

No. 661,121.

Patented Nov. 6, 1900.

D. E. FELT.
CALCULATING MACHINE.

(Application filed May 2, 1898.)

(No Model.)

11 Sheets—Sheet 1.

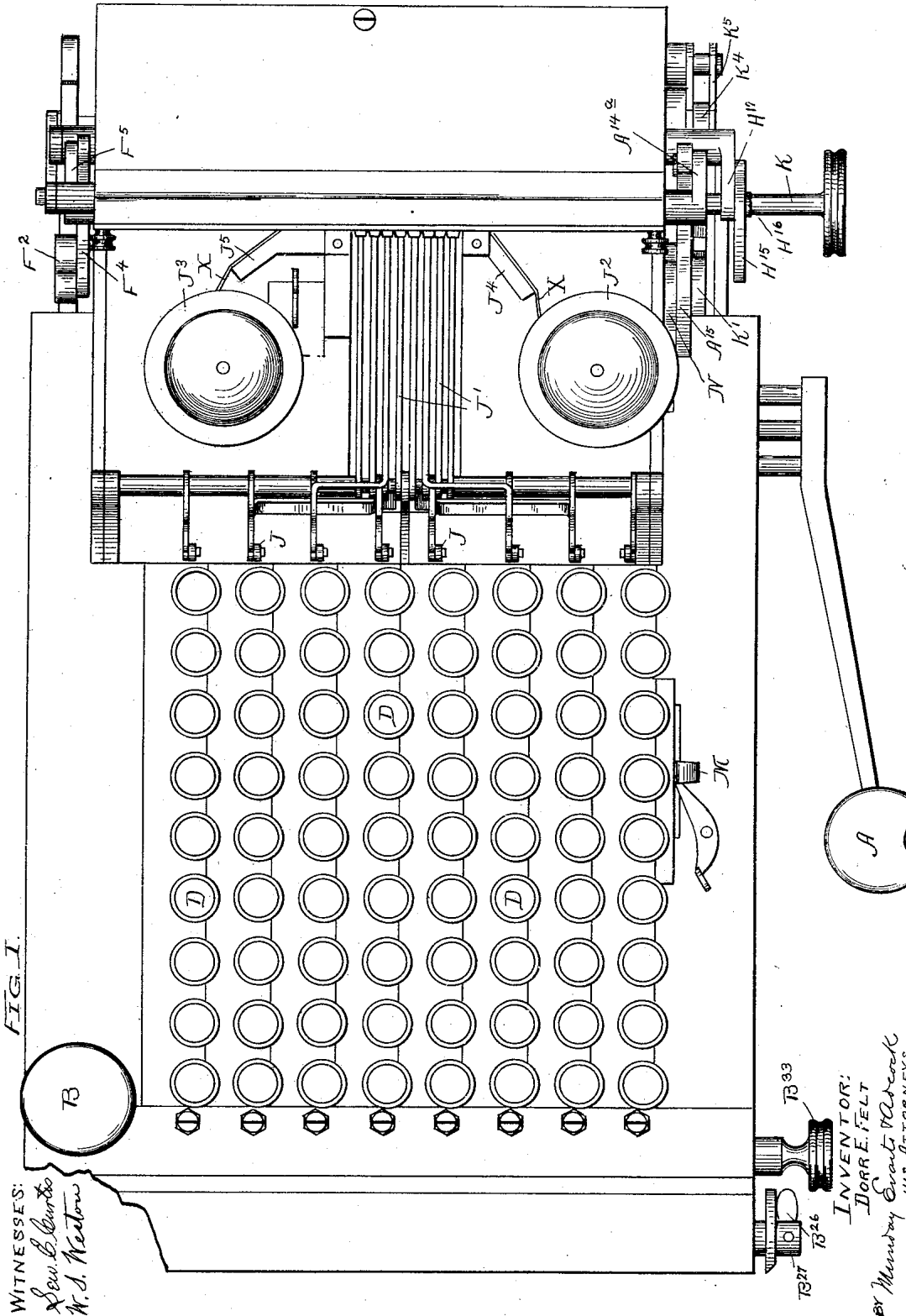


FIG. 1.

WITNESSES:
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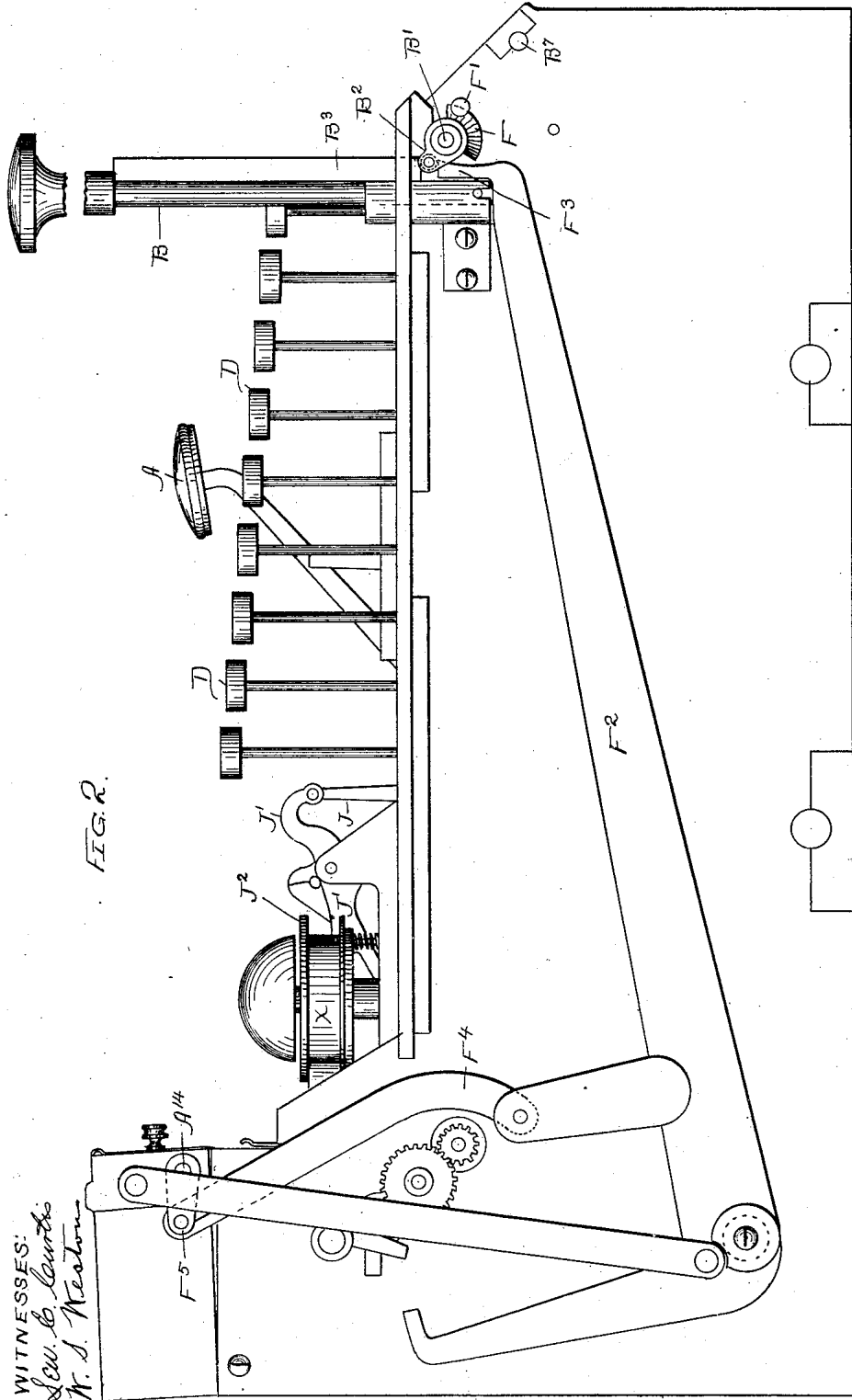


FIG. 2.

WITNESSES:
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W. J. Weston

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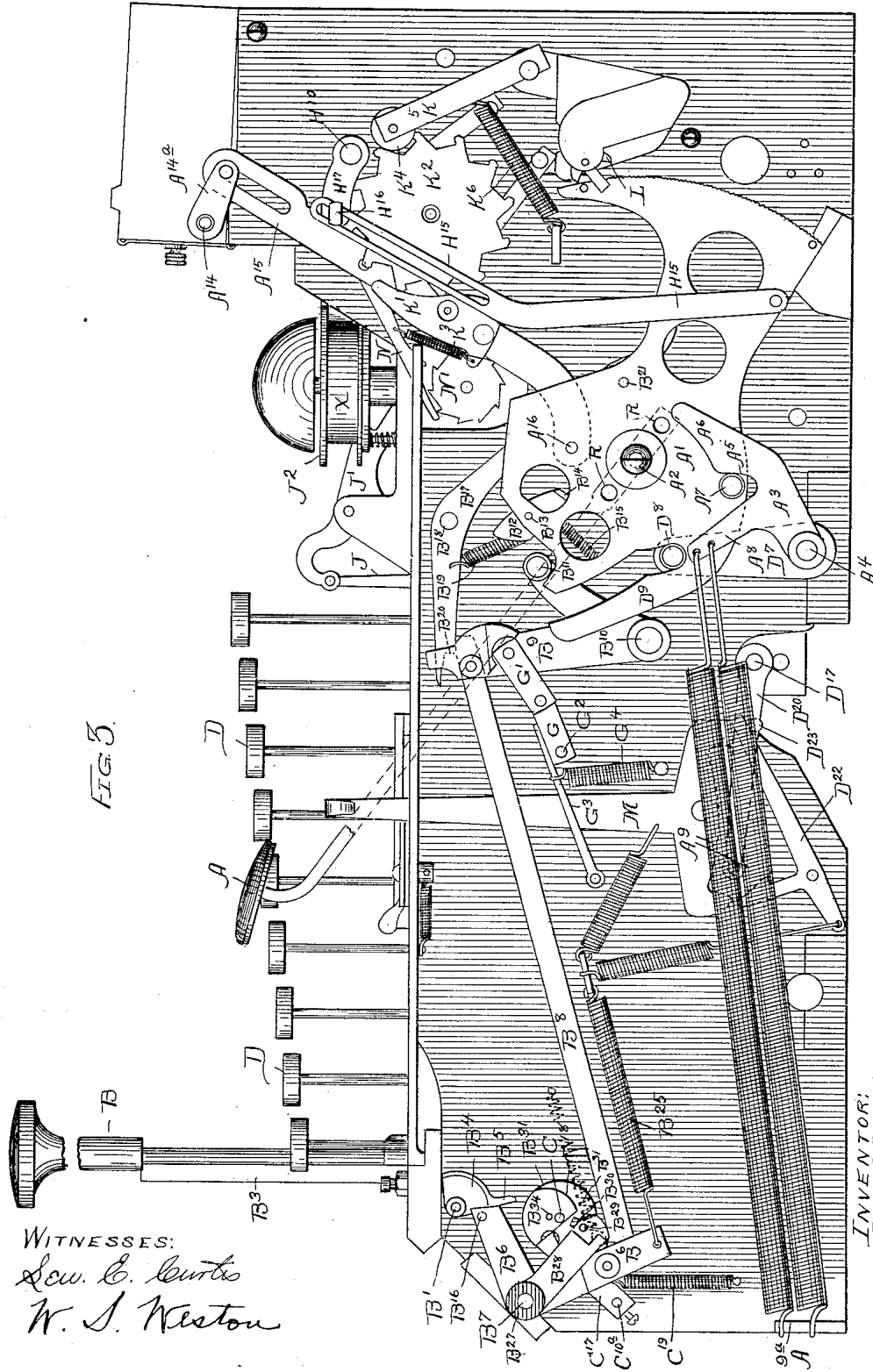


FIG. 5.

WITNESSES:
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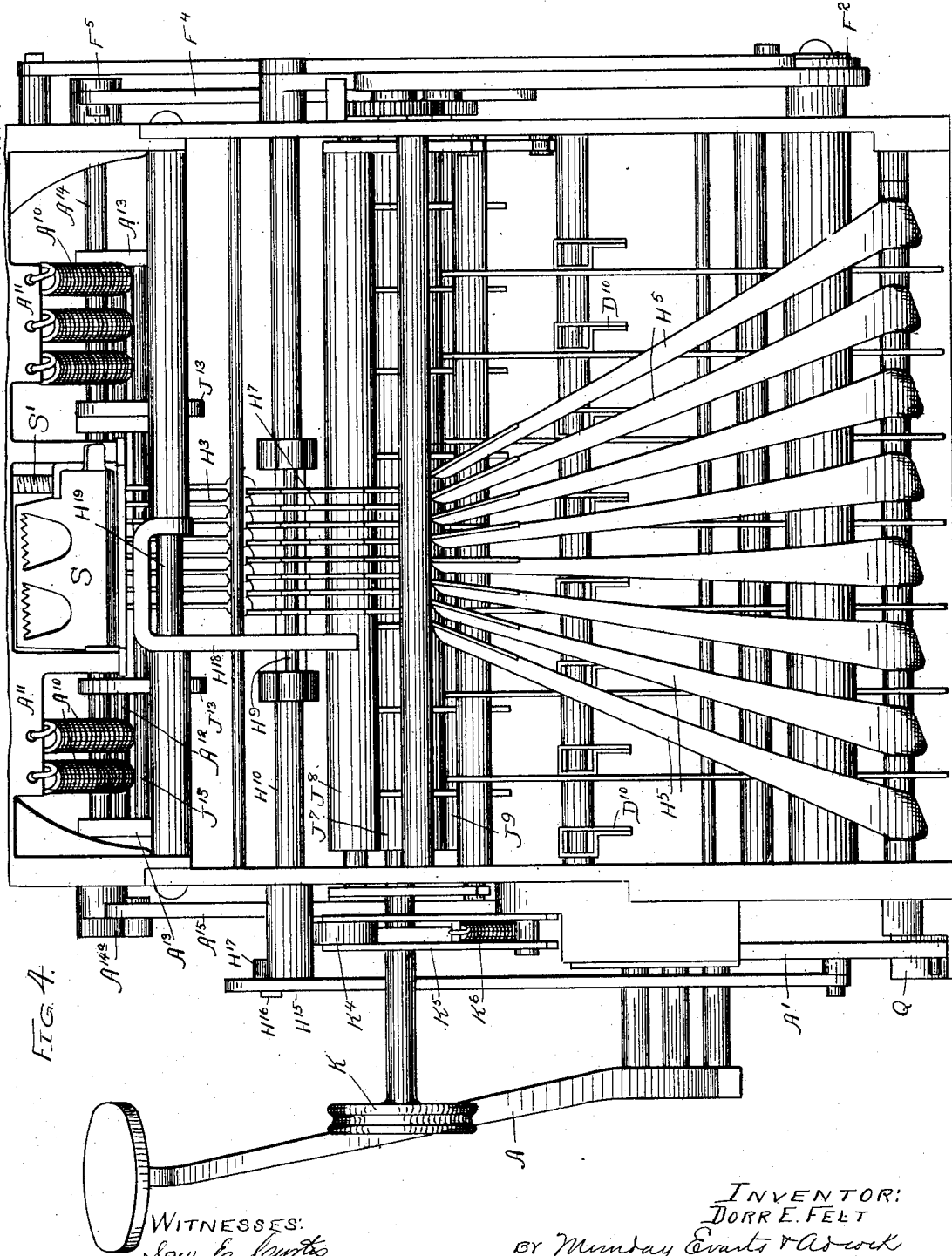


FIG. 4.

WITNESSES:
Sec. to Comptroller
W. S. Weston

INVENTOR:
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11 Sheets—Sheet 5.

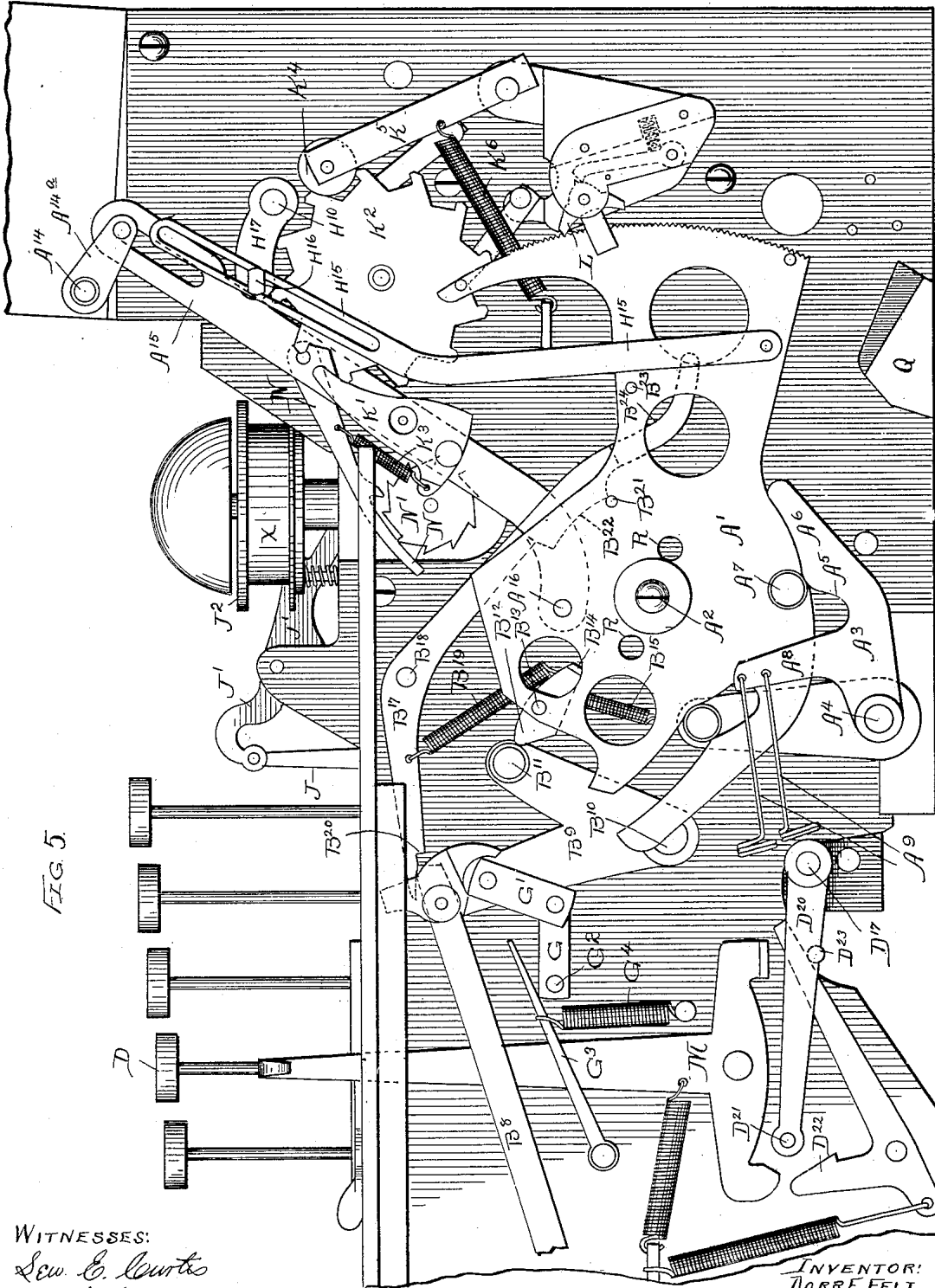


FIG. 5.

WITNESSES:
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W. A. Weston

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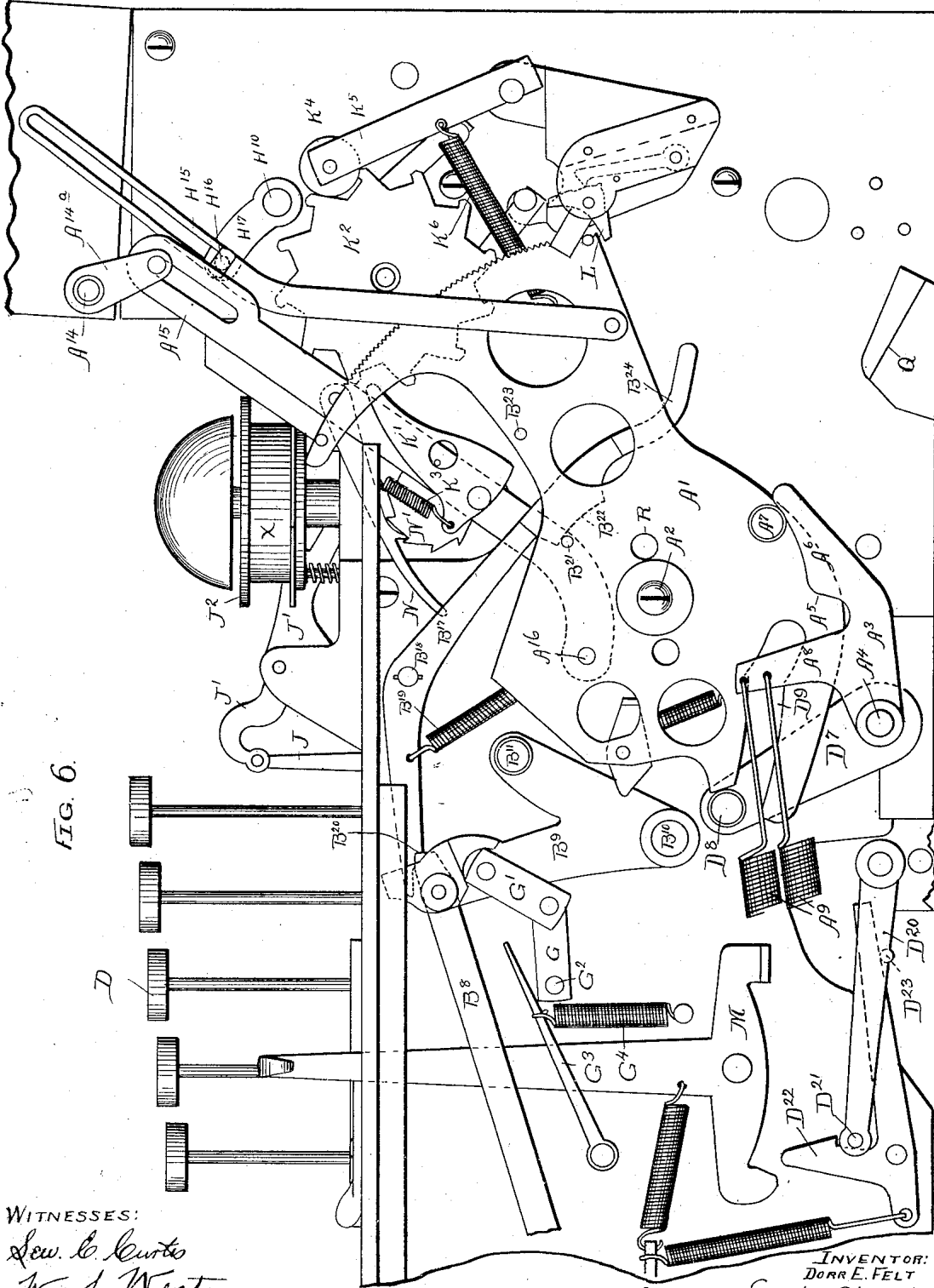


FIG. 6.

WITNESSES:

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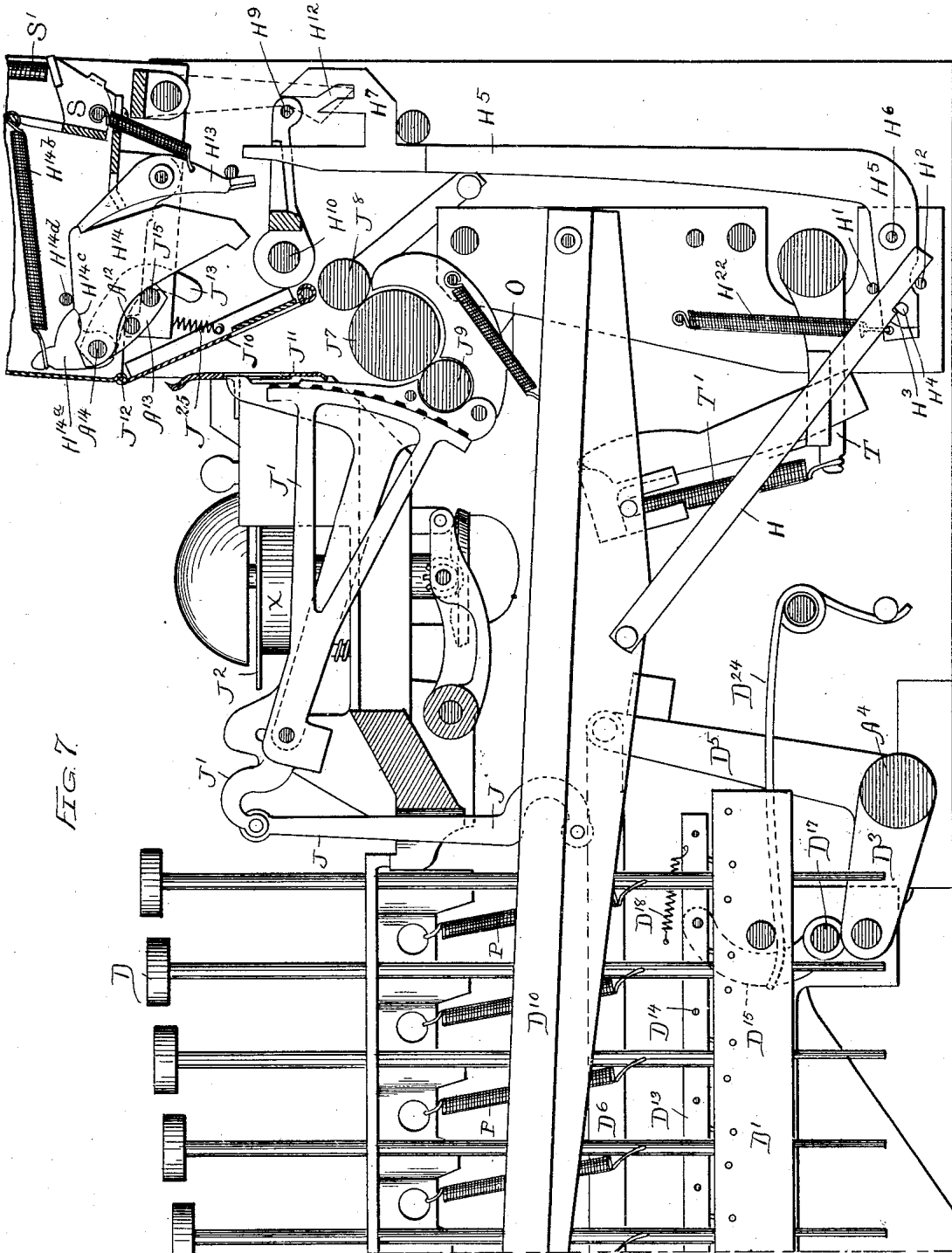


FIG. 7.

WITNESSES:
Sew. C. Lewis
W. S. Weston

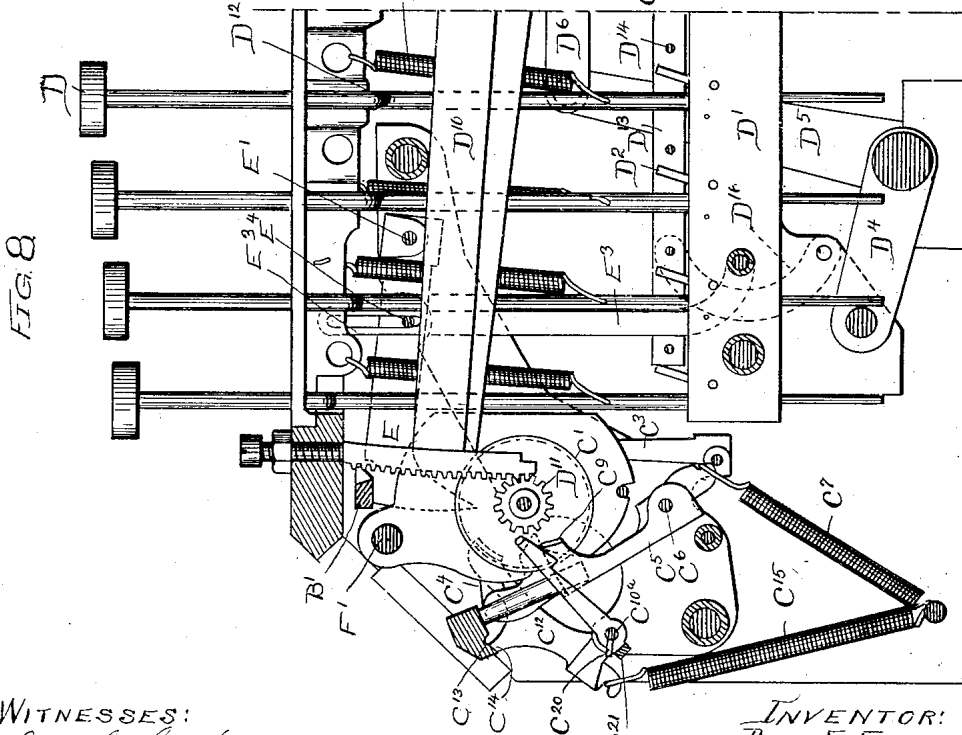
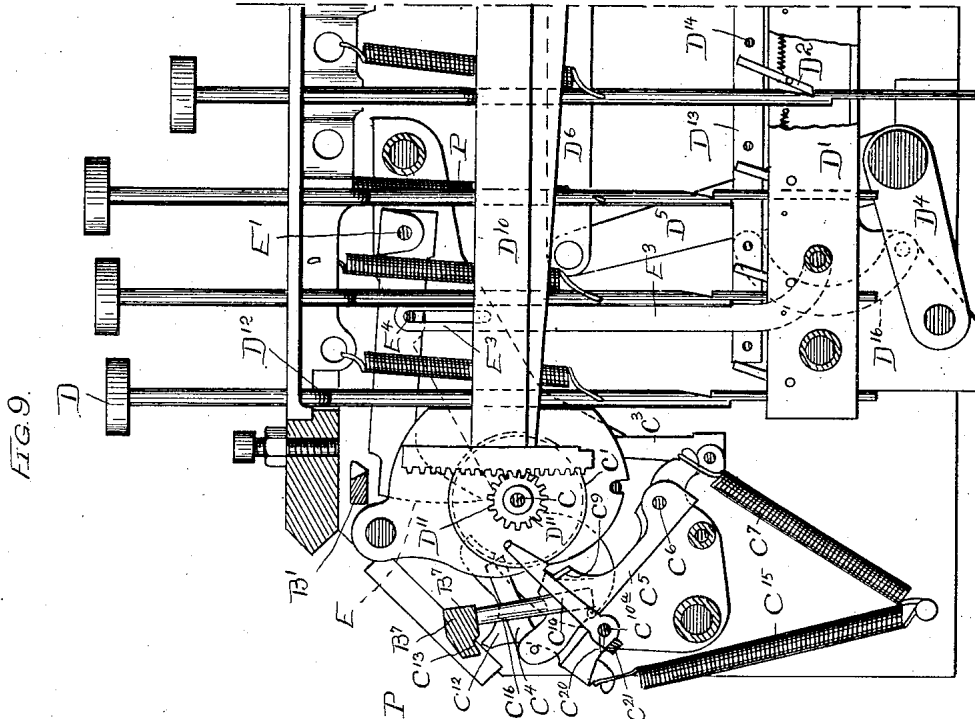
INVENTOR:
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11 Sheets—Sheet 8.



WITNESSES:
Geo. E. Curtis
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FIG. 11

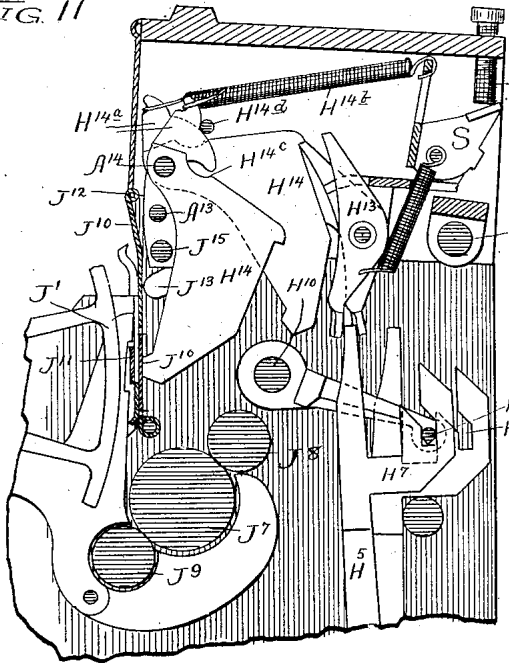


FIG. 12.

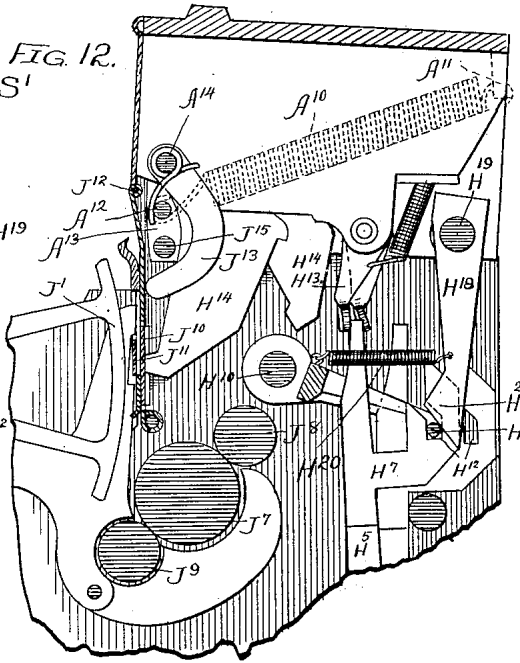
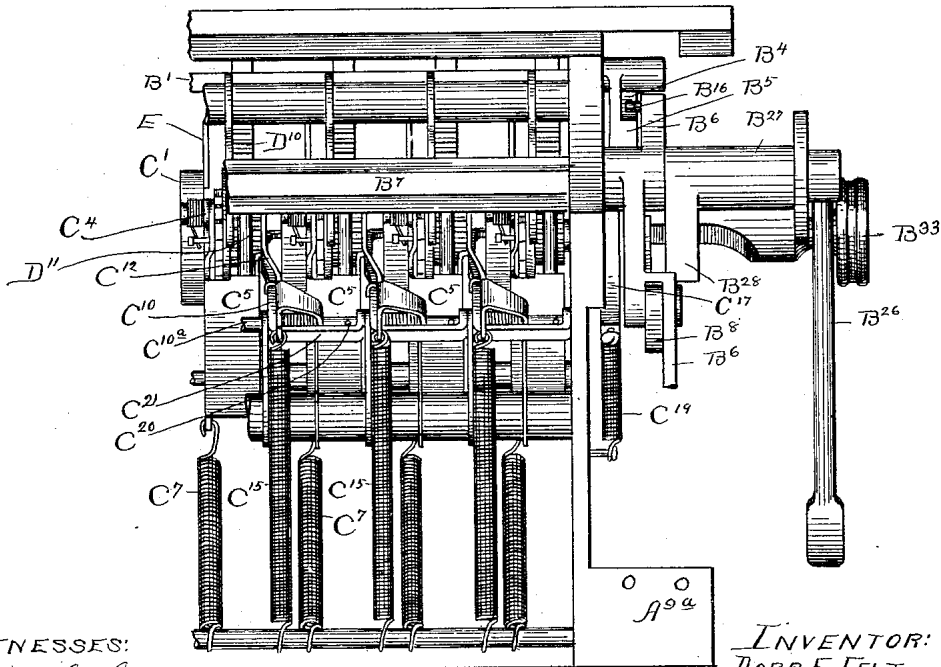


FIG. 10.



WITNESSES:
Sew. E. Curtis
W. S. Weston

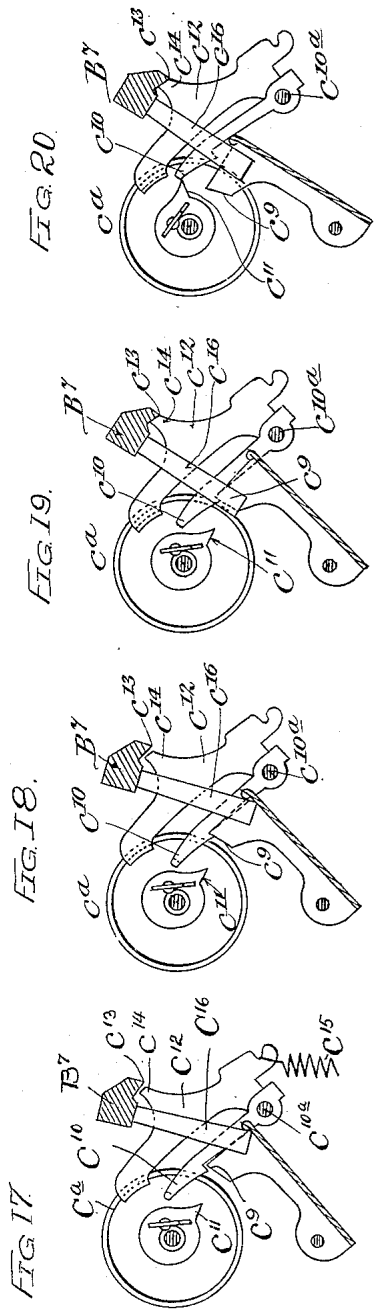
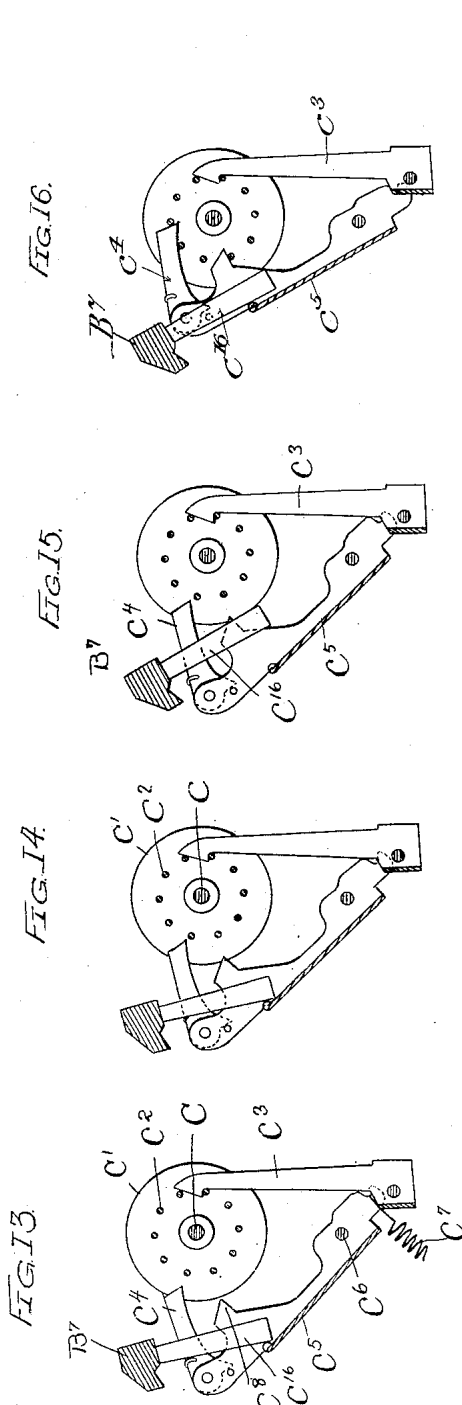
INVENTOR:
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11 Sheets—Sheet 10.



WITNESSES:
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FIG. 21

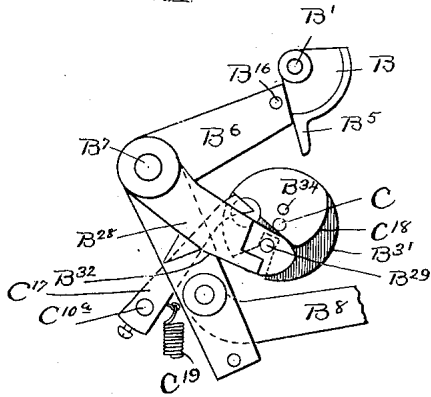


FIG. 22

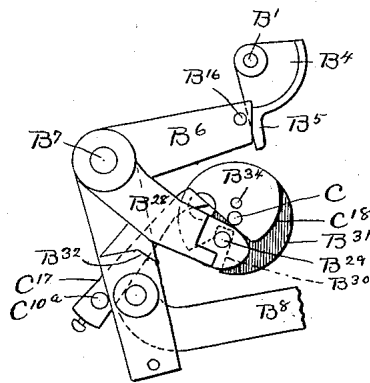


FIG. 23

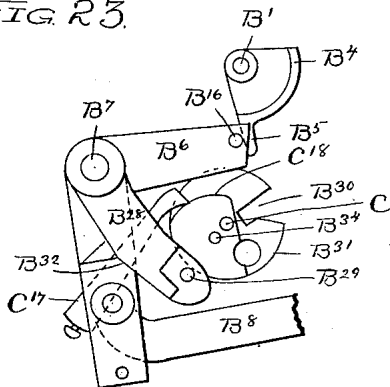


FIG. 27

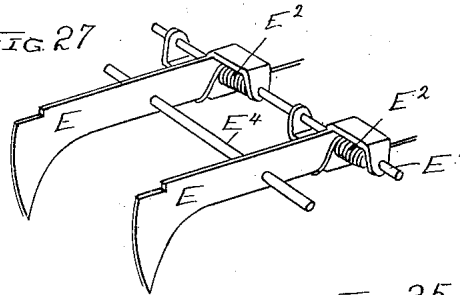


FIG. 24

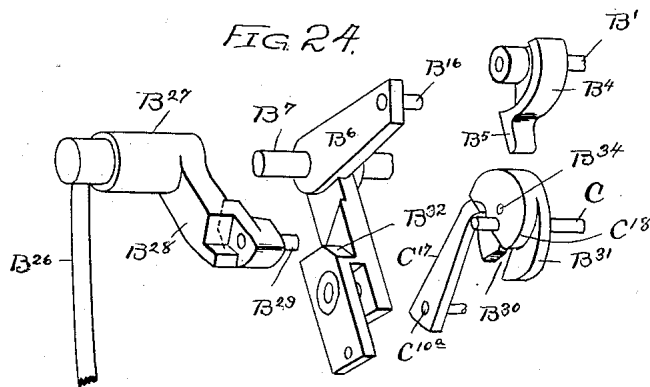


FIG. 25

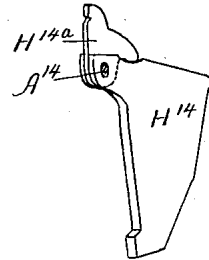
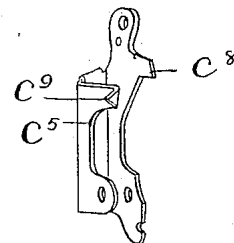


FIG. 26



WITNESSES:

Sau. C. Curtis
H. J. Weston

INVENTOR:
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UNITED STATES PATENT OFFICE.

DORR E. FELT, OF CHICAGO, ILLINOIS.

CALCULATING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 661,121, dated November 6, 1900.

Application filed May 2, 1898. Serial No. 679,461. (No model.)

To all whom it may concern:

Be it known that I, DORR E. FELT, a citizen of the United States, residing in Chicago, in the county of Cook and State of Illinois, have invented a new and useful Improvement in Calculating-Machines, of which the following is a specification.

This invention relates to certain improvements in printing and calculating machines, a type of which is shown in the patent to me, No. 568,021, of September 22, 1896, and is designed to simplify and otherwise improve their construction.

In the accompanying drawings, in which my improvements are fully illustrated, I show at Figure 1 a plan, at Fig. 2 an elevation of the side of the machine upon which the answer-printing lever is located, and at Fig. 3 an elevation, partly in section, of the opposite side of the machine, the main actuating-lever being shown in broken lines. Fig. 4 is an enlarged rear elevation. Figs. 5 and 6 are partial side elevations showing the parts in different positions. Fig. 7 is a partial longitudinal vertical section. Figs. 8 and 9 are partial longitudinal vertical sections showing parts not given in Fig. 7 and also showing the parts in different positions. Fig. 10 is a partial front elevation. Figs. 11 and 12 are partial longitudinal vertical sections showing the printing mechanism. Figs. 13 to 16, inclusive, are detail sectional views showing one of the numeral-wheels with the different positions of its carrying mechanism. Figs. 17 to 20, inclusive, are similar views looking in the opposite direction and showing also the brake. Figs. 21, 22, and 23 are detail views of the interlocking mechanism employed for purposes hereinafter explained. Fig. 24 is a detail perspective of the parts of said interlocking mechanism. Fig. 25 is a detail perspective of the printing-hammer. Fig. 26 is a detail view of the carrying-lever; and Fig. 27 is a perspective view of the stop-levers.

Referring to the drawings, A represents the main operating-lever, serving as the means both of actuating the numeral-wheels in the adding operations and of causing the printing of the numbers added. It is attached to a cam A', which I term the "main" cam, because it is through the medium of this cam

that the lever A accomplishes its various functions. The cam is pivoted at A², so it may turn when power is applied to the lever. It is moved in one direction by the lever and returned to its normal position by spring-power, as now to be explained.

At A³ is a lever loosely pivoted on the end of a shaft A¹ and having a notch at A³ and an arm A⁶. The cam carries a stud A⁷, which when the cam is in its normal position lies in the notch of the lever, as at Fig. 3, but which swings the lever and moves out of the notch and onto the arm A⁶ soon after the cam begins its movement with lever A, as at Fig. 5. Attached to another arm A⁸ of the lever are one or more springs A⁹, secured to a stationary side projection A¹⁰ and acting upon the lever in a direction contrary to the movement imparted thereto by the cam. These springs are overcome by the hand-lever at the commencement of its stroke, and as the cam and lever near the end of their return movement where there is most resistance to the return of the cam the springs exert considerable power upon them and insure the completion of that movement, but they have no influence upon the cam while the stud A⁷ is riding on the arm A⁶, because their strain is then borne by the axis A². They also receive all the distention to which they are subject at the start of the movement of lever A³ and do not become greatly distended at any time. It will thus be seen that the springs A⁹ are intended mainly to actuate the lever and cam during the latter part of their return movements and to hold them in their normal positions. The initial and also the main part of the return movements of the main lever and cam are caused by springs A¹⁰, Figs. 4 and 12, stationarily attached at A¹¹ at one end and with their moving ends secured to a cross-bar A¹², seated at its ends in arms A¹³, secured upon a cross-shaft A¹⁴, said shaft being rocked with each stroke of the main lever, as will be understood from Figs. 3 and 6, by means of a crank-arm A^{14a} and a connecting-bar A¹⁵, pivotally joined to the main cam at A¹⁶ and to the crank A^{14a}. The springs A⁹ reinforce or supplement spring A¹⁰ in the concluding part only of the return stroke of the main cam and lever; but by reason of the means employed to keep them out of action

until the stroke is nearly complete and to lessen the distention imparted to them the shock, noise, and vibration occasioned at the end of the stroke are much less than has been the case heretofore.

To avoid any possibility of actuating either the main lever or the answer-printing or totalizing plunger B before the other of them has completely finished its stroke, I provide suitable interlocking mechanism adapted to automatically hold each of them stationary after the commencement of a stroke by the other until the latter fully completes its stroke and returns to its normal position. This interlocking mechanism is preferably constructed as follows: In front of the machine is a rock-shaft B¹, having at one end a projecting arm B², which has a lateral stud standing under the feather B³ of the plunger, as seen at Fig. 2, so that when the latter is pushed down by the operator a rocking movement will be imparted to the shaft. At the other end the shaft carries a grooved cam B⁴, (best shown at Figs. 10 and 21 to 24,) having also a downwardly-projecting point B⁵. Adjacent to this cam is an elbow-lever B⁶, (also shown in said figures,) attached to the shaft B⁷ and connected by a rod B⁸ to a bell-crank lever B⁹ (shown at Figs. 3, 5, and 6) and pivoted at B¹⁰, and also having a lateral stud B¹¹, lying in the path of a latch B¹², pivoted at B¹³ to the cam and carrying a stop B¹⁴, entering an opening in the cam and acting to limit the movement of the latch upon its pivot in one direction. A spring B¹⁵ draws the latch to its normal position. The elbow-lever B⁶ has a laterally-projecting pin B¹⁶, which in one position of the lever enters the groove of the cam B⁴ and in another position of the lever encounters the point B⁵.

With the construction above detailed the operation will be seen to be that when the main lever is depressed the latch B¹² encounters the stud B¹¹ and rocks the bell-crank B⁹, thereby imparting such movement to lever B⁶ as will carry the pin B¹⁶ from the position shown at Fig. 21 to that of Fig. 22 and in front of the cam projection B⁵, thereby locking the cam B⁴, so that its shaft cannot be rocked by the plunger B. This locking action is maintained until the main lever and cam have returned to their normal positions by employing devices to hold the lever B⁶ in the position just described. These devices may consist of a catch-lever B¹⁷, (see Figs. 3, 5, and 6,) which is pivoted between its ends, as at B¹⁸, and which is rocked from its normal position, (given at Fig. 3,) in which it rides on the end of rod B⁸, by a spring B¹⁹ to its locking engagement with the end of rod B⁸ as soon as the latter has moved far enough toward the front of the machine to allow the catch to drop and present its shoulder B²⁰ to the end of the rod. The catch is shown as thus engaging the rod at Fig. 6; but the bell-crank B⁹ is preferably moved a little beyond the extent necessary to bring about engagement between these

parts, as seen at Fig. 5. The main cam carries a pin B²¹, which soon after the cam begins to turn moves under the widened part B²² of the catch and holds the catch positively in engagement with the rod during all the remainder of the downstroke of the main lever and during the major part of its return movement and until another pin B²³, also carried by the main cam, comes against the rear end B²⁴ of the catch and forces the catch to release the rod. Upon the release in this manner of the rod the spring B²⁵, acting upon the elbow-lever B⁶, returns that lever to the position shown at Fig. 21 and in so doing also carries lever B⁹ back to its starting-point, so that the lock against movement by the plunger is now withdrawn and all the parts are ready for another operation. As the main cam returns to its normal position the latch B¹² yields sufficiently to permit it to pass the stud B¹¹ without imparting any movement to the stud or its carrying-lever B⁹, and this movement of the cam precedes in point of time the release of levers B⁶ and B⁹.

The locking of the main lever during the operations of the answer-plunger is effected by the mechanism above described as follows: As already noted, the lever B⁶ carries a laterally-projecting pin B¹⁶, which in addition to its engagement with the point B⁵ of the cam B⁴ is also adapted to enter the groove of said cam when the latter turns with shaft B¹. After the pin has thus entered the groove of the cam it will be obvious that the lever B⁶ cannot move, inasmuch as the impulses imparted to it by the main lever are calculated to carry the pin B¹⁶ downward, and any such movement will now be prevented by the outer side of the cam-groove.

The interlocking mechanism described also assists in locking the answer-plunger during the operation of cancellation or setting the numeral-wheels at zero. For this purpose a hand-lever B²⁶, (shown at Figs. 1, 10, and 24,) the hub B²⁷ whereof is journaled on B⁷, is provided, and projecting from this same hub is an arm B²⁸, (shown at B²⁴.) This arm has a laterally-projecting pin B²⁹, which enters a slot B³⁰ in a disk B³¹, fast upon the end of the numeral-wheel shaft C. In its normal position (given at Figs. 1 and 21) this pin is in the slot and locks the numeral-wheel shaft against rotation. The arm B²⁸ laps over the lower limb of lever B⁶, bearing on it at B³², so that when the lever B²⁶ is actuated by the operator pulling the lower end of the lever toward the front of the machine, preparatory to a canceling operation, the lever B⁶ will move with the arm B²⁸, and thus carry the pin B¹⁶ in front of the point B⁵ of cam B⁴ and cause the locking of the answer-plunger. The operator now retains the lever B²⁶ in the position to which it has just been moved for a limited time, and the movement described as given to the arm B²⁸ carries the pin B²⁹ out of the slot B³⁰, so that the numeral-wheel shaft is released and free to be turned to any needed extent by

the knob B³³, Fig. 1, which is attached to shaft C, and also has a pin located eccentrically so it may enter the opening B³⁴ in disk B³¹. After the cancellation is complete and upon the release of the lever B²⁶ the parts return to their normal positions under the power of spring B²⁵. It will also be seen that the depression of the plunger B, rocking of shaft B', and moving of cam B⁴, so as to bring the groove of the latter over the pin B¹⁶, thus locking lever B⁶ against movement, as before described, prevent also the operating of arm B²⁸, carrying the pin B²⁹, so that through said pin B²⁹ and its engagement with the slot B³⁰ the disk B³¹ and shaft C are also locked against being turned by the knob B³³. Were it not for the interlocking action of the pin B¹⁶ and the cam B⁴, having the groove and point B³, a novice in the use of the machine might undertake to operate the plunger and main lever or the plunger and the canceling-knob simultaneously, and thus strain the vital parts of the machine.

The numeral-wheels are shown at C', Figs. 13 to 20. Each is provided on one side with equally-spaced pins or teeth C², as shown at Figs. 13 to 16, with which a pivoted spring-catch C³, adapted to prevent backward rotation, engages. Said teeth are also engaged by the pawl C⁴, carried and actuated by the carrying-lever C⁵, pivoted at C⁶ and receiving motion from a spring C⁷, Fig. 8. This lever is formed by bending a flat plate of metal into U form, as seen at Fig. 26, the bent-up vertical sides affording bearings for the pivot C⁶ and also for the attachment of the pawl C⁴. I also form on one of these bent-up sides the stop projection C⁸, which moves into engagement with the pins C² when the carrying-lever actuates the wheel (see Figs. 15 and 16) and prevents overrotation. One point of the bent-up side of lever C⁵ is also bent laterally, so as to form a stop C⁹, which engages the spring-latch C¹⁰. This latch by means of this engagement acts to hold the carrying-lever back from its operative position during the intervals between the carrying operations and until the cam C¹¹, attached to the numeral-wheel, strikes the upper end of the catch and releases the lever, so it may yield to spring C⁷. The lever C⁵ is forced back as hereinafter described. For each numeral-wheel there is also provided a brake-lever C¹², pivoted on the same cross-shaft C^{10a} as the latch C¹⁰. It bears against the inner surface of the rim C³ of the wheel, and its normal position is indicated at Figs. 19 and 20. When the main hand-lever operates and causes the rocking of lever B⁶, the latter rocks also the angular shaft B⁷, upon the end of which said lever B⁶ is supported, and this shaft is provided with a shoulder C¹³ on its under surface, which engages the point C¹⁴ upon the brake. In its normal position the shaft bears against the brake, as seen at said figures, and keeps the latter out of action; but when said shaft is rocked it moves away

from the brake and allows the latter to bear against the wheel in obedience to its spring C¹⁵, so that the brake is in operation to steady the wheel during the time the wheel is usually actuated by power from the main hand-lever.

In the canceling operation I also provide means for positioning all the carrying-levers at a uniform distance from and quite close to the numeral-wheels, so that they will have a very short distance to move before engaging the wheels and will actuate the latter in their proper successive order. I have been led to introduce this feature, because at the time of the canceling operations some of the levers are apt to be in their outermost positions (shown at Fig. 13) and others in intermediate positions—as, for instance, that shown at Fig. 15. When in the outer positions, they have a considerable distance to move before engaging the wheels, and such movement delays their action somewhat as compared to such carrying-levers as are in the intermediate position, so that they are liable to operate the wheels out of their proper order. This positioning of the levers is brought about as follows: When the operator moves lever B²⁶ preparatory to canceling, he moves it far enough at least to carry the arms C¹⁶, extending down from shaft B⁷, to a position intermediate of the positions given at Figs. 13 and 16, and which will allow all the carrying-levers when released to move up against said arms and into close proximity to their operative positions. This movement of the lever B²⁶ should also be sufficient to carry the pin B²⁹ out of slot B³⁰, so that as soon as the operator turns the numeral-wheel shaft said pin will ride on the edge of the disk B³¹. The disk will now by its engagement with the pin and through the medium of the intervening mechanism control the arms C¹⁶ and retain them in the intermediate position above described even if the operator should release lever B²⁶. The latches C¹⁰ of such of the carrying-levers as at the time may be back in their normal positions are now released, as follows: Upon the end of shaft C^{10a} is an arm C¹⁷, adapted to rock the same. The free end of this arm rides upon the edge of a cam C¹⁸, carried by the disk B³¹, and is held to the same by a spring C¹⁹. The shaft C^{10a} carries transverse pins C²⁰, bearing upon the portion C²¹ of the latches C¹⁰ which extends in front of said shaft. The cam allows the arm to remain normal during about half its revolution and rocks the shaft shortly before the numeral-wheels are moved into the zero position, and such rocking causes the release of all the latches which are in action at the time, so that the carrying-levers of such latches may then swing up against the arms C¹⁶ (which are now in the intermediate position described) and into advantageous positions for operation. At the conclusion of the canceling the slot B³⁰ is presented to the pin B²⁹, which under the power of spring B²⁵ is forced into the same, thereby allowing the rocking

of shaft B⁷ sufficiently to carry the arms C¹⁶ back to the position of Fig. 16 and permitting the carrying-levers to act. The carrying-lever after it has acted on the wheel will
 5 be brought back to its normal position by the arm C¹⁶ and shaft B⁷ and into position to be again engaged by the latch C¹⁰ at the next following rocking of said shaft.

The operating of the rock-shaft B⁷, by which
 10 the carrying-levers are controlled in my present invention, is devolved upon the lever B⁹ and latch B¹², carried by the main cam and the catch-lever B¹⁷. I deem this mechanism much better for the purpose than that de-
 15 scribed in my Patent No. 568,021 because it is much more easily adjusted and is less likely to get out of adjustment. It also insures a uniform quick action by the carrying-levers under all conditions, whereas in the patented
 20 construction they would sometimes move slowly and sometimes quickly, depending upon the varying speed of the main lever in returning to its normal position.

The keys are shown at D, Fig. 9, and the
 25 channel-bars of the vibrating frame, to which the keys are coupled by the latches D², are shown at D'. The vibrating frame is supported on and actuated by cranks D³ and D⁴, receiving motion from shaft A⁴ and connected
 30 together upon one side of the machine by cranks D⁵ and bar D⁶. The shaft A⁴ is rocked by power from the cam A', it having an arm D⁷, provided with a pin D⁸, working in the slot D⁹ of the cam. The keys pass through
 35 or in proximity to the segment-levers D¹⁰, which mesh with pinions D¹¹, and thereby actuate the numeral-wheels and engage the same by means of the graduated shoulders D¹², formed in the stems of the keys. The bars
 40 and cross-wires of the frame for releasing the keys from the latches of the vibrating frame are shown at D¹³ and D¹⁴, the arms upon which
 said frame moves horizontally in the performance of its releasing function at D¹⁵ and D¹⁶,
 45 the shaft carrying said arms D¹⁵ at D¹⁷, the retracting-spring at D¹⁸, the crank-arm rocking said shaft D¹⁷ at D²⁰, the pin on said crank-arm at D²¹, the spring-latch which encounters
 said pin when the vibrating and releasing
 50 frames move down at D²², and at D²³ the pin carried by the crank-arm D²⁰ and normally holding the latch out of operation, as at Fig. 5, the acting position of the latch being shown
 at Fig. 6. In the latter position the latch
 55 serves as the frames move upward to detain the end of crank-arm D²⁰, and thus causes the rocking of shaft D¹⁷ and the horizontal releasing action by the releasing-frame. The construction shown of these parts does not differ
 60 materially from that given in my Patent No. 568,021. One of the springs for lifting the vibrating frame is shown at D²⁴.

With each numeral-wheel a stop-lever E (shown at Figs. 8 and 9 and also at Fig. 27) is
 65 provided. They are pivoted at E', are normally held out of action by springs E², and are attached to the vibrating frame by two or

more slotted bars E³ and cross-rod E⁴. In Fig. 8 the lever shown is in its normal position, and in Fig. 9 it is shown as in action. In
 70 my said patent the stop-levers were independent of each other and each was retracted solely by the power of its own spring; but I now unite them by means of the cross-rod E⁴,
 75 which passes through all of them, and thus avoid any danger of any one sticking in its return action, because all the springs E² act
 upon the united series of levers at the same time and unusual friction on any one would
 80 not hold a stop against the united action of all the springs. The stop-levers E are operated when the plunger B is brought into
 use, one purpose of their employment being to hold the wheels stationary during the printing
 85 of the answers, and they are depressed by power from the plunger as follows: The shaft B', already mentioned, extends across the machine and is angular in cross-section,
 as seen at Fig. 8, and also arranged directly
 90 over the ends of the stop-levers. From its shape and location it is adapted when rocked by the answer-plunger to force the series
 of stop-levers into action. The stop-levers are also thrown into action by the vibrat-
 95 ing frame at the conclusion of the downward stroke of the frame, as will be understood from Fig. 9, and they are thus enabled
 to hold the wheels stationary during the printing operations taking place with each
 100 stroke of the main lever. Of course they do not assume control of the wheels until after the latter have been actuated by the segment
 and carrying levers. The shaft B' also carries a cam F at the plunger side of the ma-
 105 chine, (see Fig. 2,) whose office it is to impart a slight longitudinal motion to a shaft F'. This shaft is identical in construction and
 function with the shaft K⁸ of my said patent and needs no further description here. To
 110 overcome the friction upon shafts B' and F', which may tend to obstruct their return to normal position, I find it desirable to provide the lever F², which is depressed by the
 plunger and is returned by spring-power,
 115 with an upward extension F³, setting close under the arm B² or its lateral stud. This extension carries the retracting power of the
 lever F² to the arm B² and insures a positive return of the shafts B' and F' to their starting
 120 positions.

In the machine of my Patent No. 568,021 the return stroke of the main lever was at-
 tended with some noise, which while slight was nevertheless sometimes objectionable. I find much of this can be overcome by lim-
 125 iting the return stroke of lever B⁹ by means of a toggle G G', attached to said lever at one end and to a stationary point G² at the other end, the toggle being adapted to prevent
 actual contact between its stud B¹¹ and the
 130 main cam at the end of the return stroke. The toggle is kept with its center joint below the dead-center by a lever G³ and spring G⁴.

Each segment-lever carries a bar or lever

H, (shown at Fig. 7,) extending downwardly and rearwardly and pivotally united to the segment-lever. At its lower end it passes between guides H¹ H². A shoulder H³ on the under side of the bar engages with a stud H⁴, carried upon the lower end of an elbow-lever H⁵, pivoted at H⁶. The descent of the segment-lever causes a limited rocking of lever H⁵, (the engagement between the stud H⁴ and lever H⁵ being quickly broken,) which carries its upper end inward. The lever H⁵ has an elbow-like projection H⁷, the upper point of which engages the cross-bar of a swinging frame H⁹, secured to a rock-shaft H¹⁰. The downward motion of frame H⁹ carries its cross-bar into the inclined slot H¹² of the elbow projection, and this causes the upper extremity of the lever to bear against the pawl H¹³ of the printing-hammer H¹⁴ corresponding to the segment-lever. The movement of the frame H⁹ is received from the main cam through the medium of a slotted lever H¹⁵, a pin H¹⁶ working in the slot and attached to a crank H¹⁷ upon the shaft H¹⁰. In order to hold the swinging frame H⁹ stationary in its lower position until the proper time arrives for it to move up, and thus avoid the creation of undesirable friction between the bar H and its guides, such as might be caused if the lever H⁵ began to move prematurely, I employ a detent H¹⁸, mounted upon a rock-shaft H¹⁹ and held toward the swinging frame by a spring H²⁰. The detent has a triangular projection H²¹, which sets over the frame H⁹ when in its lower position and yieldingly holds the frame down; but its sloping side does not absolutely prevent the frame from rising at the proper time. The detent yields when the frame moves down, as will be readily understood. The slotted lever H¹⁵ is adapted to act upon the crank H¹⁷ at each end of its stroke. The lever H⁵ returns to its starting position under the power of spring H²².

The segment-levers are each connected by bent rods J to pivoted type-heads J', which are presented in front of the hammers H¹⁴, the position of the type-heads being determined, as in my previous patent, by the extent of the depression given the segment-levers. The ink-ribbon X is controlled by the spools J² J³ and guides J⁴ and J⁵ and moves horizontally past the printing-center, and the paper upon which the numbers added and the answers are recorded or printed moves vertically past said center, being fed by rolls J⁷, J⁸, and J⁹ and guided by guides J¹⁰ and J¹¹.

The hammers are different from those of the patent, each being now made with the head H^{14a} separate from the rest or main body of the hammer. My object in this feature is to soften the blow against the type and allow the hammer to drop back a little from the paper immediately after striking, the head being actuated by the spring H^{14b} and being hinged to the same shaft A¹⁴ which supports the body portion of the hammers and being also adapted to bear upon the body at H^{14c},

and thus to give the body the impulse or motion necessary to carry it against the type, but being itself arrested by a stop-rod H^{14d}, extending transversely of the series of hammers, before the hammer reaches the paper.

The center paper-roll J⁷ is adapted to be actuated by hand when necessary through the medium of the thumb device K, and it is also actuated automatically by means of the pawl K', pivoted upon the slotted lever A¹⁵ and a ratchet-wheel K², borne upon the journal of said roll. A spring K³ tends to force the acting end of the pawl against the wheel at all times. This pawl at each movement of the main cam carries the wheel one notch in the direction required for feeding the paper, and it is adapted to feed in that direction only. It is released at the conclusion of each operation upon the wheel by the contact of the tooth next following the one last engaged with the undersurface of the pawl. As shown, this under surface is rounded or curved, so that when the pawl is in its normal position (shown at Fig. 3) said under surface forms an arc substantially concentric with the ratchet, and consequently the ratchet-teeth can move along this under surface so long as the pawl is in that position without engaging the pawl and without affecting it in any respect except detaining it from fresh engagement. By this construction the ratchet is left free to be turned in either direction by the hand device K until the next actuation of lever A¹⁵ occurs, when the position of the pawl will be changed, so that it will then engage the ratchet during the first part of the upward movement of the lever.

In order to insure perfect uniformity in the intermittent movements of the ratchet-wheel, as well as for the purpose of holding it and the roll stationary between movements and for preventing overrotation, I apply to the wheel a dolly-roll K⁴, supported in a swinging frame K⁵ and impelled toward the ratchet-wheel by the spring K⁶. This roll is of such dimension as enables it to center itself in the spaces between the teeth of the wheel, and it bears against the wheel with such force as to insure a correct positioning of the wheel at the conclusion of each movement in case it has turned too far or not far enough. This dolly-roll does not prevent backward movements of the ratchet, as its large diameter enables it to ride readily out of the tooth-spaces.

The paper-guide J¹⁰ is hinged, as shown at J¹², and is swung by means of the spring-arms J¹³, hinged upon the shaft A¹⁴, against the paper at the proper time to clamp and hold the paper and insure the latter being in proper position to secure a good impression. The normal position of both the guide and the spring-arms is shown at Fig. 7, the arms being held out of action by the swinging bar J¹⁵, whose main function is the lifting of the hammers after printing. The bar J¹⁵ is supported in arms A¹³, which are fast to shaft A¹⁴

and controlled by the springs A¹⁰ in one direction and in the other direction by the crank A^{14a} and connecting-bar A¹⁵ upon one side of the machine and by the lever F⁴, joined to the plunger-lever F², and the crank F⁵ upon the other side of the machine, and the bar is moved out of the way of the hammer in all the printing operations before the latter are released by their pawls, and this allows the spring-arms just mentioned to act upon the paper seasonably in advance of the printing. The guide is moved back after each printing operation by a suitable spring J²⁵, Fig. 7.

In addition to the features above described the drawings show a number of other features, such as the double-pointed pawl L, acting on the serrated or toothed edge of the main cam and acting to prevent partial strokes of the main lever, the inverted-T-shaped lever M, corresponding in function to the lever E of my said patent and adapted when moved one way to release the keys and when moved to its limit in the other direction and locked to cause the repeating of the number represented by the set-keys, the pawl N, attached to lever A¹⁵, and the ratchet N', connected to the ink-ribbon spools and serving to actuate the latter through proper intervening mechanism; O, the springs for lifting the segment-levers; P, the springs for lifting the keys; Q, the stop for limiting the return stroke of the main lever and cam; R R, the openings in the main cam, whereat the main lever is attached thereto; S, the adjustable frame whereby the tension of the hammer-springs is regulated, S', the screw for effecting the adjustments thereof, T, the arms, and T' the springs for operating the segment-levers at the time of printing the answers; but none of these devices or mechanisms are independently new, but are fully described in my previous patent, and consequently I do not elaborate the description thereof.

While I have described the parts A⁷, B¹¹, and D³ as studs, it will be understood that for the avoidance of friction they are all surrounded by freely-revolving rolls and are what many machinists call "dolly-rolls."

I claim—

1. In a printing and calculating machine, a main actuating-lever, in combination with a spring for imparting return strokes to the lever, and a reinforcing-spring acting on the lever, during the concluding portion only of the strokes, substantially as specified.

2. In a printing and calculating machine, a hand-lever for actuating the calculating and printing mechanisms, in combination with said mechanisms, a spring for actuating the lever in its return strokes, and a reinforcing-spring acting on the lever during the concluding portion only of the strokes, substantially as specified.

3. In a printing and calculating machine, a main actuating-lever, in combination with a spring for imparting return strokes to the lever, of a reinforcing-spring acting on the lever

during the concluding portion only of the strokes, and means for holding said reinforcing-spring out of action during the initial part of the strokes, substantially as specified.

4. In a printing and calculating machine, a main actuating-lever, in combination with a spring for imparting return strokes to the lever, of a reinforcing-spring acting on the lever during the concluding portion only of the strokes, and means for limiting the distention of said reinforcing-spring, substantially as specified.

5. In a printing and calculating machine, a main actuating-lever, in combination with a spring for imparting return strokes to the lever, of a reinforcing-spring acting on the lever, during the concluding portion only of the strokes, and a lever A³ to which the reinforcing-spring is attached, and which serves to hold the same out of action during the initial part of the strokes, substantially as specified.

6. In a printing and calculating machine, a main actuating-lever, in combination with a spring for imparting return strokes to the lever, of a reinforcing-spring acting on the lever during the concluding portion only of the strokes, a pivoted lever A³ having an arm A⁶ controlling said reinforcing-spring, the cam A⁴, and pin A⁷, substantially as specified.

7. The combination with the main lever and a lever B⁶ actuated thereby and having a pin B¹⁶, of the answer-printing plunger, and the cam actuated by the plunger and engaging said pin, substantially as specified.

8. The combination with the main lever and a lever B⁶ actuated thereby and having a pin B¹⁶, of the answer-printing plunger, and the cam B⁴ having a groove receiving said pin and a point B³ engaging the pin, substantially as specified.

9. The combination with the main lever and the answer-printing plunger, of the cam B⁴ constructed essentially as described and controlling the plunger, and a device engaging with said cam and controlling the main lever, substantially as specified.

10. The combination with the main lever and answer-printing plunger, of cam B⁴ controlling the plunger and lever B⁶ controlling the main lever, and means for locking the lever B⁶ in engagement with the cam, substantially as specified.

11. The combination with the main lever and answer-printing plunger, of cam B⁴ controlling the plunger and lever B⁶ controlling the main lever, and catch-lever B¹⁷ for locking the lever B⁶ in engagement with the cam, substantially as specified.

12. The combination with the main lever and answer-printing plunger, of cam B⁴ controlling the plunger and lever B⁶ controlling the main lever, and a device for locking the lever B⁶ in engagement with the cam, such device being released at the end of the return stroke of the main lever, substantially as specified.

13. The combination with the main lever and answer-printing plunger, of cam B⁴ controlling the plunger and lever B⁶ controlling the main lever, and a device for locking the lever B⁶ in engagement with the cam, such device being released by the power actuating the main lever in its return stroke, substantially as specified.

14. The combination with the main lever and answer-printing plunger, of cam B⁴ controlling the plunger, and lever B⁶ controlling the lever; and the spring catch-lever B¹⁷ for locking lever B⁶ and released by the main cam, substantially as specified.

15. The combination with the answer-printing mechanism and means for setting the numeral-wheels, of a device for controlling said mechanism, a device engaging said controlling device, and means for holding said last-mentioned device in engagement with said controlling device during the setting operation, substantially as specified.

16. The combination with the answer-printing mechanism and means for setting the numeral-wheels, of the cam B⁴ controlling said mechanism, the lever B⁶ engaging with said cam, and means for holding said lever in engagement with the cam during the setting operation consisting of the arm B²⁸ controlling said lever B⁶, the pin B²⁹ and slotted disk B³¹ on the numeral-wheel shaft, substantially as specified.

17. The combination with the numeral-wheel shaft and means for actuating the latter, of the slotted disk B³¹, the hand-lever B²⁶ having arm B²⁸ and pin B²⁹, the latter normally in the slot of the disk and adapted to be moved out of the slot and to ride on the edge of the disk during cancellation, substantially as specified.

18. The combination with the normally-locked numeral-wheel shaft, the answer-printing mechanism and means for locking the latter during the operation of the former, of means for releasing the lock upon the shaft, and means for actuating the shaft, substantially as specified.

19. In a calculating-machine, a carrying-lever consisting of a U-shaped piece of metal, the bent-up sides forming bearings and one of them also forming the stop projection C⁸, substantially as specified.

20. In a calculating-machine, a carrying-lever consisting of a U-shaped piece of metal, having the stop projection C⁸ formed upon one of the bent-up sides, substantially as specified.

21. In a calculating-machine, a carrying-lever consisting of a U-shaped piece of metal, having the latch-stop C⁹ formed upon one of the bent-up sides, substantially as specified.

22. In a calculating-machine, a carrying-lever consisting of a U-shaped piece of metal, having the stop projection C⁸ and latch-stop C⁹ formed upon its bent-up sides, substantially as specified.

23. The combination with the numeral-wheels of spring brake-levers bearing against

the inner surface of the wheel-rims, the angular rocking shaft serving to hold the levers normally out of action, and means for rocking said shaft at proper times so as to release the levers, substantially as specified.

24. The combination with the numeral-wheels of spring brake-levers, bearing against the inner surface of the wheel-rims, the angular rocking shaft acting normally to hold the levers out of action, means for rocking said shaft, and means for retaining the shaft in the releasing position, substantially as specified.

25. In a calculating-machine, the combination with the carrying levers and their detaining-latches, of the rock-shaft acting to release said latches, the cam C¹⁸ upon the numeral-wheel shaft, and the arm C¹⁷ attached to the rock-shaft and riding on said cam, substantially as specified.

26. The combination with the numeral-wheels and means for actuating them in cancelling, of the carrying-levers, the latches controlling the carrying-levers, the rock-shaft for releasing the latches, the cam C¹⁸ on the numeral-wheel shaft, and the arm C¹⁷ attached to the rock-shaft and riding on said cam, substantially as specified.

27. The combination with the carrying-levers of the rock-shaft B⁷, the arms carried by said shaft and controlling the positions of the levers, and means for operating said shaft, substantially as specified.

28. The combination with the answer-printing plunger and the lever F², having an upward extension F⁵, of the shaft B⁷ having arm B² receiving impulses in both directions from the plunger and lever, substantially as specified.

29. The combination with the shafts B⁷ and F⁷, of the answer-printing plunger, the arm B², cam F and lever F², having extension F⁵, substantially as specified.

30. The combination with the numeral-wheels, of stop-levers E, one for each wheel, springs for lifting said levers, and a cross-rod E⁴ tying the levers together, substantially as specified.

31. The combination with the main cam, and lever B⁹, of the toggle for controlling said lever and preventing noisy contact with the main cam, substantially as specified.

32. The combination with the main cam, of the lever B⁹ returned to its normal position by spring-power, and the toggle for limiting the return movement of said lever, substantially as specified.

33. The combination with the main cam, of the lever B⁹ returned to its normal position by spring-power, the toggle for limiting the return movement of said lever, and a spring G acting to keep said toggle in acting position, substantially as specified.

34. The combination with the swinging frame H⁹, the lever H⁵, and the devices actuating said lever, of a spring-detent acting on said frame, substantially as specified.

35. The combination with the swinging frame H⁹, the lever H⁵ controlled by said frame, the lever H receiving motion from the segment-lever, and giving motion to lever
5 H³, and the guides between which said lever H moves, of the detent H¹⁸, substantially as specified.

36. The combination with the levers H⁵, and the swinging frame H⁹, of a detent acting to
10 prevent premature movement of said levers, such detent having a triangular projection which adapts it to yield and allow the frame to move at proper times, substantially as specified.

37. The calculating-machine, having type and hammers for impressing the paper against the type, said hammers having hinged heads made separate from the bodies, actuating-springs attached to the heads, and means for
15 arresting the heads before the hammers can make the impressions, substantially as specified.

38. In a machine for printing numbers, the combination with the type, of swinging hammers having their heads made separate from their bodies, springs attached to the heads and through them actuating the bodies, and means for arresting the heads before the making of the impressions, substantially as specified.
30

39. In a machine for printing numbers, the combination with the type, of swinging hammers composed of hinged heads and hinged bodies, the actuating-springs being attached to the heads and the heads adapted to actuate the bodies, and means for arresting the heads before the completion of the stroke, substantially as specified.
35

40. In a machine for printing numbers, a printing-hammer made in two parts and hinged together, one part receiving the actuating power and imparting it to the other, and being itself arrested before the making of the impression, substantially as specified.
40

41. In a machine for printing numbers, a

printing-hammer consisting of a head and a body made separate and hinged upon the same shaft, the head bearing upon the body and receiving the power for making the impression and imparting it to the body, and
50 means for arresting the head, substantially as specified.

42. The combination with the paper-roll and its ratchet, of a pawl for actuating the ratchet, said pawl being shaped to ride idly
55 on the ratchet when in its normal position and to engage when moved from its normal position, substantially as specified.

43. The combination with the paper-roll and its ratchet, of a pawl for actuating said
60 ratchet, and a movable support for the pawl, the pawl engaging the ratchet when the support moves from its normal position, and at other times riding idly thereon, substantially as specified.

44. The combination with the carrying-levers and the rock-shaft for controlling them, of means for rocking said shaft consisting of a lever connected to the shaft, a latch operating said lever, and an oscillating device carrying the latch, substantially as specified.
65

45. The combination with the carrying-levers and the rock-shaft for controlling them, of means for rocking said shaft consisting of a lever connected to the shaft, a latch operating said lever, the cam carrying the latch, and means for temporarily locking lever B⁹ in the position to which it is moved by said stud, substantially as specified.
75

46. The combination with the carrying-levers and rock-shaft controlling the same, of mechanism for rocking said shaft, and means for holding the shaft in the position to which it is moved by the rocking mechanism, substantially as specified.
80

DORR E. FELT.

Witnesses:

EDW. S. EVARTS,
LEWIS E. CURTIS.