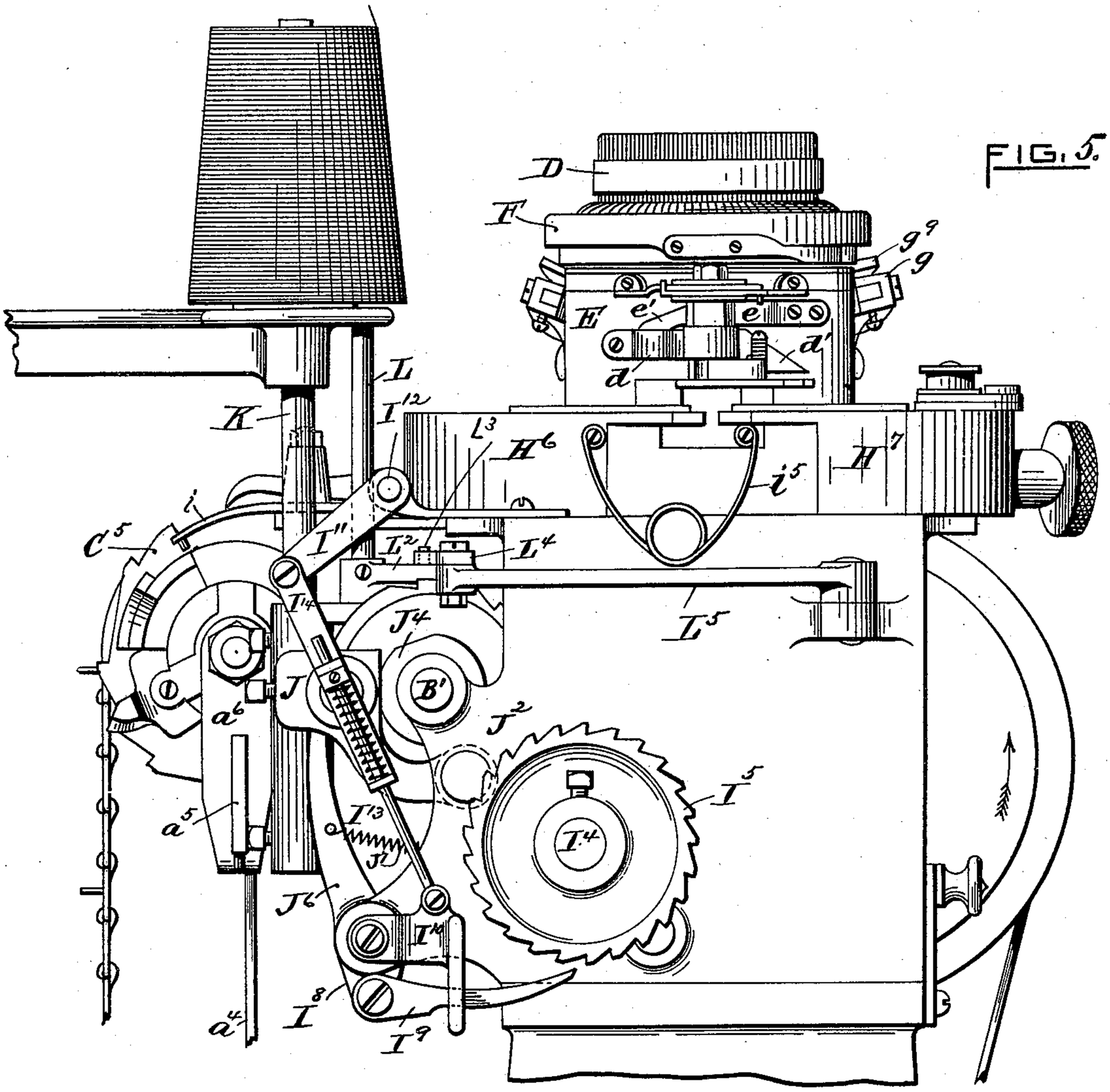
FIG. 5.



WITNESSES.

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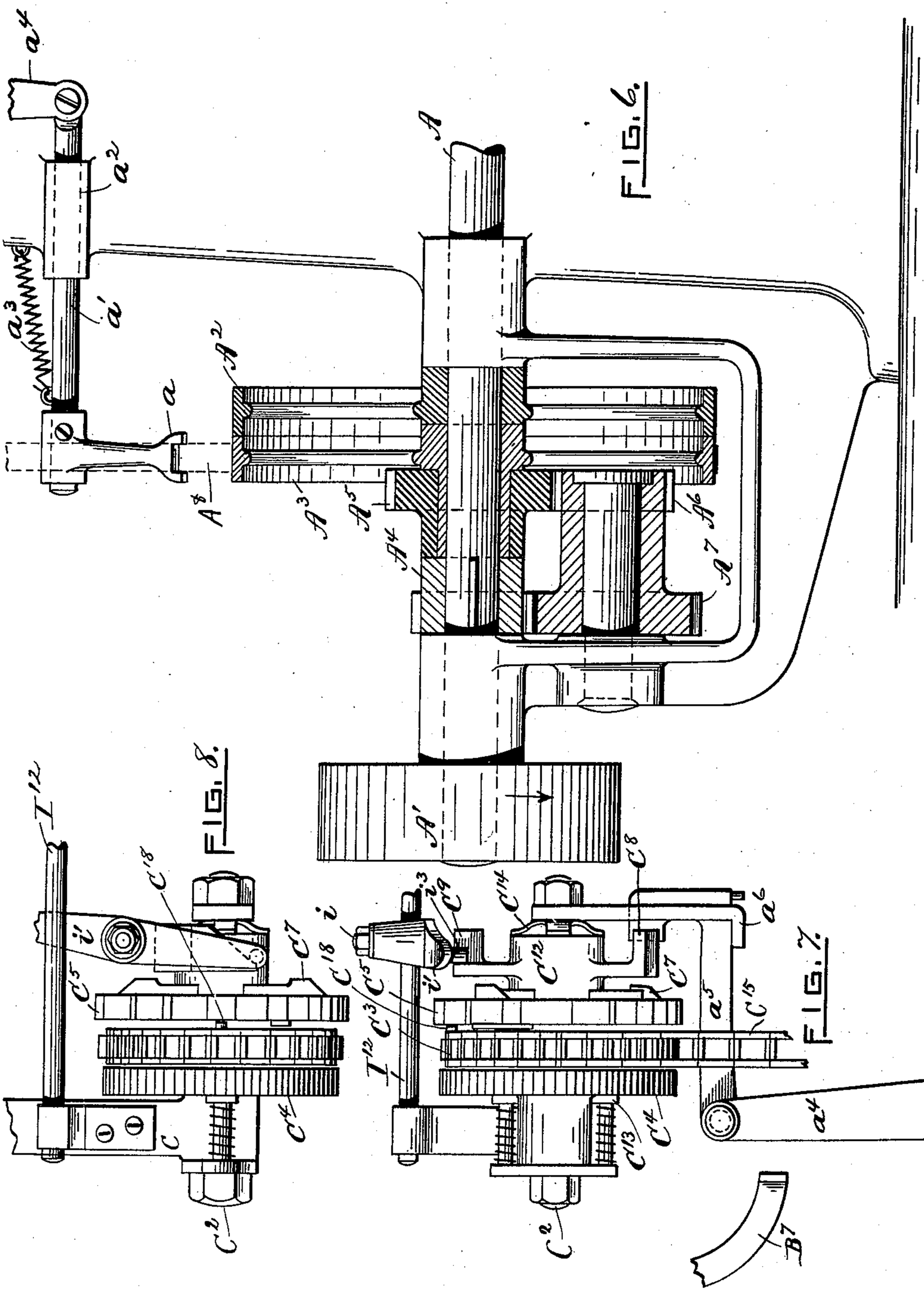
No. 570,059. Patented Oct. 27, 1896.



WITNESSES.

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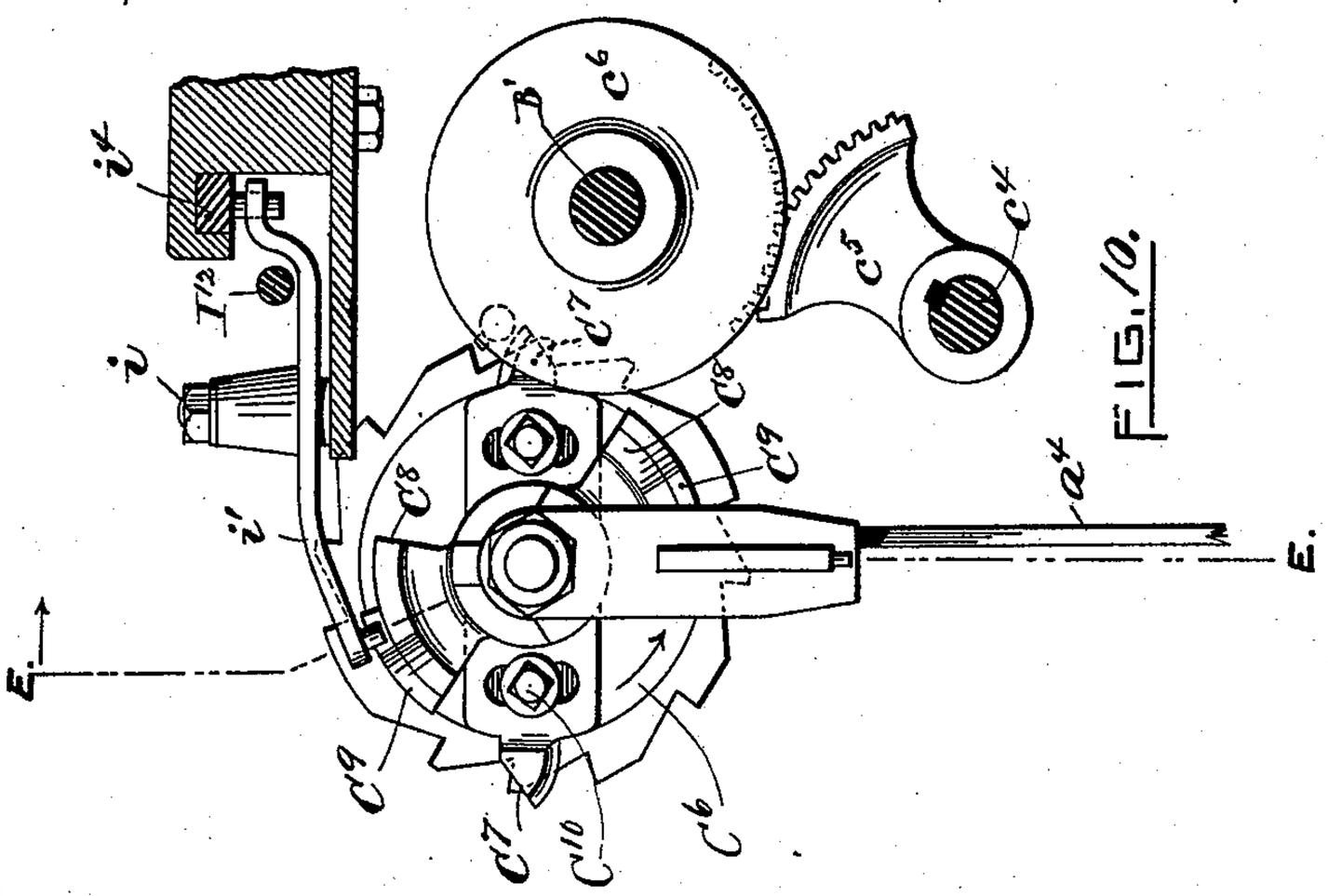

FIG. 10.

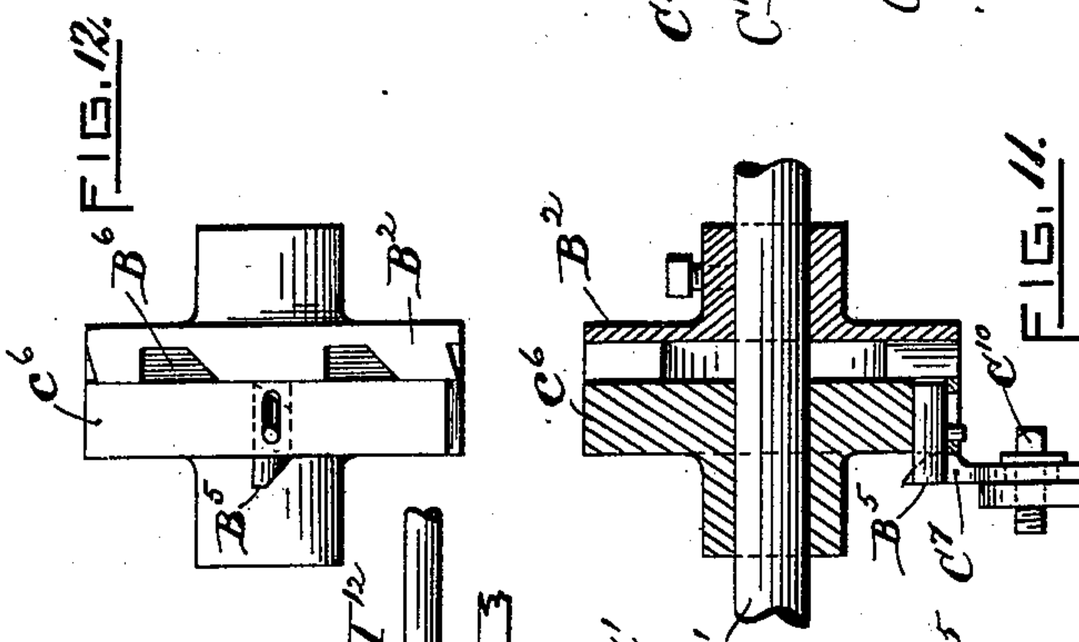

FIG. 12.

FIG. 11.

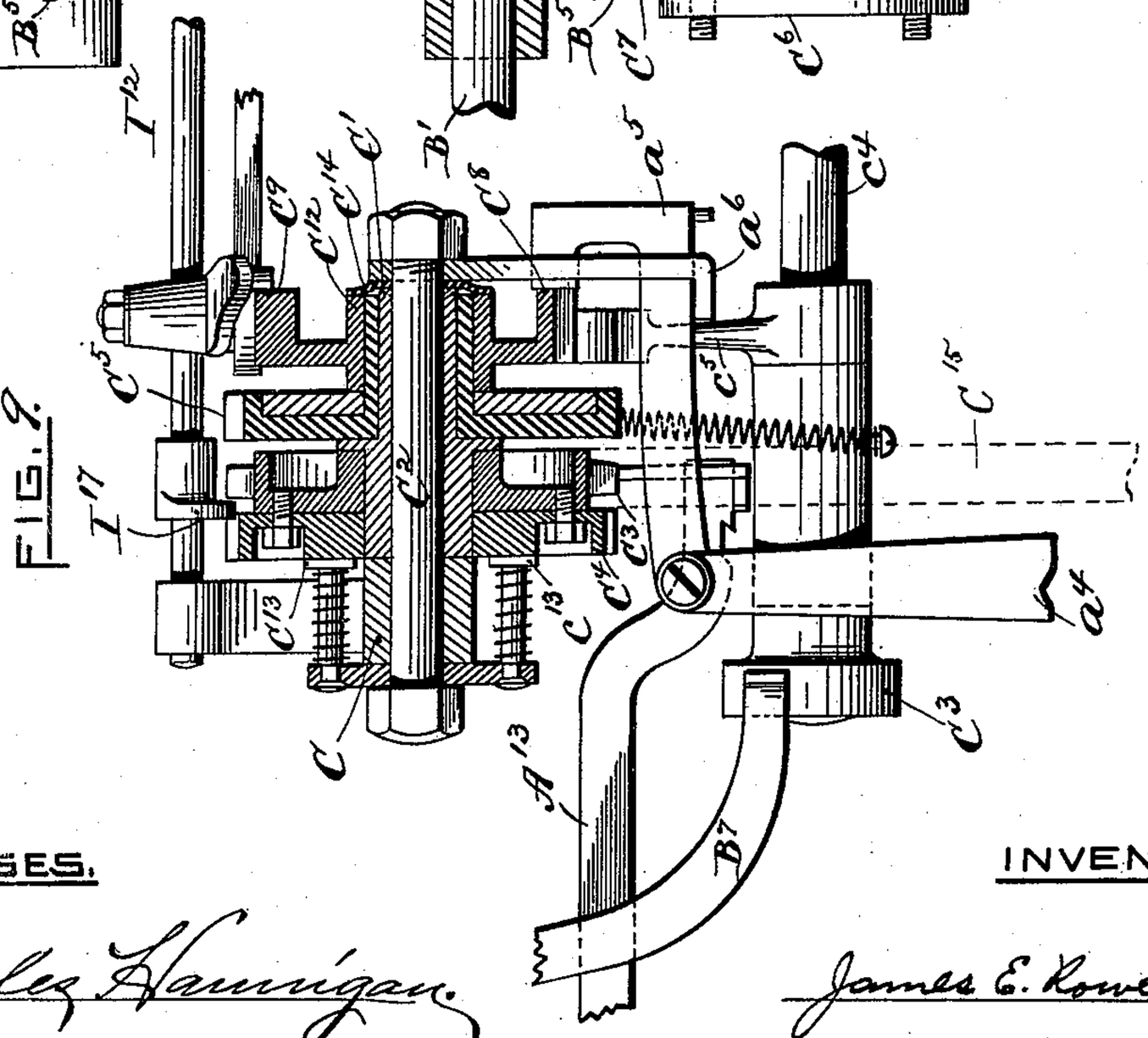

FIG. 9.

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KNITTING MACHINE.

No. 570,059. Patented Oct. 27, 1896.

FIG. 16.

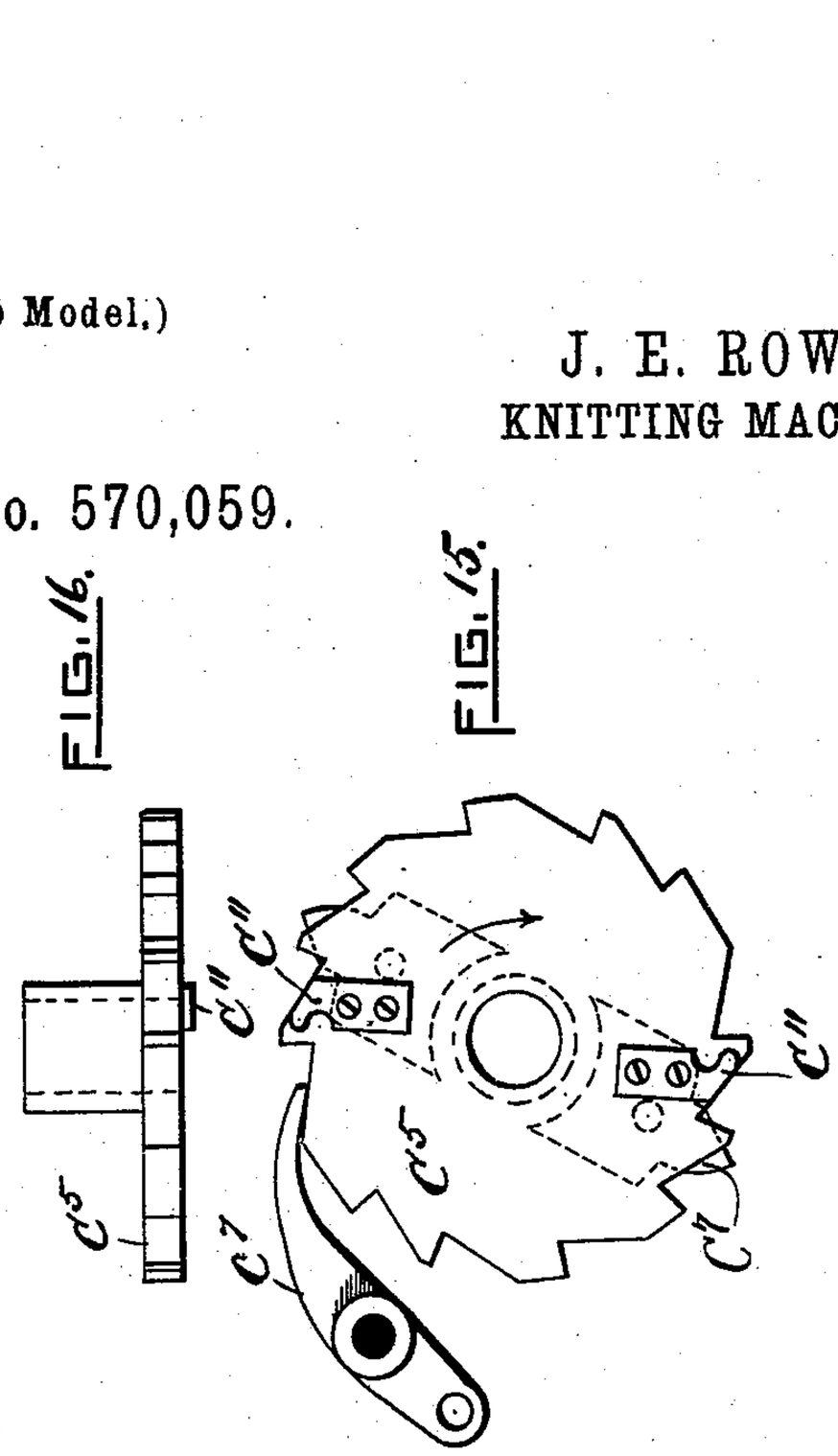

FIG. 15.

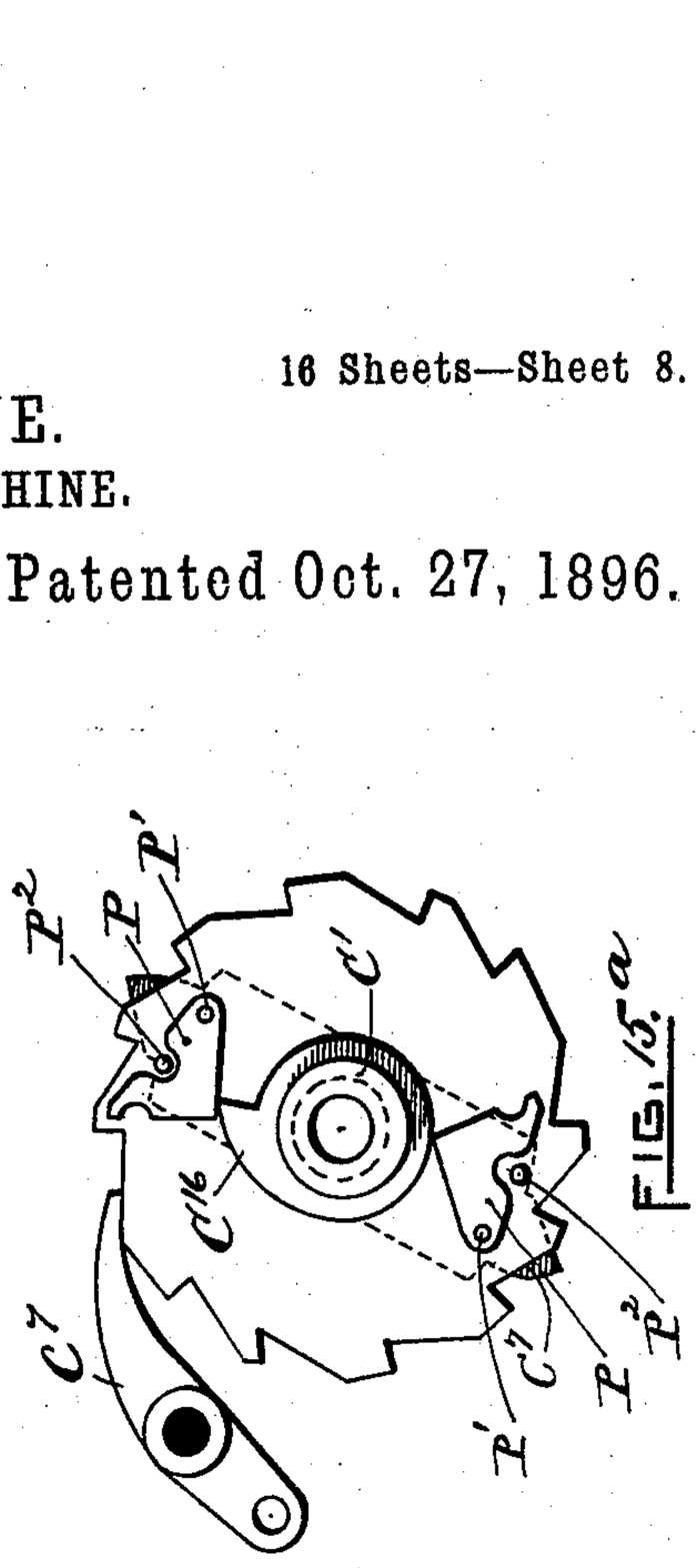

FIG. 15a

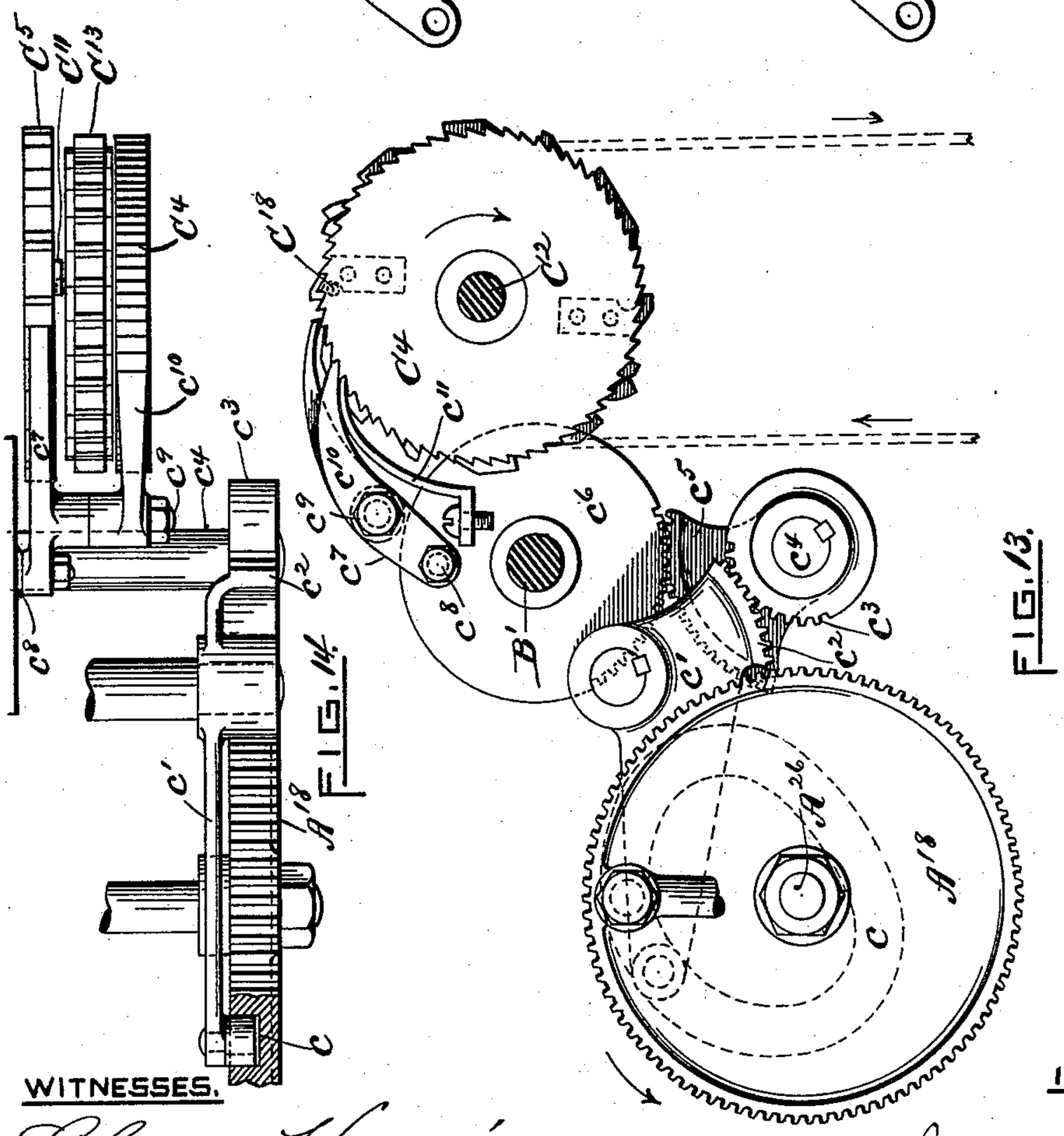

FIG. 14.

FIG. 13.

WITNESSES.

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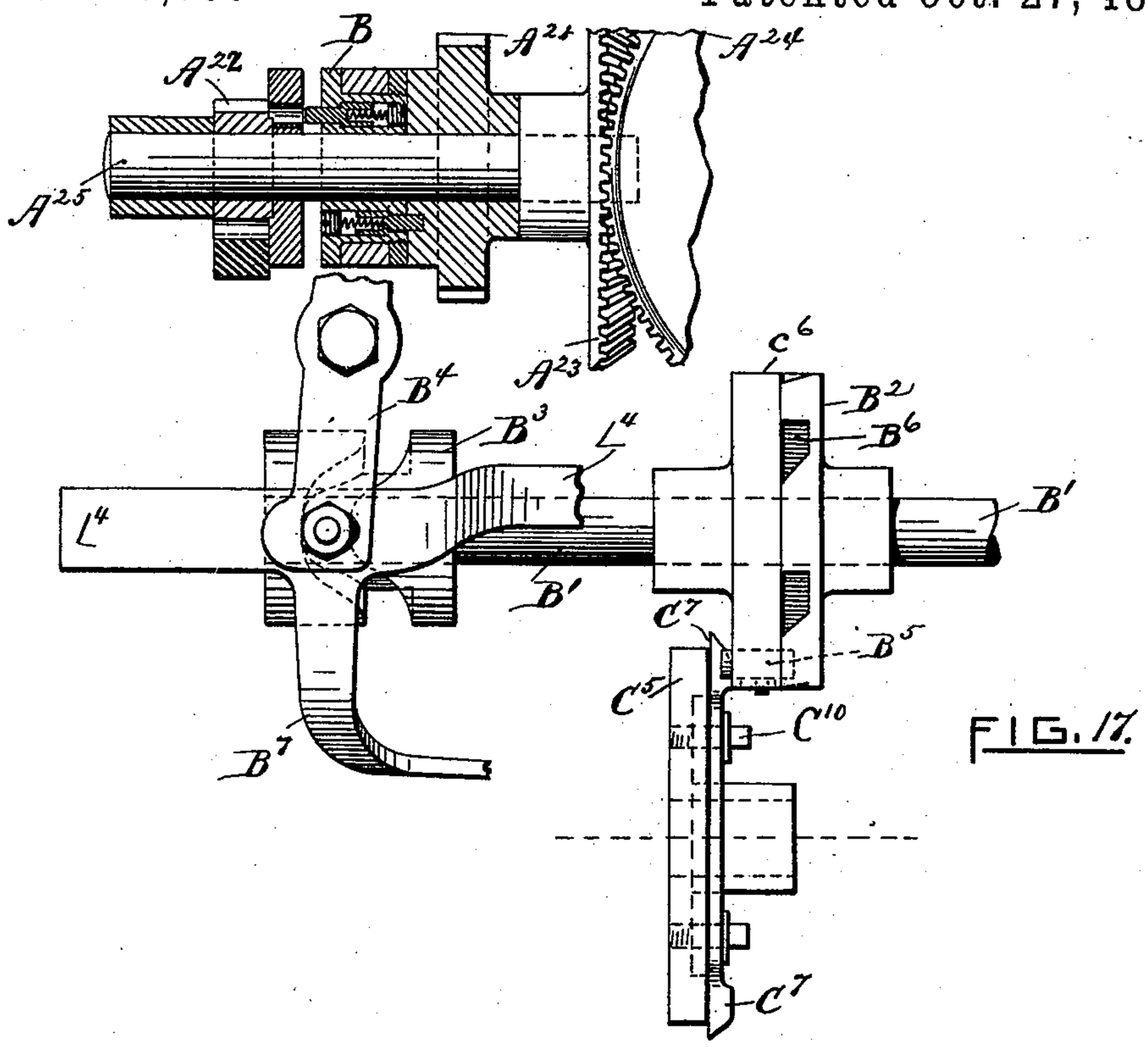

FIG. 17.

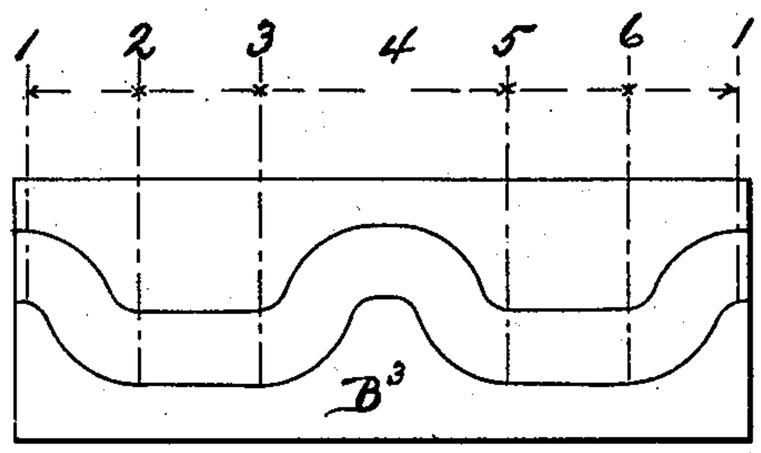

FIG. 18.

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J. E. ROWE.

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No. 570,059. Patented Oct. 27, 1896.

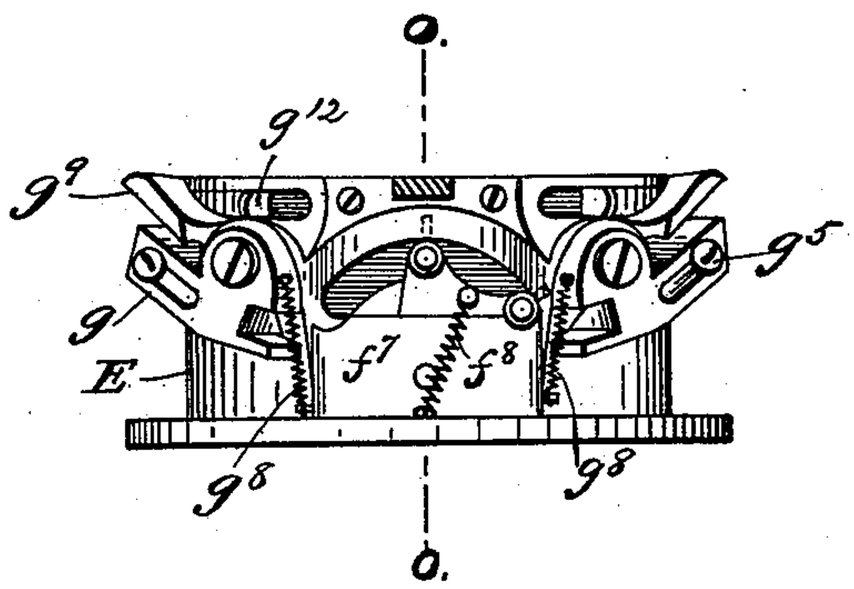

FIG. 20.

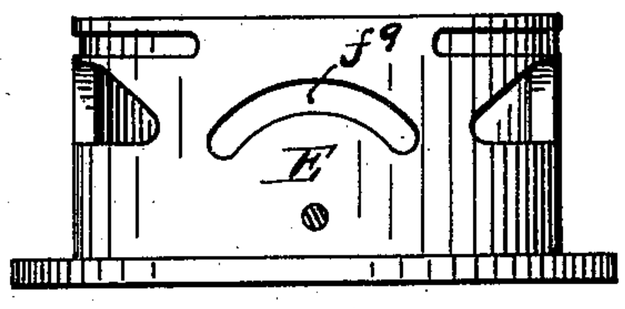

FIG. 19.

FIG. 22.

FIG. 21.

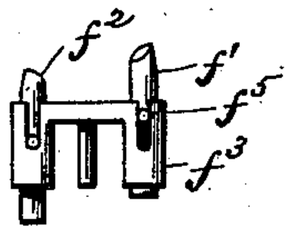

FIG. 24.

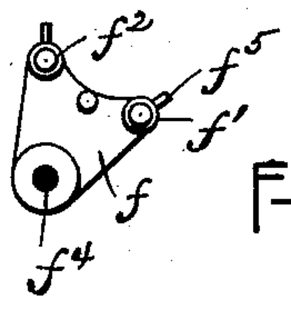

FIG. 23.

WITNESSES.

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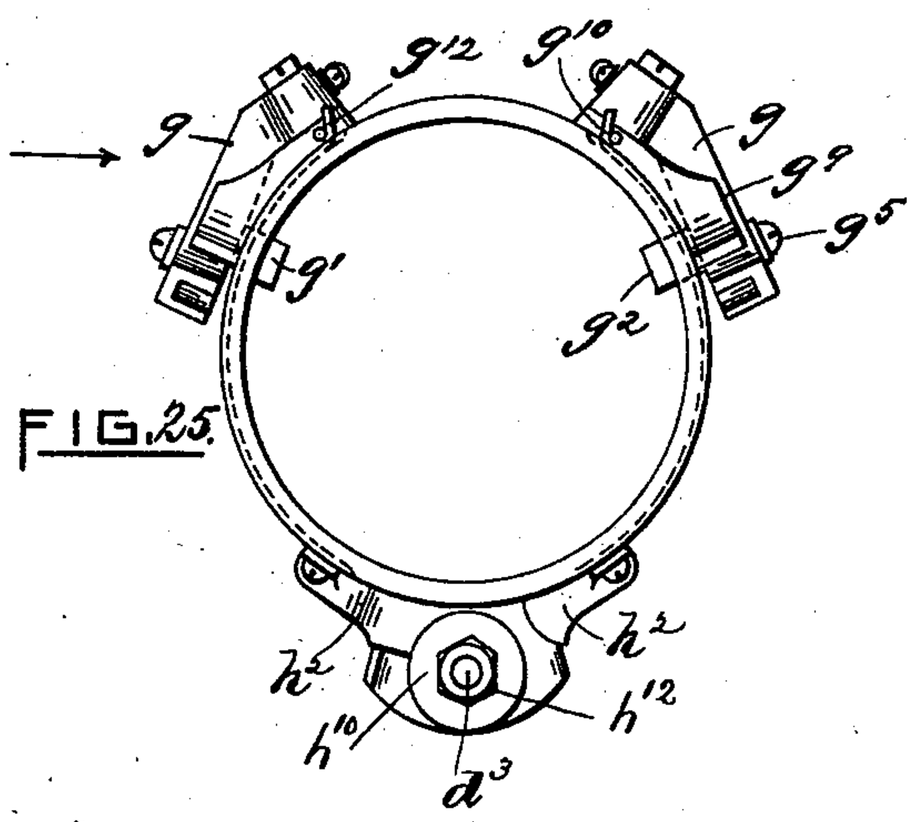

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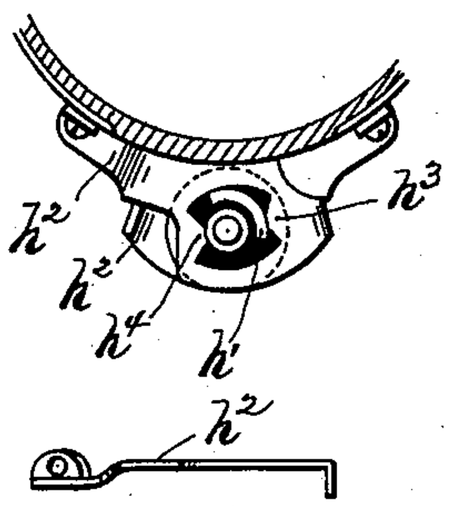
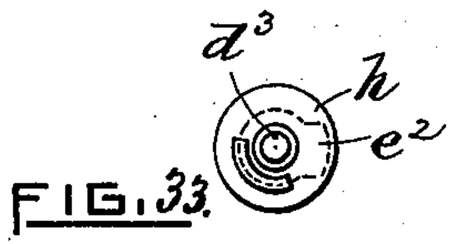


FIG. 30.

FIG. 32.



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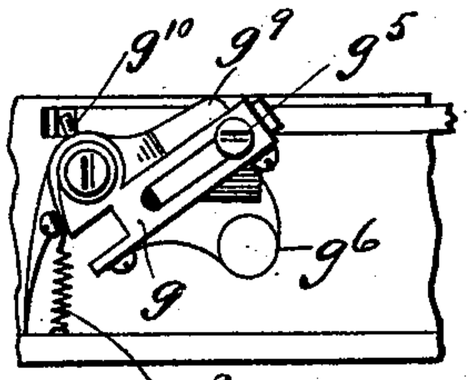

FIG. 27.

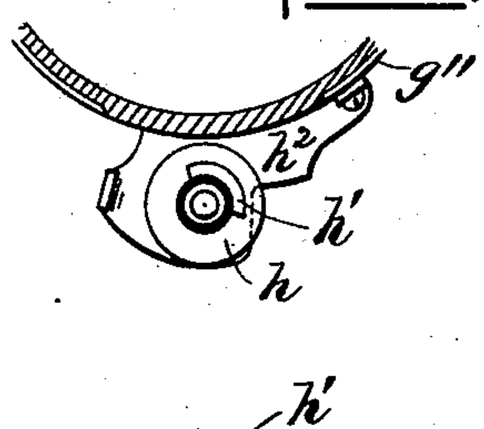

FIG. 29.

FIG. 34.

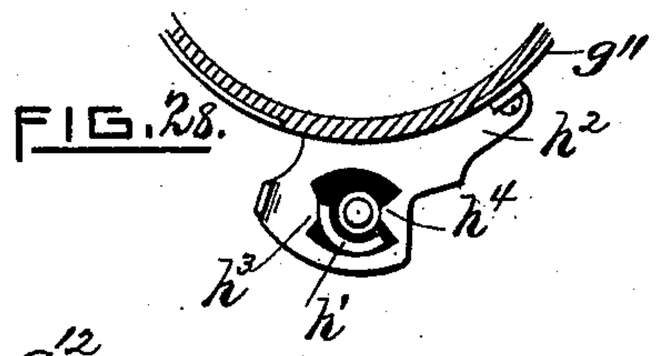

FIG. 28.

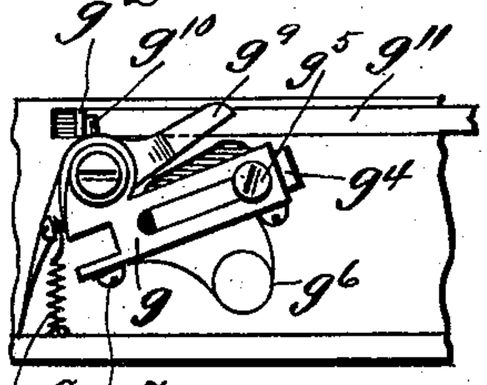

FIG. 26.

WITNESSES.

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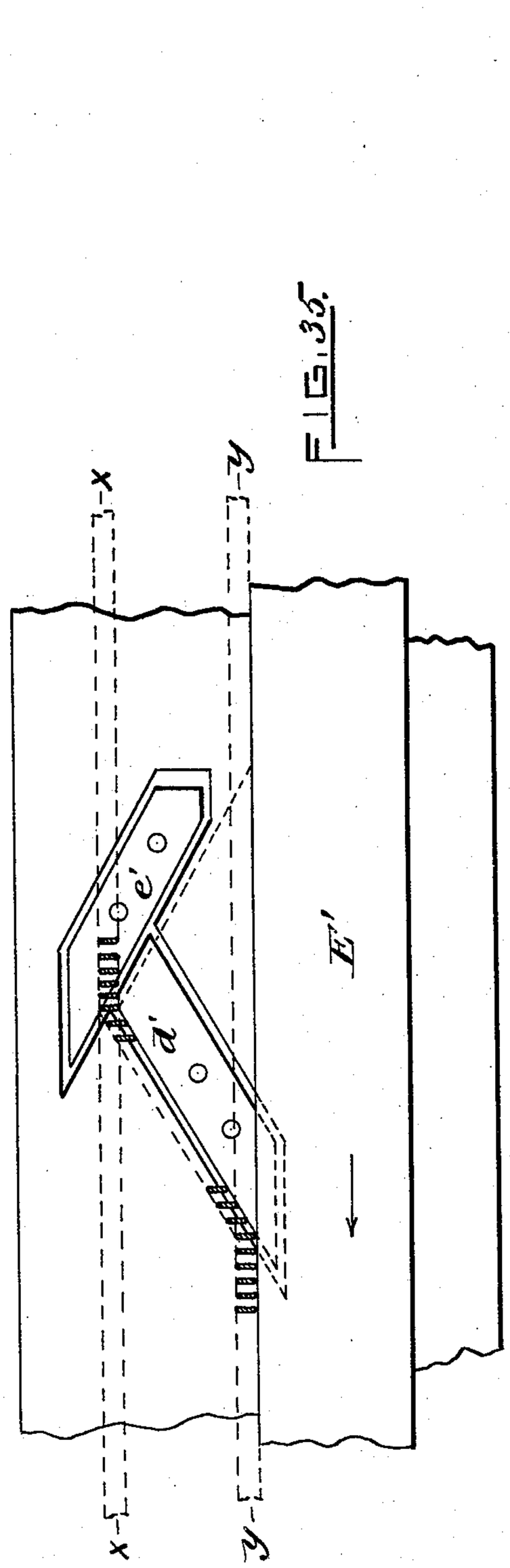
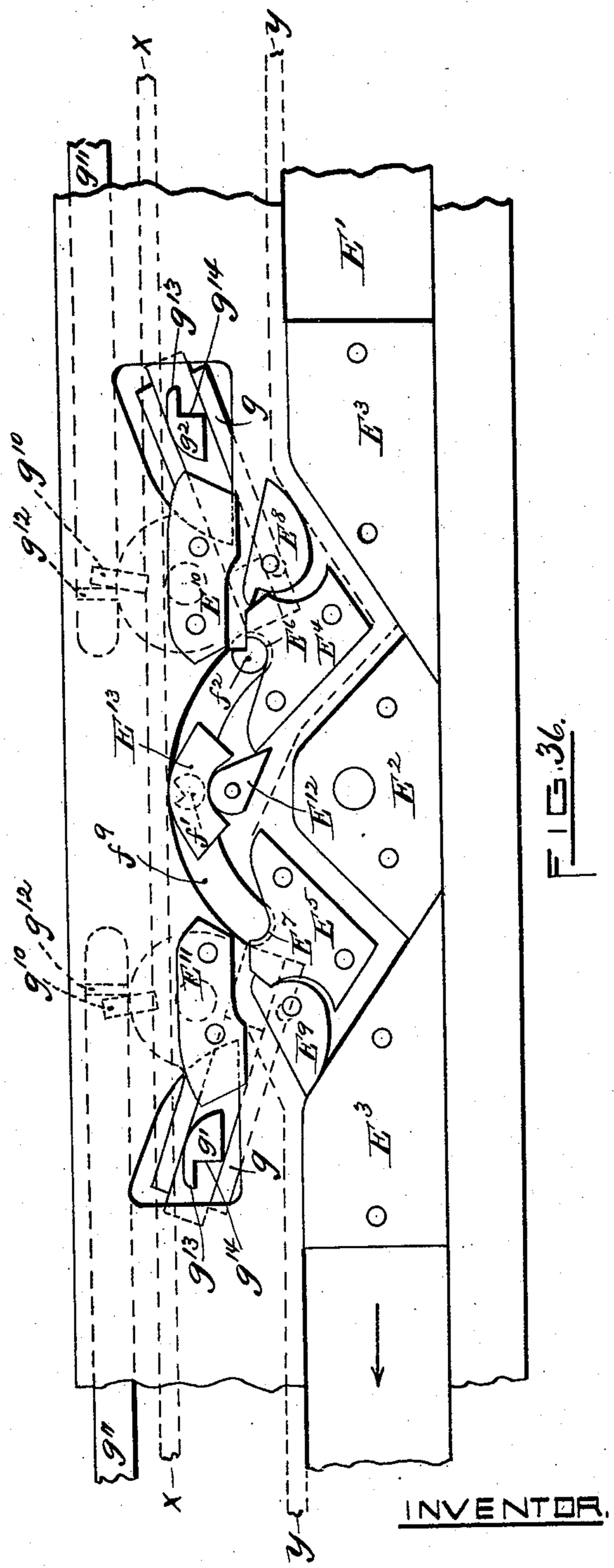
J. E. ROWE.

KNITTING MACHINE.

No. 570,059. Patented Oct. 27, 1896.





WITNESSES.

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KNITTING MACHINE.

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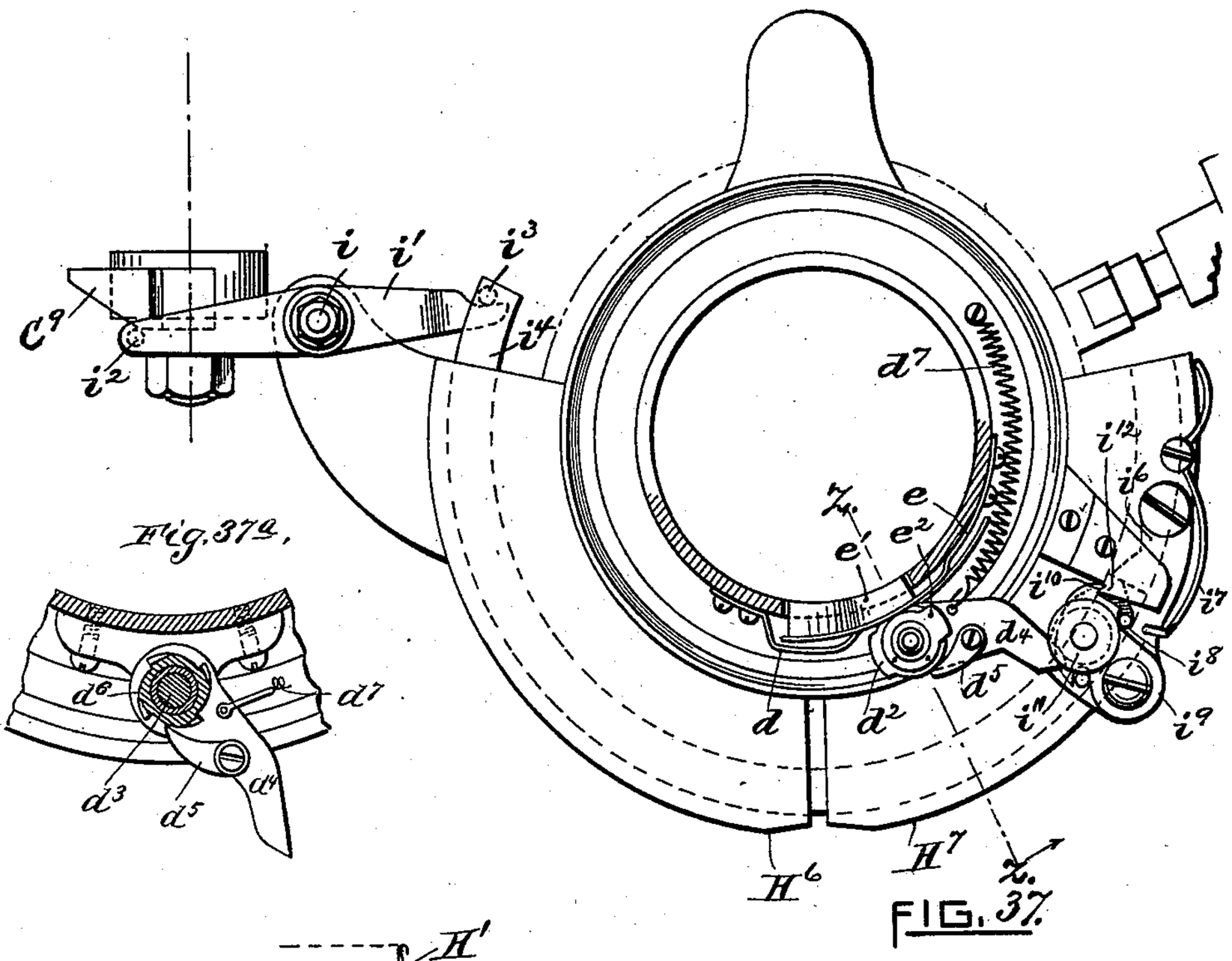

FIG. 37.

Fig. 37a.

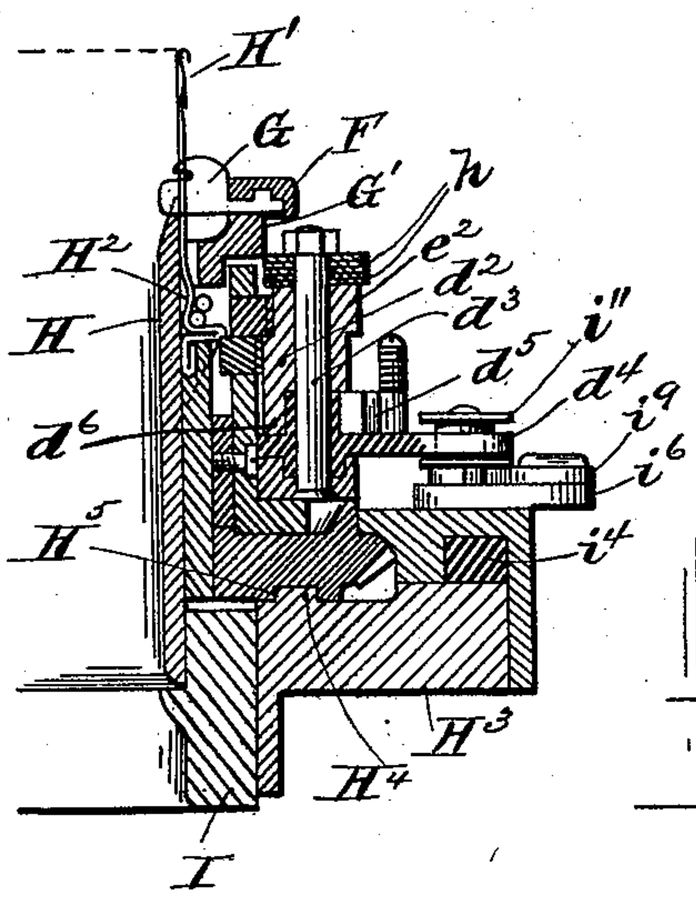

FIG. 38.

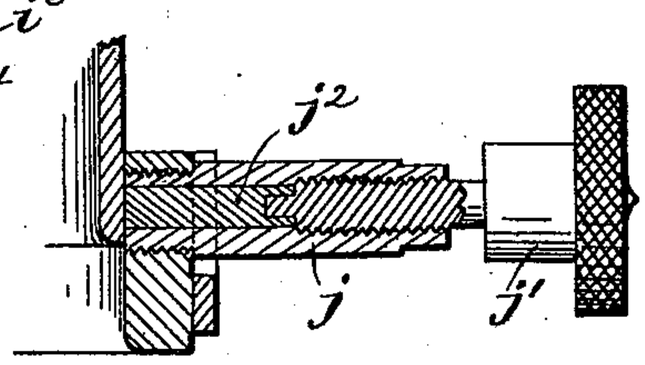

FIG. 39.

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KNITTING MACHINE.

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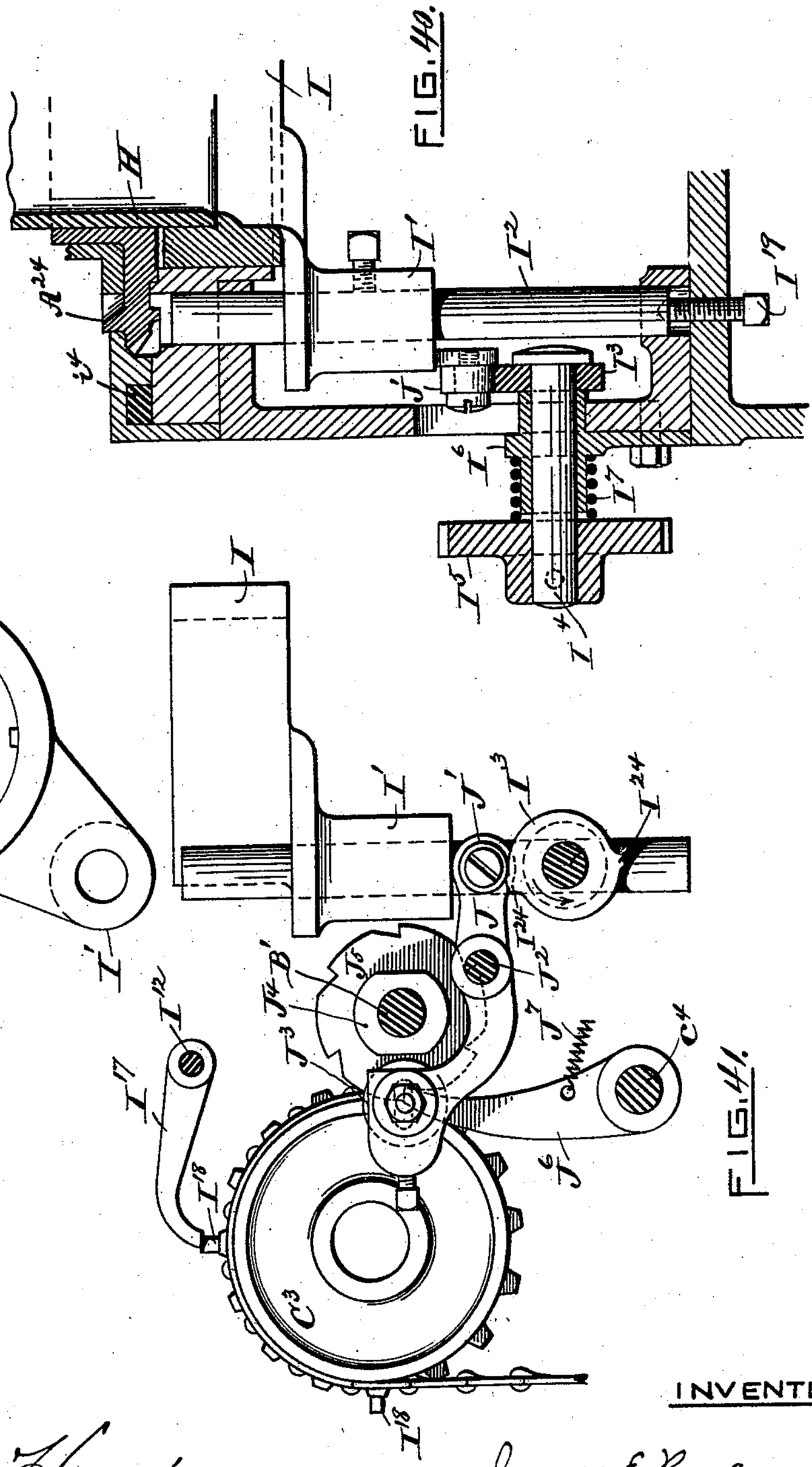

FIG. 42.

FIG. 41.

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KNITTING MACHINE.

No. 570,059. Patented Oct. 27, 1896.

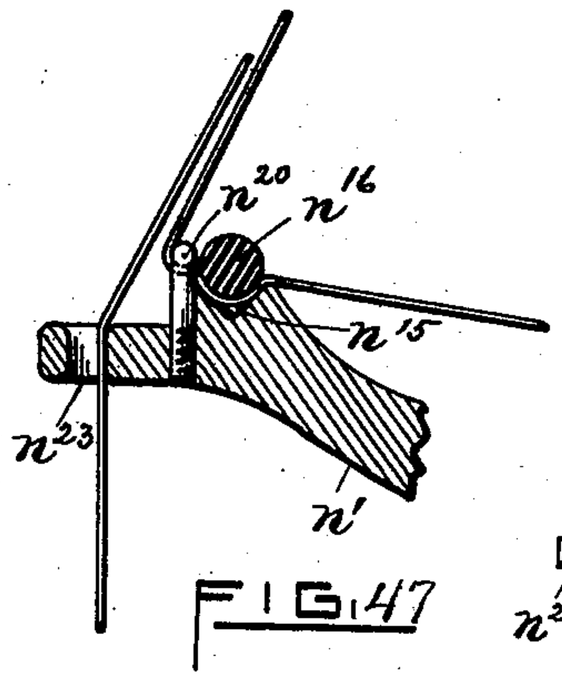

FIG. 47

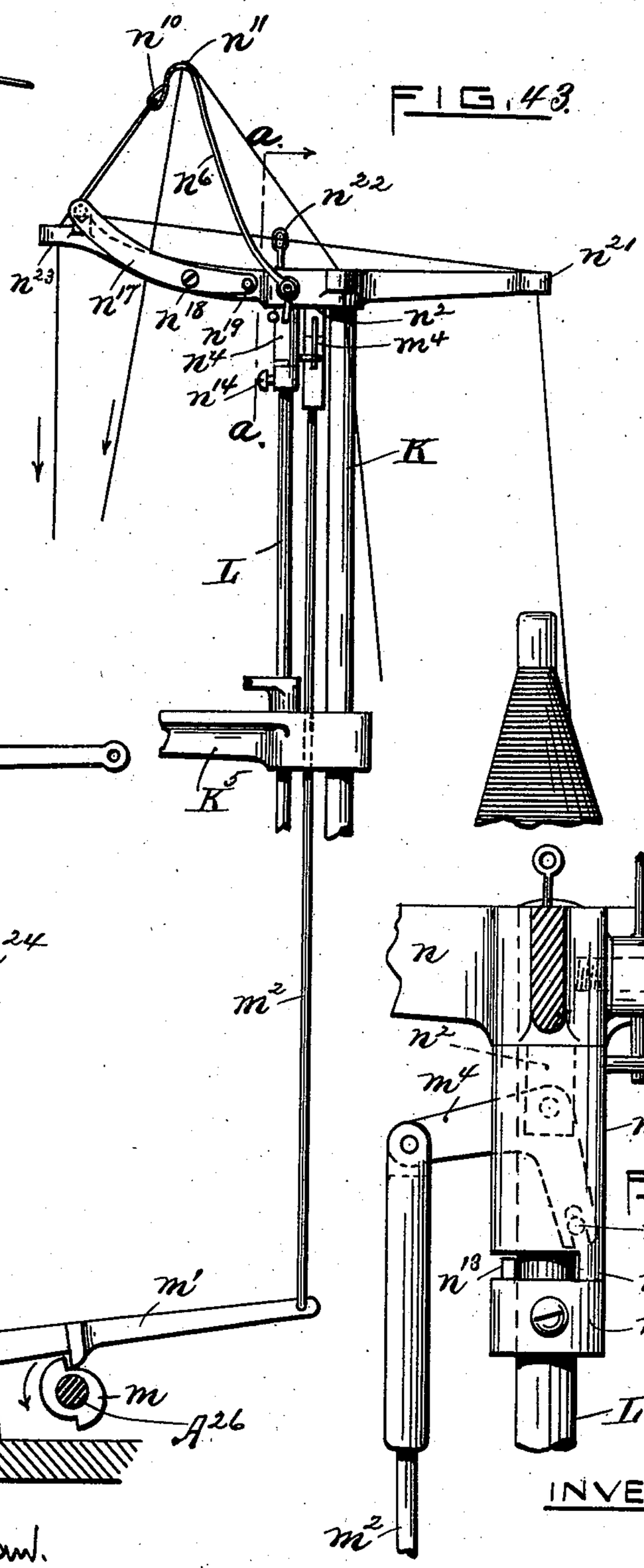

FIG. 43.

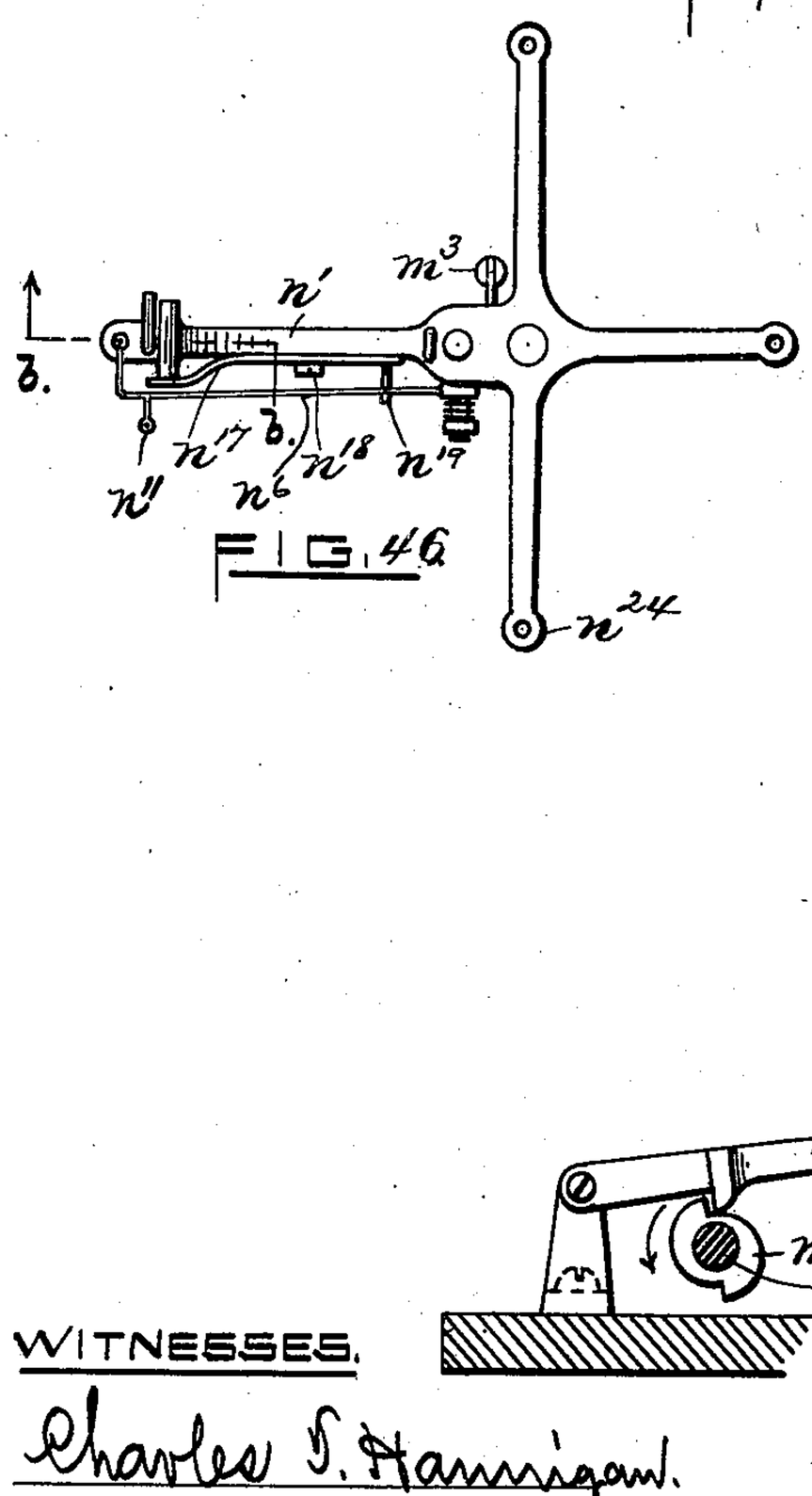

FIG. 46

FIG. 45.

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KNITTING MACHINE.

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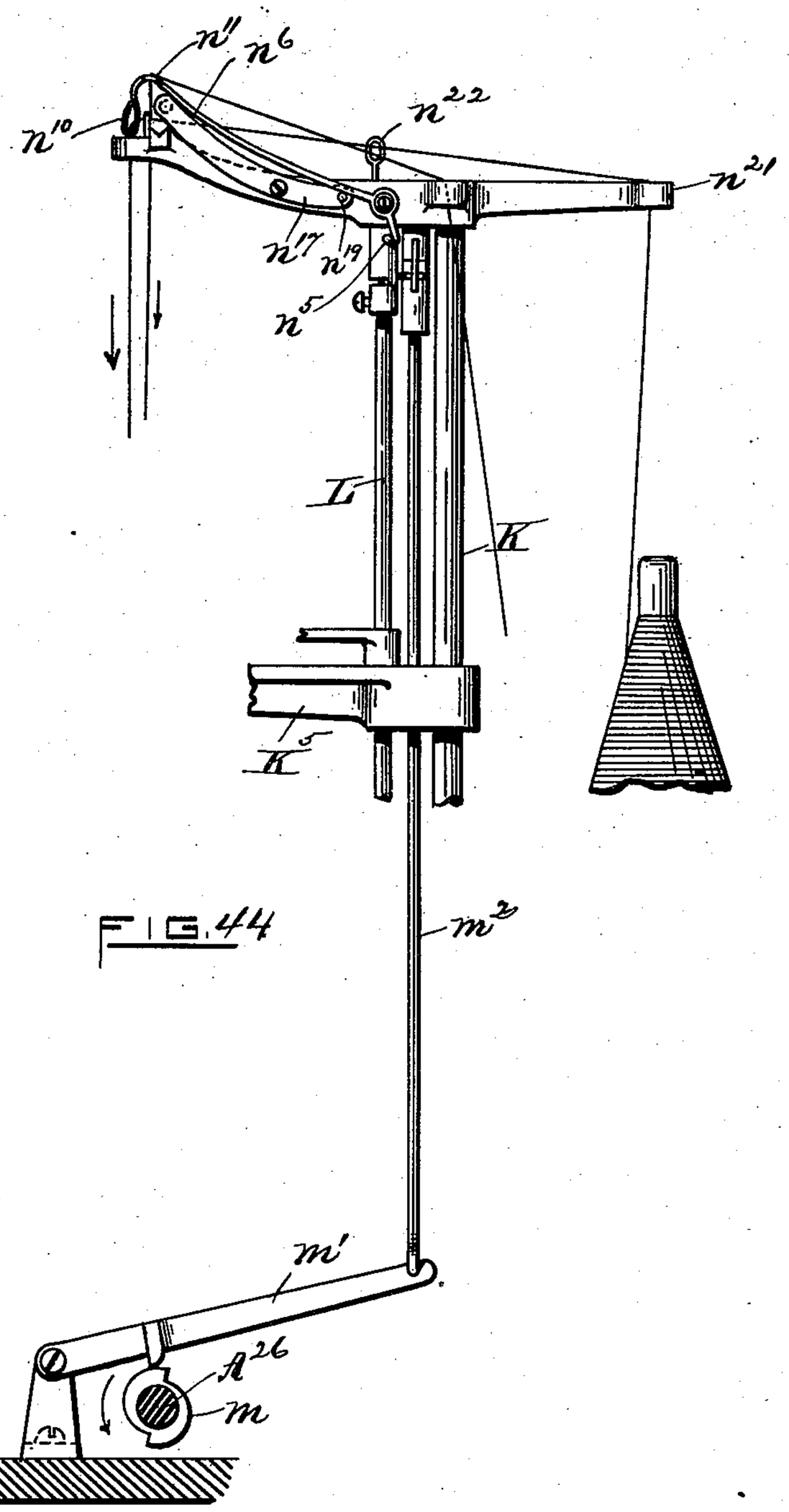

FIG. 44

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INVENTOR,

James E. Rowe

by Wilmarth H. Thurston

Atty.

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UNITED STATES PATENT OFFICE.

JAMES E. ROWE, OF PAWTUCKET, RHODE ISLAND, ASSIGNOR TO THE E. JENCKES MANUFACTURING COMPANY, OF SAME PLACE.

KNITTING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 570,059, dated October 27, 1896.

Application filed November 20, 1895. Serial No. 569,583. (No model.)

To all whom it may concern:

Be it known that I, JAMES E. ROWE, of the city of Pawtucket, county of Providence, in the State of Rhode Island, have invented certain new and useful Improvements in Knitting-Machines; and I do hereby declare the following specification, taken in connection with the accompanying drawings, forming a part of the same, to be a full, clear, and exact description thereof.

The present invention relates more especially to automatic rotary knitting-machines used for knitting stockings, and has for its object the improvement of the various mechanisms used in machines of this class, whereby the number of parts is reduced and the speed of the machine increased.

To this end the invention consists of the improvements hereinafter described, and particularly set forth in the claims.

In the accompanying drawings, which illustrate one embodiment of said improvements, Figure 1 is a plan view with the parts above the knitting-head removed. Fig. 2 is a front elevation of the upper part of the machine with take-up mechanism removed. Fig. 3 is a rear elevation. Fig. 4 is an end view looking toward the left in Fig. 1. Fig. 5 is an end elevation looking toward the right in Fig. 1. Fig. 6 is a detail view, partly in section, showing a portion of the speed-changing mechanism. Figs. 7 and 8 are an elevation and plan view, respectively, of the controller and pattern-chain. Fig. 9 is a vertical longitudinal section of the parts shown in Fig. 7. Fig. 10 is an end view looking toward the left in Fig. 9. Figs. 11 and 12 are details showing a portion of the driving mechanism for shifting the clutch. Fig. 13 is an elevation of the driving mechanism for the controller and pattern-chain. Fig. 14 is a plan view of the parts shown in Fig. 13. Figs. 15 and 16 are detail views showing the ratchet for driving the controller. Fig. 15^a shows a modification of the ratchet. Fig. 17 is a plan view of the clutch and devices for shifting the same. Fig. 18 shows a development of the clutch-shifting cam. Fig. 19 is an elevation of the cam-cylinder with the narrowing and widening cams removed. Fig. 20 is an elevation of the cam-cylinder with the narrowing and widening cams mounted thereon. Fig. 21 is a vertical section of the cam-cylinder, showing the knitting-cams. Fig. 22 is a sectional view taken on line *o o*, Fig. 20. Figs. 23 and 24 are detail views of the narrowing-cams. Fig. 25 is a plan view of the cam-cylinder, showing the widening-cams and the means for controlling the same. Figs. 26 and 27 are details showing the widening-cams in and out of operation. Figs. 28 to 30 and 32 to 34, inclusive, are details of the mechanism for controlling the widening-cams. Fig. 31 is a detail of the pin for connecting the sinker cam-ring and cam-cylinder. Fig. 35 is a development of the inside of the cam-cylinder, showing the throw-in and throw-out cams. Fig. 36 is a development of the inside cam-cylinder, showing the knitting and the narrowing and widening cams. Fig. 37 is a plan view, partly in section, of the knitting-head, showing the device for controlling certain of the cams carried by the cam-cylinder. Fig. 37^a is a detail view of the ratchet and actuating-pawl for operating said device. Fig. 38 is a sectional view taken on the line *z z*, Fig. 37. Fig. 39 is a sectional view showing the set-screw for securing the needle-cylinder to its supporting-ring. Fig. 40 is a sectional view showing the fashioning mechanism. Fig. 41 is an elevation of the mechanism shown in Fig. 40. Fig. 42 is a plan view of the needle-supporting ring. Figs. 43 and 44 are elevations showing the take-up mechanism in two different positions. Figs. 45, 46, and 47 are details of the take-up mechanism.

The machine which has been shown to illustrate an embodiment of the present improvements comprises the elements common to rotary knitting-machines—to wit, a speed-changing mechanism for reducing the speed during reciprocating knitting, a motion-changing mechanism for changing the motion of the cam-cylinder from rotary to reciprocating, and vice versa, a knitting-head comprising a needle-cylinder and cam-cylinder carrying the knitting-cams, narrowing and widening cams, and means for throwing a portion of the needles out of and into operation,

a take-up mechanism, a fashioning mechanism, and a pattern chain or carrier for governing the operation of the machine.

Speed-changing mechanism. (Figs. 3, 4, 6, 7, and 9.)—Mounted in suitable bearings in the frame of the machine is the driving-shaft A, carrying the pulleys A′ A^2 A^3 and the pinion A^4, the pulleys A′ A^2 and the pinion being secured to the shaft and the pulley A^3 being loose on the shaft. The pulley A^3 carries a pinion A^5, secured to its hub and meshing with a smaller pinion A^6, mounted on a stud projecting from the frame. The pinion A^6 is secured to a larger pinion A^7, which meshes with the pinion A^4. The gearing is so proportioned that the pulley A^3 is driven at a slower speed than pulley A^2. A belt A^8 transmits motion from pulleys A^2 A^3 to the pulley A^9, loosely mounted on a shaft A^{10}. The speed is controlled by the cams C^8 by the following mechanism: A sliding bar a^5, supported by the hanger a^6, has one end in the path of cams C^8 and the other end pivoted to the upper end of the belt-shifting lever a^4, pivoted at a^{44}. The other end of the lever a^4 is pivoted to the end of the rod a', which slides in the bearing a^2 and carries at its other end the belt-shifter a. The belt A^8 is normally held on the fast pulley by the spring a^3, secured to the belt-shifter and the frame, and is moved onto the slow pulley against the tension of the spring by the action of cams C^8 on the bar a^5. The pulley A^9 is connected to the shaft A^{10} by means of a friction-clutch member A^{11}, keyed to the shaft in a well-known manner. A hand-lever A^{12}, pivoted to the frame and to the clutch member, serves to throw the clutch member into engagement with pulley A^9. For holding the clutch in engagement a bar A^{13} is pivoted to the rear end of the lever A^{12} and is provided with a hook or shoulder which engages a lug A^{14} on the frame of the machine. This shoulder may be disengaged from the lug by pressing the bar A^{13} or by a lug on the pattern-chain in any well-known manner, and when so disengaged the spring A^{16} draws the clutch member from engagement with pulley A^9 and thus stops the machine.

Motion-changing mechanism. (Figs. 1, 2, 3, 9, and 17.)—Fast to the shaft A^{10} is a pinion A^{17}, which meshes with an intermediate gear A^{18}, secured to shaft A^{26}. The gear A^{18} in turn meshes with and drives a pinion A^{21}, loose on the clutch-shaft A^{25}. Also loose on the clutch-shaft is a pinion A^{22}, which is oscillated by means of a rack A^{19}, connected to a crank-pin on the gear A^{18} by means of an adjustable connecting-rod A^{20}. Keyed on the shaft A^{25}, between the pinions A^{21} and A^{22}, is a sliding clutch member B, provided with spring-pins, one adapted to engage a recess in the hub of pinion A^{22} and the other adapted to engage a recess in the hub of pinion A^{21}, according as the clutch member is shifted in one direction or the other. Secured to the end of shaft A^{10} is a beveled gear A^{23}, which meshes with a beveled gear A^{24}, secured to the cam-cylinder. When the clutch member is in engagement with the pinion A^{21}, the cam-cylinder is given a rotary motion, and when the clutch member is shifted into engagement with the pinion A^{22} the cam-cylinder is given a reciprocating motion.

The shifting of the clutch B to change from rotary to reciprocating knitting, and vice versa, is controlled by the cams C^7 through the following mechanism: Mounted in suitable bearings in the frame of the machine is the shaft B′, which carries the clutch-shifting cam B^3, secured thereto. The cam B^3 is provided with a cam-groove which engages a bowl secured to the rear end of the clutch-shifting lever B^4 and actuates the said lever to shift the clutch in either direction. Loosely mounted on the shaft B′ is a disk c^6, which is oscillated by means hereinafter described. Secured to the shaft B′ adjacent the disk c^6 is a disk B^2, provided with notches B^6 in its face. The disk c^6 carries a sliding pin B^5, provided with beveled ends and arranged in position to be acted on at the proper time by the cams C^7.

The operation is as follows: One of the cams C^7 being in position to be struck by the pin B^5, the latter is forced into one of the notches B^6, thus connecting the oscillating disk c^6 to the disk B^2 and causing the shaft B′ to be turned a step, thus turning the clutch-shifting cam. On the return oscillation of the disk c^6 the beveled end of the pin B^5 rides up the inclined end of the recess B^6, thus forcing the pin back into its normal position, where it remains until again acted on by one of the cams C^7.

Connected to the rear end of the clutch-shifting lever is an arm B^7. When the motion of the cam-cylinder is changed from rotary to reciprocating, the arm B^7 engages the belt-shifting lever a^4 and holds the belt on the slow pulley until the motion is changed back to rotary.

Pattern-chain and controller and driving mechanisms therefor. (Figs. 9 to 16.)—A sleeve C′ is secured to an arm C, extending from the frame by means of a bolt C^2. Loosely mounted on the sleeve C′ is the sprocket-wheel C^3, carrying the pattern-chain C^{15}. The driving mechanism for the sprocket-wheel consists of a ratchet-wheel C^4, secured thereto, and a pawl C^{10}, which works on the ratchet-wheel and advances it continuously, as will be more fully described. Loosely mounted on the sleeve C′ adjacent to the pattern-chain is a disk C^5. In the form shown this disk is also a ratchet-wheel, but the ratchet-wheel might be formed on a separate disk and disk C^5 be attached thereto. The disk C^5 has lugs C^{11} secured to it on the side adjacent the pattern-chain, which are in position to be struck by lugs C^{18} on said chain. The disk C^5 is recessed on its opposite side and a disk C^6, carrying two cams C^7, is adjustably secured in said recess by means of bolts C^{10}. The sleeve C^{12}, carrying the cams C^8 C^9, is also secured to the disk C^5 by means of a hub projecting

from said disk, and the parts carried by said disk C^5 form a controller for controlling either directly or indirectly the operation of certain of the other mechanisms.

The driving mechanisms for the controller may be of any suitable form, and in the form shown it consists of the ratchet-teeth formed on the disk and a pawl c^7 for engaging said teeth, which pawl is operated by mechanism to be described. This driving mechanism is normally inoperative by reason of the fact that the disk C^5 is provided with dwells in which the pawl c^7 works, and said mechanism is periodically thrown into operation by the lugs C^{18}, Figs. 7 and 8, engaging lugs C^{11} and moving the dwell from under the pawl and allowing said pawl to engage the teeth on the disk C^5.

Friction is applied to the ratchet-wheel C^4 by means of spring-pressed shoes C^{13} and to the controller by means of a spring-washer interposed between the hanger a^6 and the end of sleeve C′ and engaging the end of sleeve C^{12}.

The pawls c^{10} and c^7 are actuated by the following mechanism: The gear A^{18} is provided on its face with a cam-groove c, in which runs a bowl on the end of a rock-arm c', secured to a stud mounted in the frame, said arm being provided at its other end with a segmental gear c^2. This segmental gear meshes with a segmental gear c^3, secured to a rock-shaft c^4, which has secured thereto another segmental gear c^5. The gear c^5 meshes with gear-teeth formed on the disk c^6, before referred to, and to which the pawl c^7 for actuating the disk C^5 is pivoted at c^8. Projecting from the pawl c^7 is a stud c^9, carrying the pawl c^{10}, which actuates the disk C^4. By the above-described mechanism the disk c^6 will be constantly oscillated, thus causing pawl c^{10} to constantly feed forward the pattern-chain and the pawl c^7 to actuate the disk C^5 when said disk is turned by the pattern-chain to carry the dwell from under the pawl. A spring-guard c^{11} is fastened to the frame to prevent the pawl c^{10} engaging more than a predetermined number of teeth on the disk C^4. With the arrangement shown, wherein the pawl c^{10} is pivoted to the pawl c^7, should the pattern-chain become clogged for any reason and prevent the movement of the ratchet-wheel C^4 the pawl c^7 will rock on the pivot c^9 and a breakage of any of the parts be prevented. It will thus be seen that by pivoting the pawl c^{10} to the pawl c^7 a yielding member is provided in the driving mechanism for the pattern-chain for preventing breakage of the parts should the pattern-chain become clogged.

In the preferred form of controller shown the disk C^5 carries two duplicate sets of cams, each set comprising the three cams C^7 C^8 C^9, and said disk is provided with two dwells and twelve teeth, there being six teeth between the dwells, and the controller makes three revolutions for each stocking. It will be understood, however, that the present invention is not limited to the exact form of controller shown and described, and that the number and arrangement of cams may be varied, and that the number and arrangement of teeth and dwells on the driving-disk may be varied, or other means used for driving the controller, without departing from the scope of the invention.

In using a short pattern-chain it will sometimes happen that the lugs C^{11}, in being carried around with the disk C^5, would engage one of the lugs C^{18} on the pattern-chain and feed the chain along at the speed of the disk C^5. As the disk C^5 is fed at a greater speed than the ratchet C^4, the proper operation of the machine would be interfered with. To guard against this, I prefer to mount the lugs on the disk C^5 in the manner shown in Fig. 15^a. The lugs P, which correspond to lugs C^{11} in Fig. 15, are pivoted to the disk C^5 at P′ and are held up in position to be engaged by the lugs on the pattern-chain by a cam C^{16}, formed on the flange of the sleeve C′. A pin P^2 serves as a stop to limit the outward movement of the lug P. With the above construction should the lug P engage one of the lugs on the pattern-chain it would yield and pass by without affecting the feed of the chain.

Knitting-head, cam-cylinder, and mechanism carried thereby.—The knitting-head is provided with the usual guard and thread-guide D, pivoted to an arm secured to the cam-cylinder E in the usual manner and with the usual sinker cam-ring F operated from the cam-cylinder, Figs. 2 and 38. The sinkers G are guided in the usual sinker-ring G′, secured to the needle-cylinder H. The needles H′ are guided in grooves in the needle-cylinder and are held in place by spring-bands H^2, some of the needles being formed with longer butts than the others, as is common in this class of machines. The base-plate H^3 is provided with an annular rib H^4, which engages an annular groove H^5 in the gear A^{24}. The cam-cylinder is secured to the gear A^{24} and moves therewith, as is usual. The plates H^6 H^7 are secured to the base-plate and overhang the gear A^{24} to hold it in place, and also to form supports for certain parts hereinafter referred to.

The sinker cam-ring is driven from the cam-cylinder by means of a pin F′, which engages the shoulders F^2 F^3, formed by the ends of a recess in a plate F^4, secured to the sinker cam-ring, Figs. 3 and 31. In placing the sinker cam-ring on the knitting-head it has hitherto been necessary to bring the recess above the pin before the cam-ring could be placed in position. It is preferred, therefore, to make the pin F′ a yielding pin and provide it with a beveled end, so that the cam-ring may be placed on the knitting-head without regard to the recess and the cam-ring then turned axially until the pin enters the recess.

In Fig. 31 is shown the manner of mounting pin F′. In the arm F^{44}, carried by the

cam-cylinder is a recess provided with a shoulder F^5, and a spring F^6 is interposed between said shoulder and a shoulder on pin F'. The small end of pin F' outside the arm F^{44} is provided with a collar F^8, having a lug F^7, which engages a recess in arm F^{44} and prevents the pin F' turning on its axis.

The inner face of the cam-cylinder E is provided with a rib E', which serves as a rest for the butts of the needles when they are in lowered or operative position. The cams for the knitting operation are as follows: Between the ends of the rib E' are the two beveled cam-plates E^3 and the inverted-V-shaped cam-plate E^2. Just above the beveled ends of the plate E^2 are the fixed cams E^4 E^5, which are provided with depressions E^6 E^7 for the narrowing-cams, as will be more fully explained. Two pivoted switch-cams E^8 E^9 are disposed at the ends of plates E^4 E^5 and rest on the beveled ends of plates E^3. Disposed above the cams E^4 E^5 are the fixed plates or guard-cams E^{10} E^{11}, and pivoted between the adjacent ends of cams E^4 E^5 is the pivoted automatic switch-cam E^{12}. Above the cam E^{12} is a fixed plate or guard-cam E^{13}.

The position of the cams above described during the forward motion of the cam-cylinder either in rotary or reciprocating knitting is that shown in Figs. 21 and 36, and the course of the needle-butts is as indicated by dotted lines *y y*, Fig. 36. During the reverse motion of the cam-cylinder in reciprocating knitting the course of the needle-butts is above the cams E^8 E^4 and under the cams E^5 E^9.

Mechanism for throwing out of and into operation the needles not used on the heel and toe.—Secured to the outer face of the cam-cylinder and on the opposite side of the cylinder from the knitting-cams are two spring-arms *d* and *e*, carrying at their free ends the cams *d'* and *e'*, respectively, which cams play through openings in the cam-cylinder. These cams are normally held by the spring-arms, so that their inner faces are substantially flush with the inner face of the cam-cylinder, but are adapted to be projected into position to engage the butts of the needles. The cam *d'* is projected in only far enough to engage the long butts, while the cam *e'* is preferably projected into position to engage both long and short butts. The cam *d'* consists of an inclined plate, its lower end extending below the upper edge of the rib E' and its upper end terminating in the plane of the upper edge of the plates E^{10} and E^{11}, Figs. 35 and 36. When the cam is projected into operative position, the needle-butts ride along the rib E', and the long butts, engaging the inclined edge of the plate *d'*, pass up this incline into the path *x x*, Fig. 35, and out of position to be operated on by the knitting-cams, while the short butts continue along the rib E'. The cam *e'* is an inclined plate similar to plate *d'*, but inclined in the opposite direction, and its upper end extends above the upper position of the needle-butts and its lower end terminates just above the lower position of the needle-butts. When this cam *e'* is in operative position, it engages all the needle-butts, whether long or short, which may be in the upper or non-knitting position and carries them down into the lower or knitting position. The action of the cams *d'* and *e'* is controlled through mechanism which will be described hereinafter.

Narrowing mechanism.—Pivoted at f^4 on the outside of the cam-cylinder and in a plate f^7, attached thereto, is a triangular plate *f*, by which the narrowing-cams *f' f²* are carried, Figs. 22, 23, and 24. The cam *f'* in the form shown consists of a pin provided with a notched end. This pin is mounted to slide in a bearing f^3 in the plate *f*, and is provided with a pin f^5, extending through a slot in the bearing f^3 and acted on by a cam-groove f^6, formed in the plate f^7. A spring f^8 is attached to the plate f^7 and a pin on the plate *f* and tends to hold the plate *f* at either end of its throw. The cam f^2 is the same in construction and operation as cam *f'*. These cams project through a curved slot f^9 in the cam-cylinder and are normally held in the position shown in Fig. 36 by the spring f^8, with the cam f^2 resting in the recess E^6 and the cam *f'* below the upper path of the needle-butts and drawn back of the plate E^{13}. While I prefer to use a spring f^8 to hold the cams *f'* and f^2 in the recesses E^7 E^6, respectively, this spring may be omitted and the inertia of the parts alone relied on to keep the cams in position.

In rotary knitting the cams *f' f²* are in the position indicated in Fig. 36, out of the path of the needle-butts. When the cam-cylinder is reversed, however, in changing from rotary to reciprocating knitting, and after the needles with the long butts have been thrown out of action, the short needle-butts pass over the switch-cam E^8 between the plates E^{10} and E^4, and the butt of the first needle engages the notch in the narrowing-cam f^2, causing the cam-carrier *f* to swing on its pivot and carry the cam f^2 up into the position before occupied by cam *f'*. By this movement the cam *f'* is carried down into the recess E^7, that is, into position to be engaged by the butt of the first needle on the movement of the cam-cylinder in the opposite direction, when the parts will be returned to their former position. As each of the cams passes from its lowest to its highest position the cam-groove f^6 acts on the pin f^5 to draw the cam back of the plate E^{13}, and the needle-butt, which is carried up with the cam, is delivered onto and passes up over said plate and over either the plate E^{10} or E^{11}. Thus it will be seen that a needle is thrown out of operation at each reciprocation of the cam-cylinder so long as the reciprocating motion continues, and that when the cam-cylinder changes from reciprocating to rotary motion the cam f^2 is left in position to begin the narrowing operation

immediately the motion is again changed to reciprocating.

It will be seen that no mechanism is required for throwing the narrowing-cams into or out of operation, but that as each one of the cams is moved to throw a needle out of operation the fellow cam is, by reason of the connection between the two, thrown into position to engage the butt of the first needle at the next reciprocation of the cam-cylinder, and that thus the action of said cams is entirely automatic.

While the preferred construction of the narrowing mechanism is that shown and described, in which the connection between the cams is a rigid connection, and is in the form of a pivoted plate, and in which the cams have a longitudinal movement and transfer the butts to a stationary plate, which completes their upward movement, it will be understood that this construction is not essential, and that the stationary plate may be omitted and the cams have no longitudinal movement, and that the connection between the cams may be of any construction which will cause the movement of one cam to throw the other cam into operative position.

The widening mechanism.—Pivoted to the side of the cam-cylinder or to plate f^7 are two arms or cam-carriers g, and as these arms and the devices carried thereby are duplicates a description of one only will be given. The arm g is provided with a groove or guideway g^3 in its inner face, in which a slide g^4, carrying the cam g', is held by means of a screw g^5, which passes through a slot also formed in the arm g. A second screw passes through a slot in the under face of the arm g and is engaged by a spring g^6, attached to the arm g at g^7. This spring tends to hold the slide g^4 toward the free end of the arm g and the screw g^5 engages the end of its slot and forms a stop to limit the outward movement of the slide. A spring g^8 has one end attached to the arm g and the other to the plate f^7 and tends to hold the arm g against the stop g^9, formed on the plate f^7. A pin g^{10} extends from the arm g in position to be engaged by a shoulder or hook g^{12} on the end of a strap or slide g^{11}, guided in a groove in the cam-cylinder. With the strap g^{11} moved into the position shown in Fig. 26 the shoulder g^{12} engages the pin g^{10} and holds the arm g down away from the stop g^9 and the cam g' is in inoperative position. When, however, the strap g^{11} is moved into the position shown in Fig. 27, the shoulder g^{12} is moved away from the pin g^{10} and the spring g^8 draws the arm g up against the stop g^9 and throws the cam g' into operative position. The straps g^{11} are moved in the proper manner and at the proper time by mechanism which will be hereinafter described. The widening-cams in the form shown consist of lugs or projections g' g^2, extending from the slides g^4 through openings formed in the cam-cylinder, and are provided with overhanging projections g^{13}, Fig. 36. These projections g^{13} are of sufficient length to engage and draw down two needle-butts at each reciprocation of the cam-cylinder.

The operation of the widening-cams, when the slides g^{11} have been moved to throw the cams g' g^2 into position to be struck by the needle-butts, is as follows: On the forward motion of the cam-cylinder the last needle thrown up in the preceding stroke together with the one adjacent thereto pass under the projecting portion g^{13} of the cam g' and engage the vertical portion or shoulder g^{14}, forcing the cam to slide down the groove in the arm g, the needle-butts being carried down with the cam by reason of the projection g^{13}. The cam g' passes back of the cam-plate E^{11} and delivers the butts under said plate. The inclined end of the cam E^{11} forms a stationary cam to complete the carrying of the needle-butts into knitting position. As the needle-butts pass from the cam g' the spring g^6 returns the cam to its normal position at the free end of arm g. On the reverse movement of the cam-cylinder the cam g^2 acts in the same manner to draw down two needles. It will thus be seen that during the time the widening-cams are in operation two needles are drawn down and one needle thrown up at each reciprocation of the cam-cylinder, thus increasing the number of needles in operation by one at each reciprocation.

While the preferred construction of widening mechanism is that shown and described, in which the cams pass back of and transfer the needle-butts to stationary cams, which complete the depression of the butts, it will be understood that such construction is not essential, but that so far as the stationary plates act as cams for drawing down the needle-butts they might be omitted and the sliding cams alone be used for this purpose. Nor is it essential that the guideway in which the cams slide should be formed in a movable carrier, as other means could be readily devised for holding the sliding cams in inoperative position.

The mechanism which controls the operation of the various cams for operating on the needle-butts will now be described, Figs. 1, 37, and 38. Pivoted to the frame of the machine at i is a lever i', provided at the rear end with a pin i^2, which is engaged at the proper time by the cams C^9, and with its forward end engaging a pin i^3 on a segmental slide i^4. The slide i^4 is operated in one direction by the cam C^9 through the above connections and is returned to its normal position when released by the cam C^9 by a spring i^5, one end of which is secured to the plate H^6 and the other end to the slide i^4, Fig. 5. Pivoted to the plate H^7 is a plate i^6, pressed toward the cam-cylinder by the spring i^7 and normally held away by a pin i^8 on the slide i^4, as clearly shown in Fig. 1. The plate i^6 carries at its free end a pivoted arm i^9, which is provided with a hook or shoulder i^{10}, and carries an abutment in the form of a roll i^{11}.

Secured to the plate H⁷ is an arm provided with a hook or shoulder i^{12}, with which the hook i^{10} engages. When the slide i^4 is moved into the position shown in Fig. 37 by the cam C⁹, the pin i^8 rides down an incline i^{13} (see Fig. 1) on the plate i^6, allowing the spring i^7 to swing the plate i^6 and the arm i^9 in toward the cam-cylinder. This movement brings the roll i^{11} into the path of an arm d^4, pivoted to and carried by the cam-cylinder. When the arm d^4 strikes the roll i^{11} in the forward movement of the cam-cylinder, it forces the shoulder i^{10} into engagement with the shoulder i^{12}, and thus locks the parts in their inward position, as shown in Fig. 37, and the arm d^4 is swung on its pivot. On the reverse movement of the cam-cylinder the arm d^4 strikes the roll i^{11} from the other side and throws the shoulders i^{10} i^{12} out of engagement, and the arm i^6 yields and allows the arm to pass the roll i^{11} without moving said arm d^4.

The arm d^4 is pivoted on a stud d^3, secured to the cam-cylinder, and carries a spring-pressed pawl d^5, which engages a ratchet d^6, also loose on the stud d^3. A spring d^7 serves to hold the arm d^4 in its normal position. Secured to the ratchet so as to turn therewith is the cam d^2 for projecting the throw-out cam d' into operative position, the cam e^2 for projecting the throw-in cam e' into operative position, and the two eccentric or cam disks h for operating the slides g^{11} to control the widening-cams, Figs. 28 to 30, 33, 34, and 38. As shown in the drawings, the cams d^2 and e^2 are secured to the ratchet d^6 by being made integral therewith. The disks h may be secured to the top of cam e^2 by means of pins or screws in any well-known manner. The disks h are provided with segmental ribs h', which work in openings in the straps h^2, secured to the ends of slides g^{11}. The lower disk h rests on the top of cam e^2 and serves to support the lower strap h^2, as shown in Fig. 28. The upper disk rests on the rib h' of the lower disk and serves to keep the lower strap h^2 in place and also to support the upper strap h^2, as shown in Figs. 29 and 30. A washer h^{10} is held against the top of the rib h' of the upper disk by a nut h^{12} and serves to keep the upper strap in place. (See Figs. 3, 25, and 38.) With the parts in their normal position the ribs h' engage the points h^3 of the straps and hold the slides g^{11} with their free ends in the position shown in Figs. 25 and 26, thus holding the widening-cams out of operation. When the disks are turned a half-revolution, the ribs engage the points h^4 on the straps and move the free ends of the slides g^{11} toward each other or into the position shown in Fig. 27, thus allowing the widening-cams to be moved into operative position by the springs g^8.

The operation of the parts is as follows: The first movement of the slide i^4 by the cam C⁹ allows the roll i^{11} to be moved into the path of the arm d^4, thus swinging said arm on its pivot and causing the pawl d^5 to advance the ratchet and cams carried thereby one step. This movement causes the cam d^2 to project the throw-out cam d' into position to engage the long butts and throw out the needles not used on the heel or toe. The cam C⁹ then releases the slide i^4, which is returned to its normal position by the spring i^5, the pin i^8 riding up the incline on the plate i^6 and moving the roll i^{11} out of the path of arm d^4. The parts remain in this position until the narrowing is completed, when the slide i^4 is again moved by the cam C⁹ and the ratchet d^6 advanced another tooth. This movement throws cam d^2 out of engagement with cam d' and allows the spring-arm d to return the cam to its normal position and also moves ribs h' into engagement with points h^4 and allows the widening-cams to come into operation, as above explained. The third movement of the ratchet, which occurs at the end of the widening operation and about the time the machine is changing from reciprocating to rotary knitting, causes the cam e^2 to project the throw-down cam e' into position to throw down the needles not used on the heel and toe, and also to engage and throw down any of the needles which may not have been drawn down by the widening-cams. The fourth movement of the ratchet, which takes place immediately after the third movement, by reason of the fact that the machine has changed to rotary knitting and the roller i^{11} is thus engaged by the arm d^4 twice before the slide i^4 is released, releases the cam e', moves the ribs h' into engagement with the points h^3, thus throwing the widening-cams out of operative position, and moves the cam d^2 into position to operate on cam d' at the next movement of the ratchet d^6.

The fashioning mechanism.—In knitting certain kinds of stockings it is desirable to use a long stitch at the top of the leg and to gradually reduce the length of stitch over the calf. In the present machine this change in the length of the stitch is effected by raising and lowering the needle-cylinder. Long stitches are also used at the heel and toe.

The mechanism for raising and lowering the needle-cylinder for fashioning the stocking at the calf and for raising said cylinder at the heel and toe will now be described.

The needle-cylinder is clamped to the ring I by means of a set-screw j', carried by a boss j, secured to the ring I. A pin j^2 is interposed between the end of the set-screw j' and the needle-cylinder to prevent the raising of the cylinder in turning the set-screw, Figs. 39, 40, and 41. The ring I is provided with a laterally-extending boss I′, which is secured by means of a set-screw to a rod I², sliding in suitable bearings and supported at its lower end by an adjustable screw I¹⁰. The boss I′ is supported from the cam I³, mounted on a stud I⁴, which carries at its other end a ratchet-wheel I⁵. The stud I⁴ is mounted in a sleeve I⁶, and a spring I⁷ is interposed between the ratchet-wheel I⁵ and a shoulder on said sleeve to form a drag or friction-brake

and prevent the rotation of the ratchet except when engaged by its pawl. This ratchet is operated at intervals by the following mechanism, Figs. 1, 2, 5, and 41: Secured to the end of the oscillating rock-shaft c^4 is an arm I^8, carrying a pivoted pawl I^9, which is supported by an arm I^{10}, loosely pivoted to the end of shaft c^4. The arm I^{10} is connected to an arm I^{11} on the end of a rock-shaft I^{12} by means of the link consisting of the part I^{14} and the rod I^{13}. The rod I^{13} passes through two projections I^{15} I^{16} on the part I^{14} and is provided between these projections with a coiled spring which bears against the projection I^{16} and a collar secured to the rod and holds the parts in the position shown in Fig. 5. The rock-shaft I^{12} extends across the back of the machine and is provided with a rock-arm I^{17}, which overhangs the pattern-chain and is in the path of pins I^{18} thereon. When a pin I^{18} strikes the arm I^{17}, it lifts the arm and, through the shaft I^{12}, rock-arms I^{11} I^{10}, and their connecting-link, raises the pawl I^9 into yielding engagement with the ratchet I^5 and holds it there long enough for the ratchet to be advanced one tooth. The cam I^3 is thus turned and the ring I and needle-cylinder H gradually lowered to shorten the stitches over the calf of the stocking. As shown, the cam I^3 has two swells and is turned a half-revolution for each stocking-leg, remaining stationary during the knitting of the remainder of the stocking. It is obvious that a cam with any number of swells could be used and would make a corresponding part of a revolution for each stocking.

In separating contiguous stockings knit on a machine of the class described it is necessary to leave a number of courses of rotary knitting beyond the toe to prevent raveling the toe during the handling of the stocking. To insure the separating of contiguous stockings in the proper place and without unnecessary loss of time or material, means are employed in the present machine whereby the knitting mechanism is controlled to knit a row or rows of characteristic stitches between contiguous stockings to form a guide in severing the stockings. The means which is preferably used for this purpose consists of a projection on the fashioning-cam, which raises the needle-cylinder to an unusual height for several courses after the completion of each stocking, thus inserting several courses of unusually long stitches between successive stockings.

A projection I^{24} is provided at each swell of the cam I^3, and the pin I^{18}, which holds the pawl I^9 in engagement with the ratchet I^5 after the completion of each stocking, is broad enough to keep the pawl in engagement while the ratchet is advanced two teeth, that is, long enough for the projection I^{24} to raise the needle-cylinder for an instant and then lower it again slightly. So far as the mechanism above described is concerned, the boss I′ might rest directly on the cam I^3. In the construction shown, however, the boss I′ rests on the end of a lever J, which carries a bowl J′, resting on the cam I^3. This lever J is made use of to lift the needle-cylinder during the knitting of the heel and toe in the following manner: The lever J is pivoted at J^2 to the frame and is provided at its rear end with an adjustable bowl J^3, which is in position to be operated on by the cam J^4, fast to the shaft B′, which carries the clutch-shifting cam. The cam J^4 is provided with two flat or depressed portions, and when the clutch-shifting cam is in the position for rotary knitting one of these depressed portions stands opposite the bowl J^3, and the needle-cylinder is supported from the cam I^3 or the screw I^{19}, as the case may be. When, however, the clutch-shifting cam is turned into the position for reciprocating knitting, one of the raised portions of the cam J^4 engages the bowl J^3 and causes the lever J to raise the needle-cylinder. The cam holds the cylinder raised until the clutch-cam is again shifted for rotary knitting, when the other depressed portion of the cam comes opposite the bowl J^3 and the cylinder is lowered again. A ratchet J^5 is secured to the shaft B′ and is engaged by a stop-pawl J^6, pivoted on the shaft c^4. The pawl J^6 is held in engagement with the ratchet J^5 by a spring J^7 and prevents any backward movement of the shaft B′.

Take-up mechanism.—During reciprocating knitting it is desirable that a take-up device be used to take up the slack thread as the cam-cylinder changes its direction of rotation. The take-ups heretofore used exert a constant tension on the threads during the knitting of the heel and toe, which results in a less elastic stitch in these parts of the stocking than in the parts where rotary knitting is used. To overcome this difficulty, an improved take-up mechanism, in which the take-up is out of action during the knitting operation and is in action only while the cam-cylinder is reversing and no knitting is taking place, is used in the present machine. This improved take-up mechanism may be applied to any of the knitting-machines now in use. This take-up mechanism and the manner of applying it to the machine shown in the drawings will now be described, Figs. 3, 4, and 43 to 47.

A vertical rod K is secured in a standard K^4 and carries the support K′ for the thread-bobbins K^2 K^3. Secured to the rod K above the support K′ and extending over the knitting-head is an arm K^5 for supporting an extra-thread mechanism. (Not shown.) A rock-shaft L is mounted in suitable bearings in the arm K^5 and the standard K^4, and has secured to it near its lower end a rock-arm L^2, carrying a pin L^3, Figs. 1, 3, and 5. A bar L^4, arranged across the back of the machine and guided at one end in a bearing L^6 and pivoted at the other end to a pivoted arm L^5, is secured to the clutch-shifting lever B^4. The bar L^4 is provided with a slot L^7, which en-

gages pin L^3 and serves to rock the shaft L when the clutch-lever is moved to shift the clutch.

Secured to the upper end of the rod K is a bracket n, provided with four arms, in each of which is an opening forming a thread-guide. Depending from the lower side of the bracket n is a stud n^2, (shown in dotted lines in Fig. 45,) to which is pivoted a bell-crank m^4. The bell-crank is rocked at the proper time by means of a cam m acting on a pivoted lever m', which is connected to one arm of the bell-crank by the link m^2. The cam m may be mounted on any suitably-driven shaft, and, as shown, is mounted on shaft A^{26}. The other arm of the lever m^4 is provided with a slot which engages a pin or projection n^3 on a collar or sleeve n^4, loosely mounted on the rock-shaft L. The sleeve n^4 has a pin or projection n^5, which engages a pin or projection m^6 on the hub of arm n^6. The arm n^6, which forms the take-up, is provided at its free end with a loop or guide n^{10}, through which the main thread passes, and also a guide n^{11} for the extra thread. The arm may be formed with other guides, if desired. The arm n^6 is pivoted on a stud n^8, projecting from the bracket n, and is acted on by a torsional spring n^7, secured to the hub of the arm and to a collar n^9, fast to the stud n^8, which spring tends to hold the arm in the position shown in Fig. 43. The sleeve n^4 has a portion of its lower periphery cut away to form a recess n^{12}, the end of which forms a projection or abutment which is engaged at the proper time by a pin n^{13}, secured to the upper end of the collar n^{14}, fast on the shaft L. Near the outer end of the arm n' is a V-shaped recess over which the main thread passes. Coacting with this recess is a clamp formed by a pin or projection n^{16} on a lever n^{17}, pivoted at n^{18} to the arm n', and provided at its rear end with a projection or pin n^{19}. The main thread passes through guides n^{21} n^{22}, under pin n^{16} and guide n^{20}, through the loop n^{10} and guide n^{23}, to the knitting-head or to the extra-thread mechanism when one is used. The extra thread, when one is used, passes up through the guide n^{24} and through guide n^{11} to the extra-thread mechanism.

The operation during the reciprocating knitting is as follows: During the knitting operation the high portion of the cam m is passing under the lever m', and bell-crank m^4 holds sleeve n^4 with its pin n^5 bearing against pin m^6 and holding the arm n^6 in the position shown in Fig. 44. With the take-up in this position it engages pin n^{19} and holds the clamp-pin n^{16} away from the thread, and there is no tension on the thread, but it is free to be drawn from the bobbin, as in rotary knitting. As the cam-cylinder reverses, the point of one of the cams m passes from under the arm m', allowing said arm to fall to the low part of said cam, thus rocking the sleeve n^4 to suddenly move the pin n^5 away from pin m^6. The spring n^7 now operates the take-up n^6 to take up the slack thread given up by the movement of the thread-guide toward the active needles, the clamp-lever n^{17} being released on the first upward movement of arm n^6 and the pin n^{16} clamping the thread and preventing the drawing off of any thread from the bobbin. At or about the time the thread-guide arrives opposite the first active needle the inclined part of the other cam m engages and raises the arm m' and through the connections described forces the take-up down to give up the slack taken up thereby as said guide moves toward said active needle. At or about the time the needles are operated to begin the knitting operation the arm m' arrives on the high part of cam m and the take-up is in its lowest position and out of operation, and is held out of operation until the arm m' is again released by the cam m, which action takes place at or about the time the cam-cylinder reverses at the other end of the stroke. The shaft A^{26} makes one revolution for every complete reciprocation (two strokes) of the cam-cylinder. Hence two cams m are necessary, but it is obvious that the cam m could be mounted on a shaft which would make two revolutions for each reciprocation of the cam-cylinder, in which case only a single cam would be used.

It is obvious that cam m may be made of such a shape that the high part of said cam will not engage arm m' until after the take-up has been drawn down by the tension on the yarn or until after a portion of the active needles have operated, in which case said cam operates to relieve the tension on the yarn during the remainder of the stroke of the cam-cylinder. It is preferred to so construct said cam that it will positively operate the take-up when the point of the heel or toe is being formed, and will merely serve to relieve the tension during the latter portion of each stroke of the cam-cylinder at other portions of the heel or toe.

When the motion of the cam-cylinder is changed from reciprocating to rotary, the shaft L is rocked in the manner hereinbefore described, and the pin n^{13} engages the end of cut-away portion n^{12}, turning sleeve n^4 into position to hold the parts, as shown in Fig. 44. When the motion of the cam-cylinder is again changed to reciprocating, the shaft L is returned to the position shown in Figs. 43 and 45 and the take-up mechanism thrown into operation again.

It will thus be seen that the take-up is held out of operation during the knitting operation, whether rotary or reciprocating, and the thread is drawn from the bobbin under the same tension in all parts of the stocking.

General operation of the machine in knitting fashioned stockings.—Considering the parts to be in position to begin the knitting of a stocking, the pawl c^7 will be working in one of the dwells on the disk C^5, the pawl C^{10} constantly feeding the pattern-chain forward, the belt A^8 on the fast pulley, the clutch mem-

ber B in engagement with the pinion A^{21}, the take-up mechanism, widening-cams, and throw-out and throw-in cams out of operation, and the fashioning mechanism in the position shown in Figs. 40 and 41. The cam I^3 is gradually turned, as above described, until the needle-cylinder is supported from the lowest portion of said cam or by the set-screw I^{19}, as the case may be, and the parts remain in this position until the heel is reached. One of the lugs on the pattern-chain then engages one of the lugs C^{11}, moving the disk C^5 until the pawl c^7 engages the first tooth beyond the dwell, and moves the controller a step forward. This movement of the controller causes one of the cams C^8 to engage bar a^5 and shift the belt A^8 onto the slow pulley and reduce the speed of the machine. The engagement of the pawl with the second tooth beyond the dwell causes one of the cams C^9 to shift the slide i^4 and throw out the needles with the long butts, in the manner above described. This movement of the controller also brings one of the cams C^7 into position to be engaged by the pin B^5 and thus shift the clutch into engagement with the pinion A^{22} and change the motion of the cam-cylinder from rotary to reciprocating, the bowl on the clutch-lever moving from 1 to 2, in Fig. 18. The parts are so timed that the throwing out of the needles is completed before the shifting of the clutch is completed. It will also be noted that the speed is changed several courses before the clutch is shifted. The shifting of the clutch throws into operation the take-up mechanism, and also brings the holding-arm B^7 into engagement with the belt-shifting lever a^4 to hold the belt on the slow pulley. The movement of the shaft B′ also causes the needle-cylinder to be raised, as above described. The third movement of the controller carries the cam C^9 out of engagement with pin i^3 and allows the slide i^4 to return to its normal position. The fourth, fifth, and sixth movements are merely for the purpose of bringing the second dwell under the pawl c^7. The parts remain in this position until the second lug C^{11} is struck by a lug on the pattern-chain, when the controller is again fed forward. The seventh movement of the controller has no effect on the other mechanisms. During the time the controller is stationary, and during this seventh movement, the narrowing operation takes place. The eighth movement of the controller causes the second cam C^9 to engage pin i^3 and again move the slide i^4 to throw into operation the widening-cams, as above described. This movement also causes the second cam C^7 to act on pin B^5 and cause the shaft B′ to be turned, but as the bowl on the clutch-lever moves in a dwell in the cam B^3, or from 2 to 3 in Fig. 18 at this time, the clutch is not shifted. The ninth movement of the controller serves to release the slide i^4, and the tenth, eleventh, and twelfth movements simply serve to bring the first dwell again under the pawl c^7. The controller then remains stationary until a third lug on the pattern-chain engages lug C^{11}, when the controller is again fed forward. The thirteenth movement effects no change. The fourteenth movement causes the slide i^4 to be moved to throw all the needles down or into operative position and to throw the widening-cams out of operation, as above described, and also causes the shaft B′ to be moved a step forward to shift the clutch, the bowl on the clutch-lever moving from 3 to 4, Fig. 18. This movement of the shaft B′ lowers the needle-cylinder and also throws the take-up mechanism out of operation. The movement of the clutch-shifting lever also moves the holding-arm B^7 out of engagement with the lever a^4. One of the cams, C^8, however, is now in position to engage slide a^5 and hold the belt on the slow pulley. The fifteenth movement of the controller releases the slide i^4 and the slide a^5, and the parts are in position for rotary knitting. The sixteenth, seventeenth, and eighteenth movements of the controller merely serve to bring a dwell under pawl c^7. It will be noted that the change from slow to fast speed is not effected until several courses after the change from reciprocating to rotary knitting. The parts remain in this position until the toe is reached, when the same cycle of operations again takes place, the bowl on the clutch-shifting lever moving from 4 to 5, from 5 to 6, and from 6 to 1 in Fig. 18 as the shaft B′ is fed forward. After the toe has been completed and the machine has knit several courses of rotary knitting the cam I^3 is advanced two steps, as hereinbefore described, to raise the needle-cylinder to an unusual height for an instant and then lower it slightly for the formation of the characteristic stitches referred to. The parts are then in position to begin another stocking.

I do not claim herein the combination of widening and narrowing cams shown and described, since said combination is the subject of a divisional application, Serial No. 586,149, filed April 4, 1896. Neither do I claim herein the specific throw-in and throw-out cams shown and described and automatic means for operating said cams, since said combinations form the subject-matter of a divisional application, Serial No. 586,151, filed April 4, 1896.

What I claim as my invention, and desire to secure by Letters Patent, is--

1. In a knitting-machine, the combination with a motion-changing mechanism, and a speed-changing mechanism, of means operated from the motion-changing mechanism for locking the speed-changing mechanism, substantially as described.

2. In a knitting-machine, the combination with a motion-changing mechanism, and a speed-changing mechanism, of a controller for controlling the speed-changing mechanism, and means operated by the motion-changing mechanism for locking the speed-changing mechanism, substantially as described.

3. In a knitting-machine, the combination

with a motion-changing mechanism comprising a clutch-shifting lever, and a speed-changing mechanism comprising a belt-shifting lever, of an arm secured to the clutch-shifting lever and arranged to engage the belt-shifting lever, substantially as described.

4. In a knitting-machine, the combination with a motion-changing mechanism comprising a shifting-clutch member, of an independent speed-changing mechanism, a controller comprising a plurality of cams rigidly supported to revolve about their axis for controlling the shifting of said clutch and said speed-changing mechanism, a driving mechanism for said controller, and means for periodically throwing said driving mechanism into operation, substantially as described.

5. In a knitting-machine, the combination with a motion-changing mechanism, comprising a shifting-clutch member, an independent speed-changing mechanism, and mechanism for controlling the instep-needles of a controller comprising a plurality of cams rigidly supported to revolve about their axis for controlling said mechanisms, a driving mechanism for said controller, and means for periodically throwing said driving mechanism into operation, substantially as described.

6. In a knitting-machine the combination with a motion-changing mechanism comprising a shifting-clutch member, an independent speed-changing mechanism, a cam-cylinder carrying a needle-engaging cam, a controller comprising a plurality of cams rigidly supported to revolve about their axis, a driver for said controller and means for periodically throwing said driver into operation, substantially as described.

7. In a knitting-machine the combination with a cam-shaft a disk secured to revolve with the same and provided with notches, a reciprocating member carrying a sliding pin, and means for periodically projecting said pin into said notches, substantially as described.

8. In a knitting-machine, the combination with a fashioning mechanism comprising a cam for raising and lowering the needle-cylinder, of a driving mechanism for the cam comprising an intermittently-operating clutch, a controller for said driving mechanism, driving mechanism for said controller, and means for periodically throwing said controller-driving mechanism into operation, substantially as described.

9. In a knitting machine, the combination with a motion-changing mechanism comprising a clutch-shifting cam, a disk secured to revolve with the cam and provided with notches, and a reciprocating member carrying a sliding pin, of means for periodically projecting the pin into said notches, substantially as described.

10. In a knitting-machine, the combination with a clutch of a lever for shifting the clutch, a cam secured to a shaft, a disk provided with notches on its face also secured to the shaft, an oscillating disk loosely mounted on the shaft adjacent said notched disk, a sliding pin carried by said oscillating disk, and a cam for projecting the pin into said notches, substantially as described.

11. In a knitting-machine, the combination with a pattern-carrier provided with lugs, of a controller, yielding lugs mounted on said controller adjacent to said pattern-carrier, and means for preventing the yielding of said lugs when engaged by the lugs on said carrier, substantially as described.

12. In a knitting-machine, the combination with a pattern-carrier provided with lugs, of a controller adjacent said pattern-carrier, lugs pivoted to said controller, stops for said lugs, and a cam for holding said pivoted lugs in the path of the lugs on said pattern-carrier, substantially as described.

13. In a knitting-machine the combination with a motion-changing mechanism, an independent speed-changing mechanism, a cam-cylinder carrying a plurality of needle-engaging cams, a controller comprising a plurality of duplicate sets of cams rigidly supported to revolve about their axis, for controlling said mechanism and said needle-engaging cams, substantially as described.

14. In a knitting-machine, the combination with a motion-changing mechanism comprising a shifting-clutch member and an independent speed-changing mechanism, of a controller for said mechanisms comprising a plurality of duplicate sets of cams rigidly supported to revolve about their axis, substantially as described.

15. In a knitting-machine, the combination with a speed-changing mechanism, and a motion-changing mechanism comprising a shifting-clutch member, of a controller comprising a ratchet-disk provided with dwells and a plurality of duplicate sets of cams carried by said ratchet-disk, substantially as described.

16. In a knitting-machine, the combination with a cam-cylinder carrying a throw-out cam, a throw-in cam and widening-cams, of a device for controlling the operation of said cams, substantially as described.

17. In a knitting-machine, the combination with a cam-cylinder carrying a throw-out cam, a throw-in cam and widening-cams, of a device for controlling the operation of said cams also carried by the cam-cylinder, substantially as described.

18. In a knitting-machine, the combination with a cam-cylinder carrying needle-engaging cams, of a stud carried by the cam-cylinder, a series of cams mounted on said stud for controlling the operation of said former cams; and means for operating said latter cams, substantially as described.

19. In a knitting-machine, the combination with the cam-cylinder carrying a normally-inoperative needle-engaging cam, and a stud carried by said cylinder, of a cam on said stud for controlling the operation of said

needle-engaging cam, a ratchet attached to said cam, an arm pivoted to the cam-cylinder and carrying a pawl engaging said ratchet, and an abutment movable into and out of the path of said arm, substantially as described.

20. In a knitting-machine, the combination with the cam-cylinder carrying a normally-inoperative needle-engaging cam, and a stud carried by said cylinder, of a cam on said stud for controlling the operation of said needle-engaging cam, a ratchet attached to said cam, an arm pivoted to the cam-cylinder and carrying a pawl engaging said ratchet, an abutment movable into and out of the path of said arm, a slide for moving the abutment, and a cam for moving the slide, substantially as described.

21. In a knitting-machine the combination with a cam-cylinder, of a cam-carrier pivoted to said cam-cylinder, a needle-engaging cam carried by said carrier, and means for moving said cam radially of said cam-cylinder, substantially as described.

22. In a knitting-machine the combination with a cam-cylinder, of a cam-carrier pivoted to said cam-cylinder, needle-engaging cams carried by said carrier, and means for moving said cams radially of said cam-cylinder, substantially as described.

23. In a knitting-machine, the combination with a cam-cylinder, of a cam-carrier pivoted to said cam-cylinder, needle-engaging cams carried by said cam-carrier, and a spring for holding the cam-carrier at either limit of its throw and means for moving said cams radially of said cam-cylinder, substantially as described.

24. In a knitting-machine, the combination with a cam-cylinder, of a stationary cam and a needle-engaging cam carried thereby, and means for moving said needle-engaging cam radially of said cam-cylinder whereby said needle-engaging cam passes back of the stationary cam, and the needle-butts are transferred from said needle-engaging to the stationary cam, substantially as described.

25. In a knitting-machine, the combination with a cam-cylinder, of a cam-carrier pivoted thereto, needle-engaging cams mounted to slide in said cam-carrier, and a stationary cam carried by the cam-cylinder, and to which the needle-butts are transferred, substantially as described.

26. In a knitting-machine, the combination with a cam-cylinder, of a cam-carrier pivoted thereto, needle-engaging cams consisting of notched pins mounted to slide in said cam-carrier, a stationary cam carried by the cam-cylinder to which the needle-butts are transferred, and a stationary cam for acting on said notched pins, substantially as described.

27. In a knitting-machine, the combination with a cam-cylinder, of a guide carried thereby, a needle-engaging cam arranged to slide in said guide and means for automatically throwing said cam into operation, substantially as described.

28. In a knitting-machine, the combination with a cam-cylinder, of a movable guide carried thereby, a needle-engaging cam arranged to slide in said guide, and means for moving said guide to hold the said cam out of operative position, substantially as described.

29. In a knitting-machine, the combination with a cam-cylinder, of a cam-guide pivoted thereto, a needle-engaging cam arranged to slide in said guide, a spring for holding said guide in its raised position, and means for moving said guide against the tension of said spring to carry said needle-engaging cam out of operative position, substantially as described.

30. In a knitting-machine, the combination with a cam-cylinder, of a cam-guide pivoted thereto, a needle-engaging cam arranged to slide in said guide, a projection on said guide, a slide carried by said cam-cylinder and engaging said projection, and a cam for operating said slide, substantially as described.

31. In a knitting-machine, the combination with a knitting mechanism of a take-up independent thereof and means operative during reciprocating knitting for intermittently holding said take-up out of operation, substantially as described.

32. In a knitting-machine the combination with a take-up, of means for positively operating said take-up, and means for throwing said operating means out of operation during rotary knitting, substantially as described.

33. In a knitting-machine the combination with a take-up, of means comprising a cam for operating said take-up, and means for rendering said cam inoperative during rotary knitting, substantially as described.

34. In a knitting-machine the combination with a take-up, means operative during reciprocating knitting for intermittently holding said take-up out of operation, and independent means for holding said take-up out of operation during rotary knitting, substantially as described.

35. In a knitting-machine the combination with a spring-actuated take-up, of means operative during reciprocating knitting for intermittently holding said take-up out of operation against the tension of the spring, substantially as described.

36. In a knitting-machine the combination with a take-up, of means operative during reciprocating knitting for intermittently holding said take-up out of operation, and means for rendering said holding means inoperative during rotary knitting, substantially as described.

37. In a knitting-machine, the combination with a take-up of a spring for moving the take-up to take up slack thread, and mechanism operative during reciprocating knitting for positively moving the take-up in the other direction, substantially as described.

38. In a knitting-machine, the combination with a take-up of a sleeve engaging said take-up, a cam, connections between the cam and sleeve for oscillating said sleeve, and independent means for oscillating said sleeve to hold the take-up out of operation during rotary knitting, substantially as described.

39. In a knitting-machine, the combination with a take-up of a spring for raising said take-up, a cam and connections between the cam and take-up said cam and connections being operative during reciprocating knitting, substantially as described.

40. In a knitting-machine, the combination with a take-up and means for intermittently holding the same out of operation comprising a cam and a lever engaging the cam, of means for holding the lever out of engagement with the cam during rotary knitting, substantially as described.

41. In a knitting-machine, the combination with a take-up independent of the knitting mechanism of a clamp, and means operative during reciprocating knitting for intermittently holding the take-up and clamp out of operation, substantially as described.

42. In a knitting-machine the combination with the knitting mechanism, of fashioning mechanism for controlling said knitting mechanism to knit fashioned stockings, and means carried and actuated by said fashioning mechanism for causing said knitting mechanism to knit a series of characteristic stitches between contiguous stockings, substantially as described.

43. In a knitting-machine, the combination with the needle-cylinder of means for raising the same to an unusual height after the completion of each stocking, and immediately lowering the same, whereby a series of unusually long stitches are inserted between contiguous stockings, substantially as described.

44. In a knitting-machine, the combination with the needle-cylinder of a cam for raising and lowering the same, and a short projection at the swell of said cam, substantially as described.

45. In a knitting-machine, the combination with a pattern chain or carrier, a ratchet-wheel for feeding the same, a pawl engaging said ratchet-wheel, an arm to which said pawl is pivoted, said arm being free at one end and a reciprocating member to which the other end of said arm is pivoted, substantially as described.

46. In a knitting-machine, the combination with a controller and a pawl for actuating the same, of a pattern-chain, a ratchet-wheel for feeding said pattern-chain, a pawl pivoted to said controller-pawl, and an oscillating disk to which said controller-pawl is pivoted, substantially as described.

47. In a knitting-machine, the combination with a cam-cylinder provided with a radially-yielding pin, of a sinker cam-ring provided with shoulders adapted to be engaged by said pin, substantially as described.

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