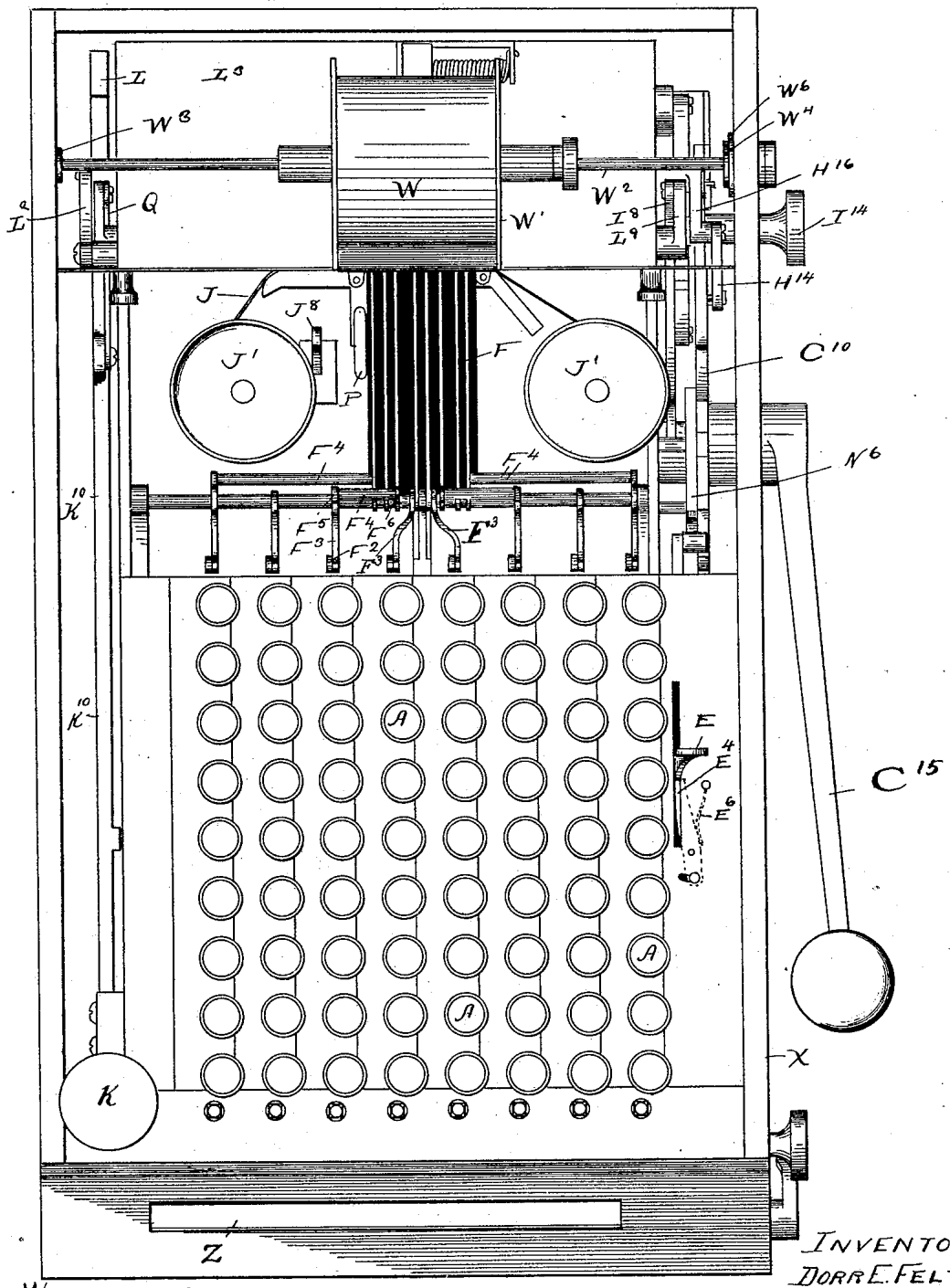
(No Model.) 12 Sheets—Sheet 1.

D. E. FELT.

PRINTING AND CALCULATING MACHINE.

No. 568,021. Patented Sept. 22, 1896.

FIG. I.



WITNESSES:
Lew. C. Curtis
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INVENTOR:
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HIS ATTORNEYS.

(No Model.) 12 Sheets—Sheet 2.

D. E. FELT.

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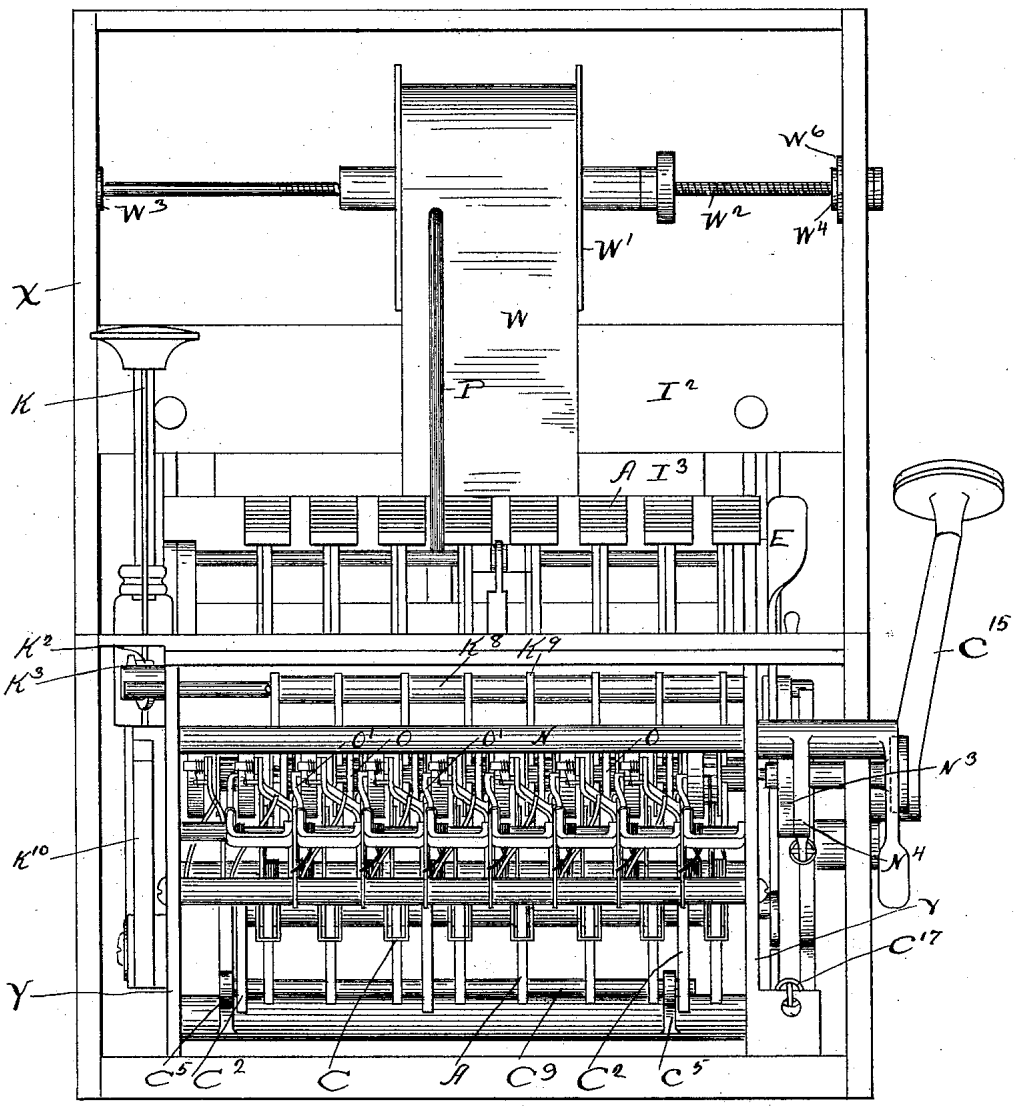
FIG. 2.



WITNESSES:
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INVENTOR:
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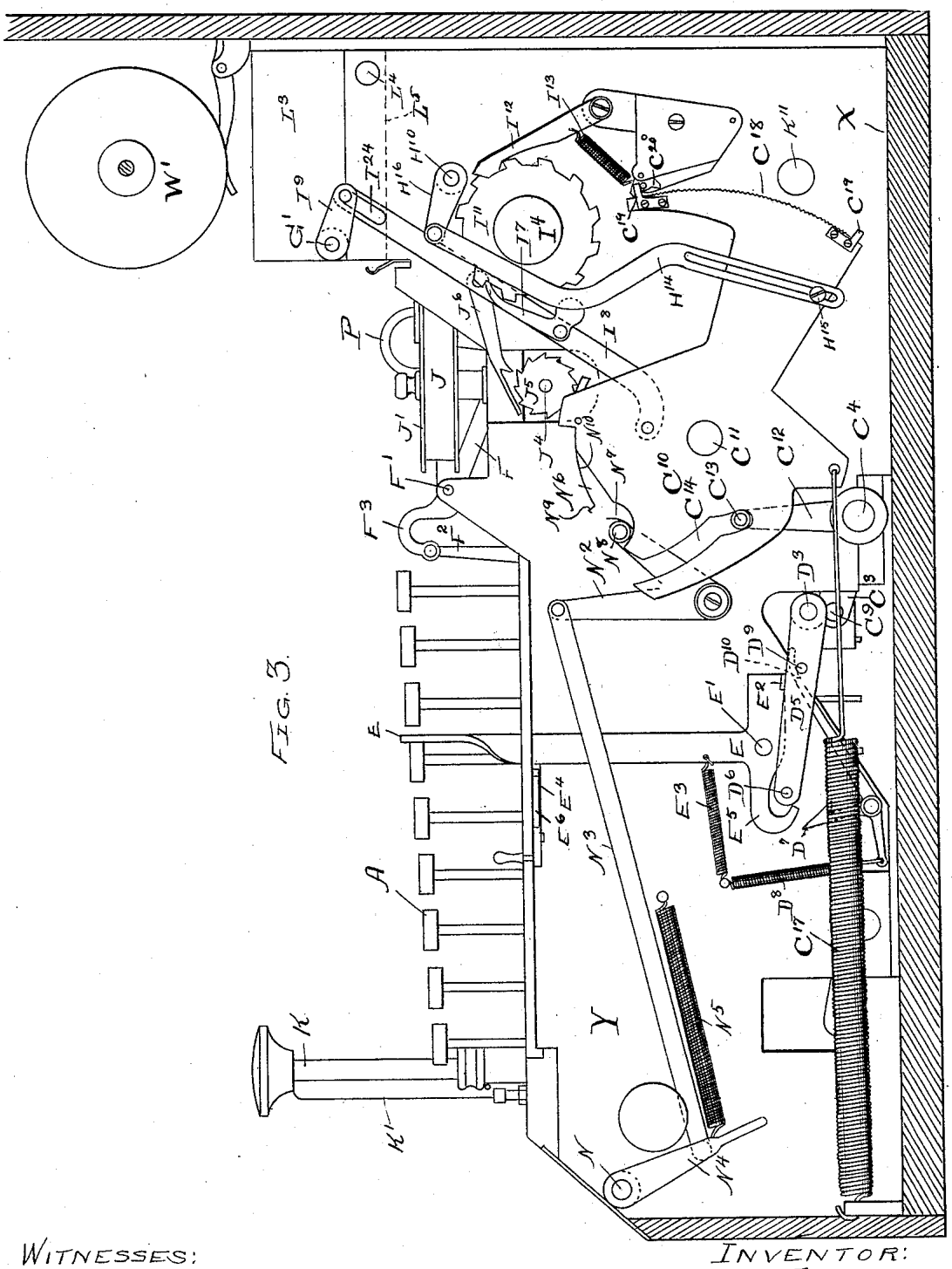

FIG. 3.

WITNESSES:
Sew. C. Curtis
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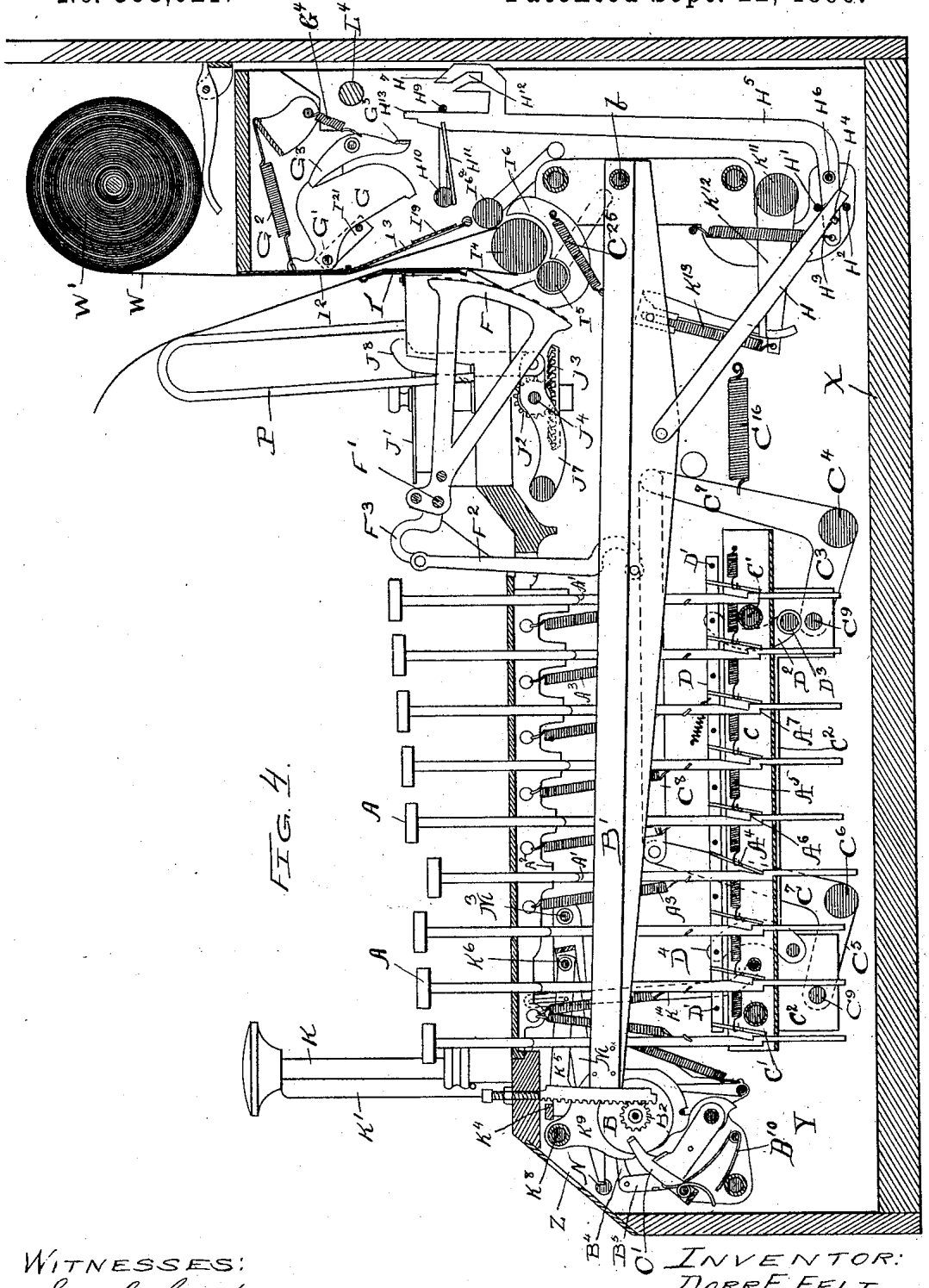

FIG. 4.

WITNESSES:
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(No Model.) 12 Sheets—Sheet 5.

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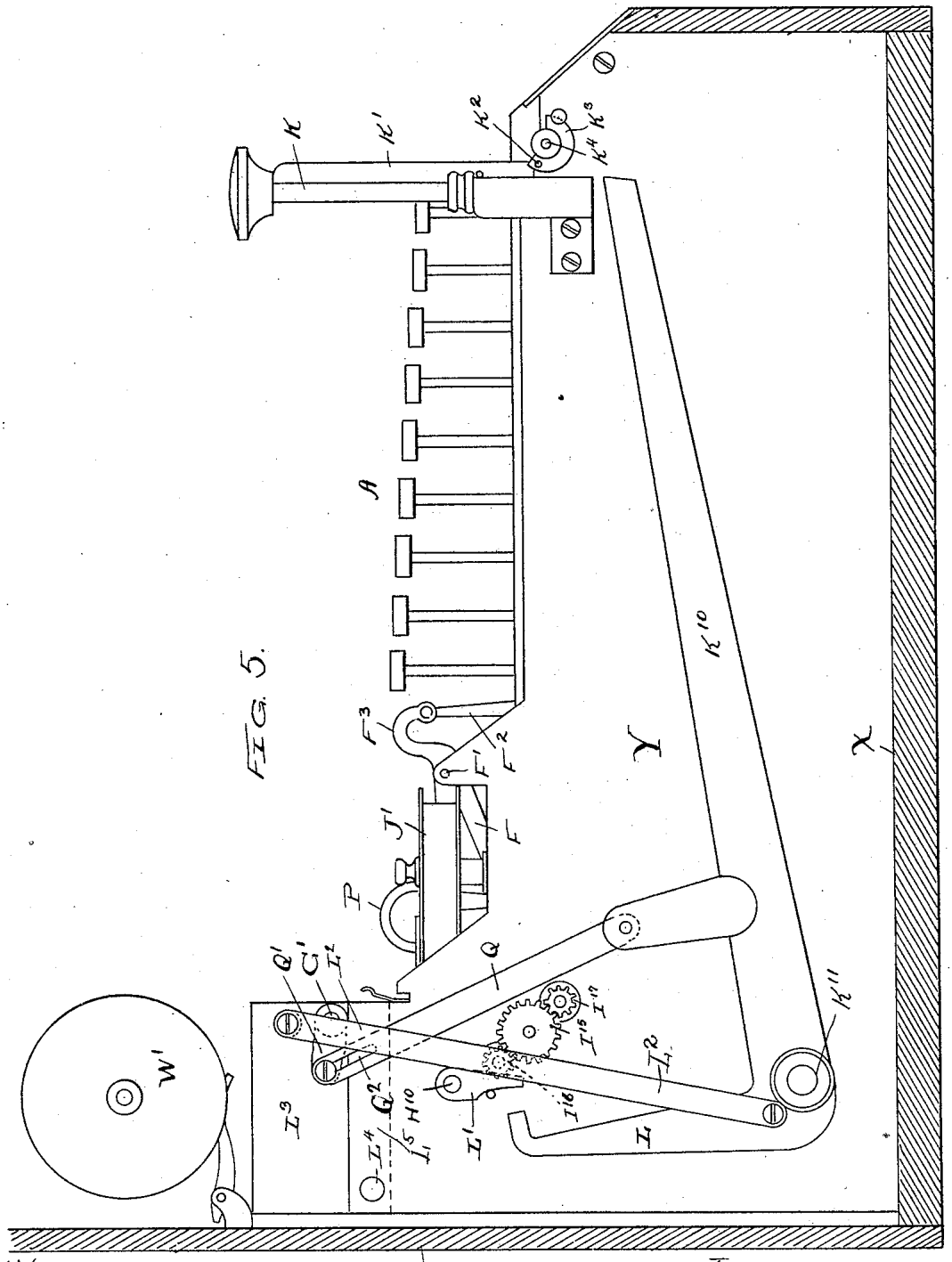

FIG. 5.

WITNESSES:
Lew. E. Curtis
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(No Model.) 12 Sheets—Sheet 6.

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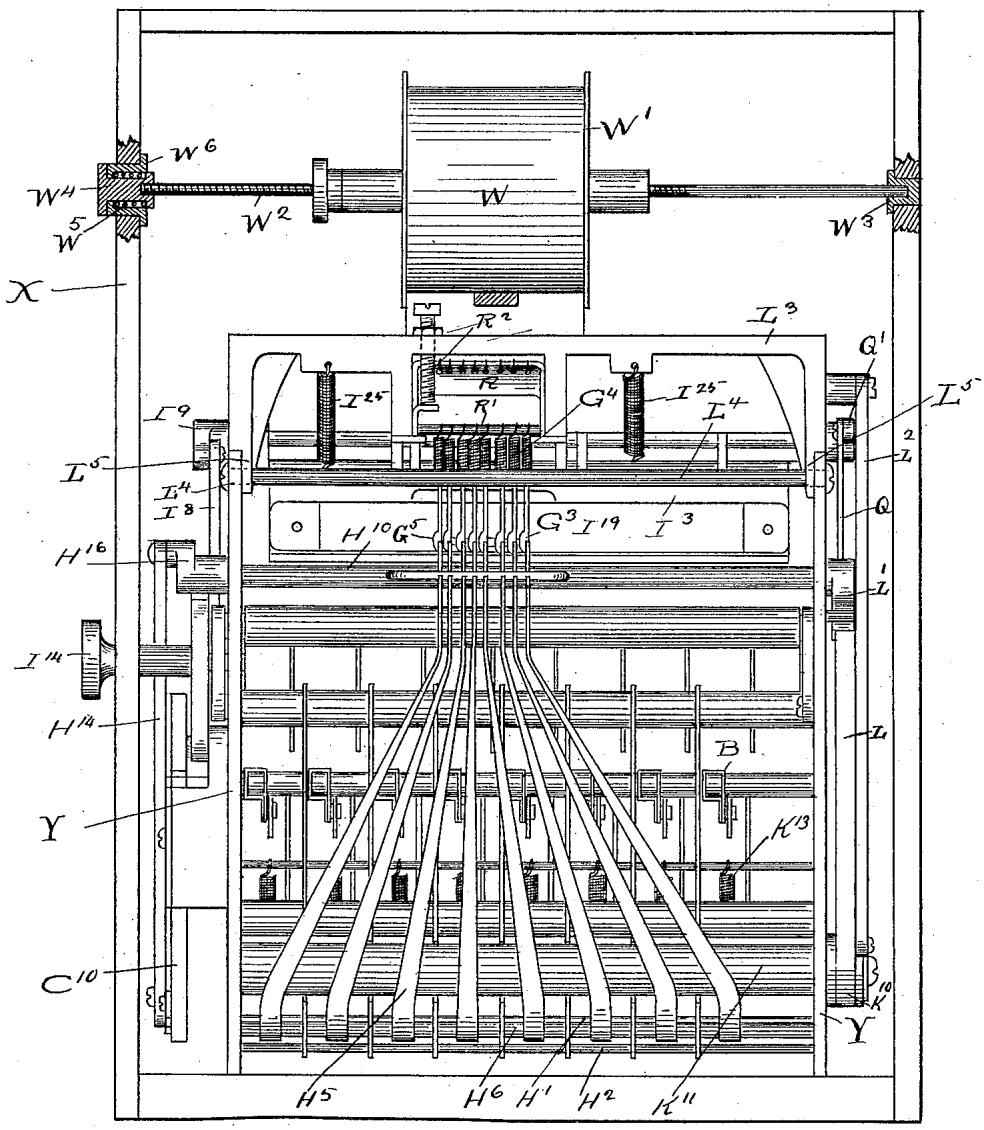
FIG. 6.



WITNESSES:
Lew. E. Curtis
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FIG. 7.

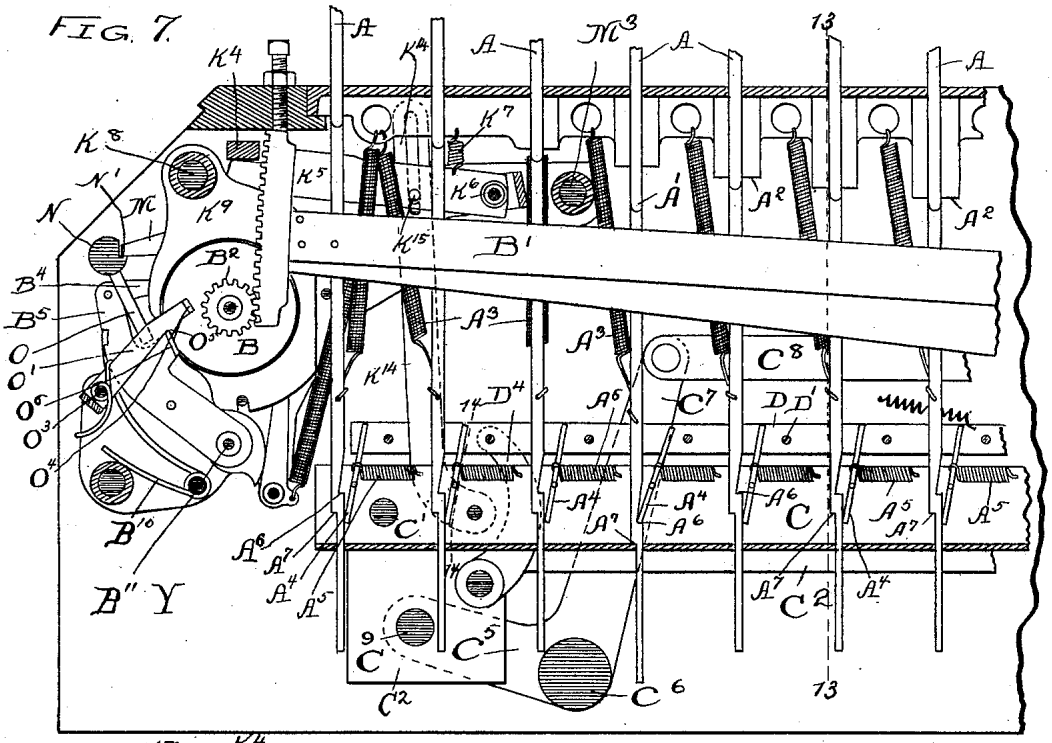


FIG. 8

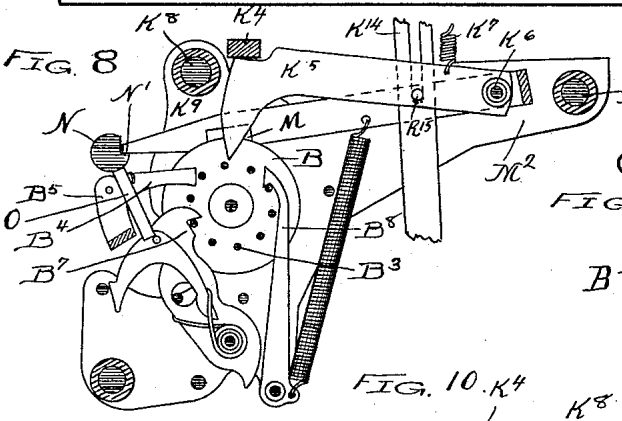


FIG. 9.

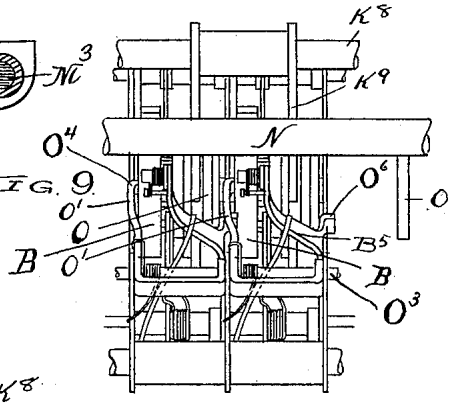


FIG. 10.

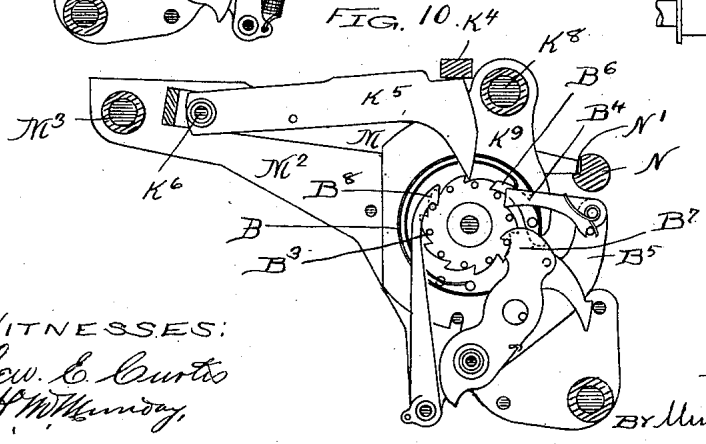
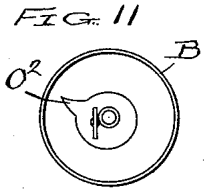


FIG. 11



WITNESSES:
Lew. E. Curtis
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PRINTING AND CALCULATING MACHINE.

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FIG. 12

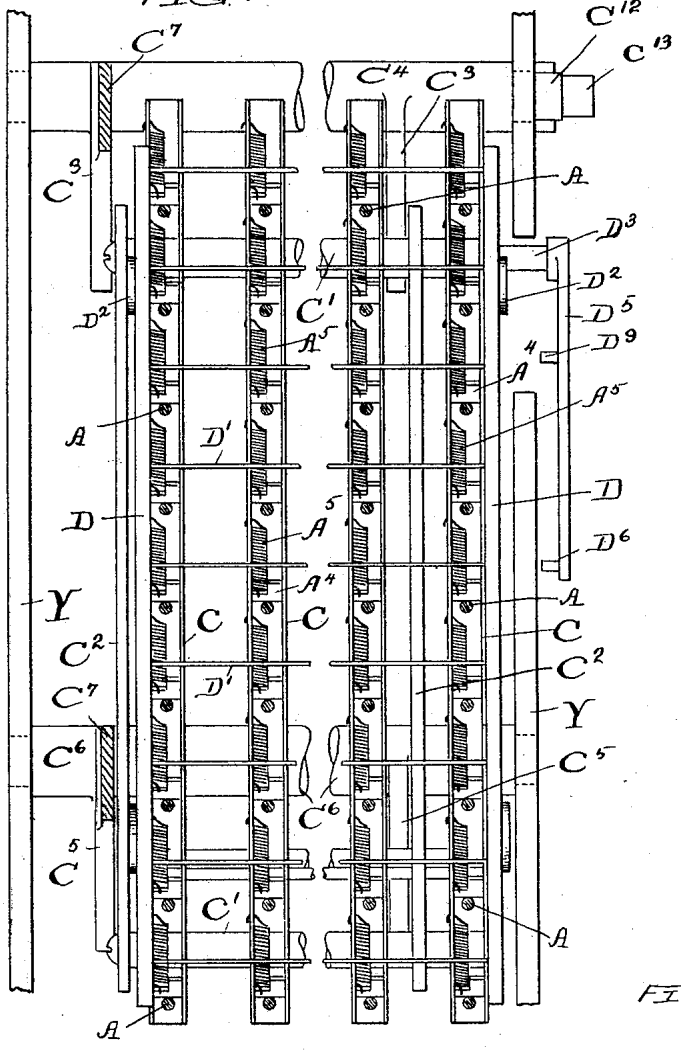


FIG. 13

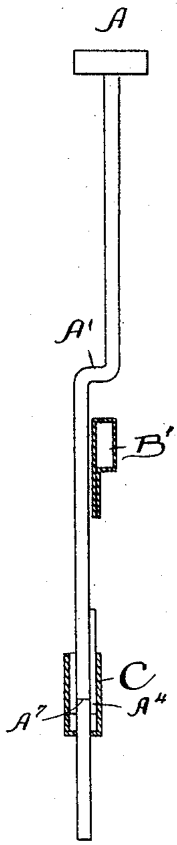


FIG. 15

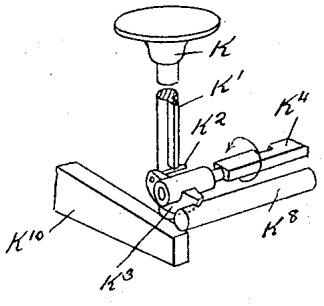
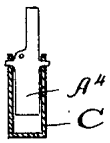


FIG. 14



WITNESSES:
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FIG. 16

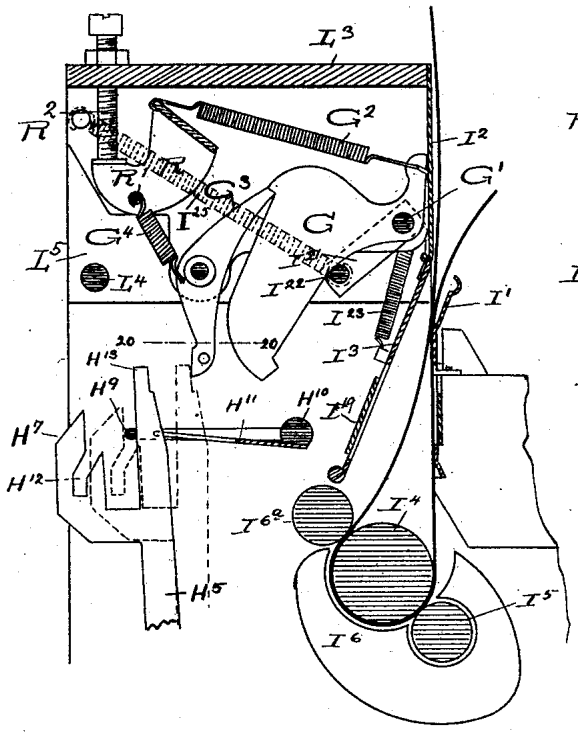


FIG. 17

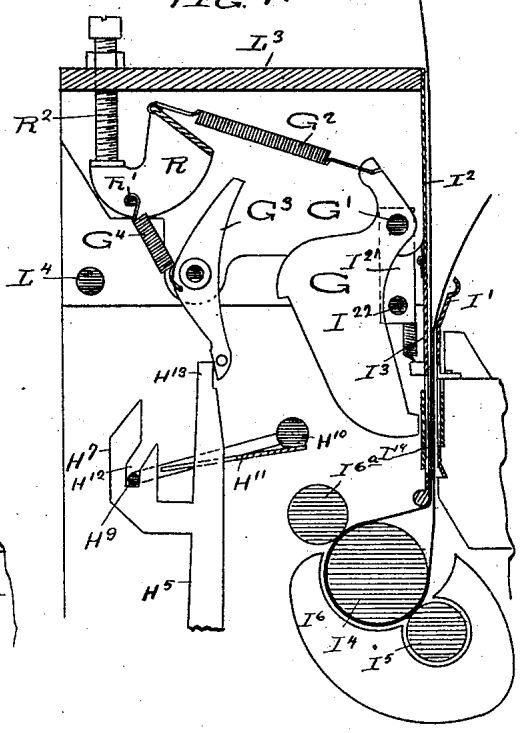


FIG. 18

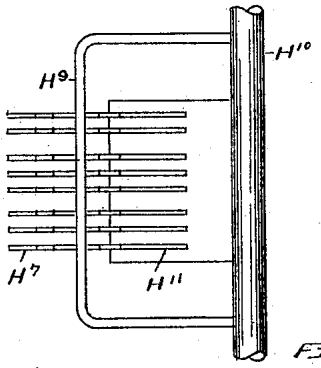


FIG. 19

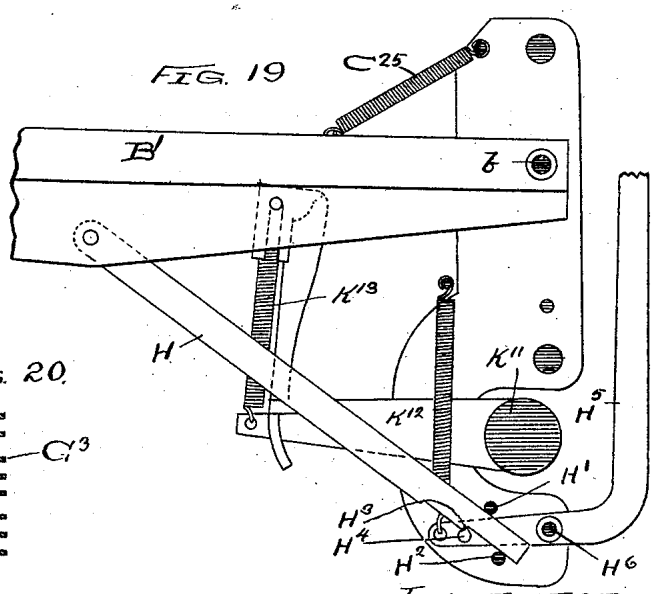


Fig. 20a

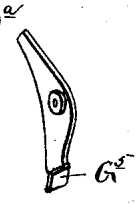
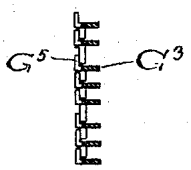


FIG. 20.



WITNESSES:
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INVENTOR:
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FIG. 21

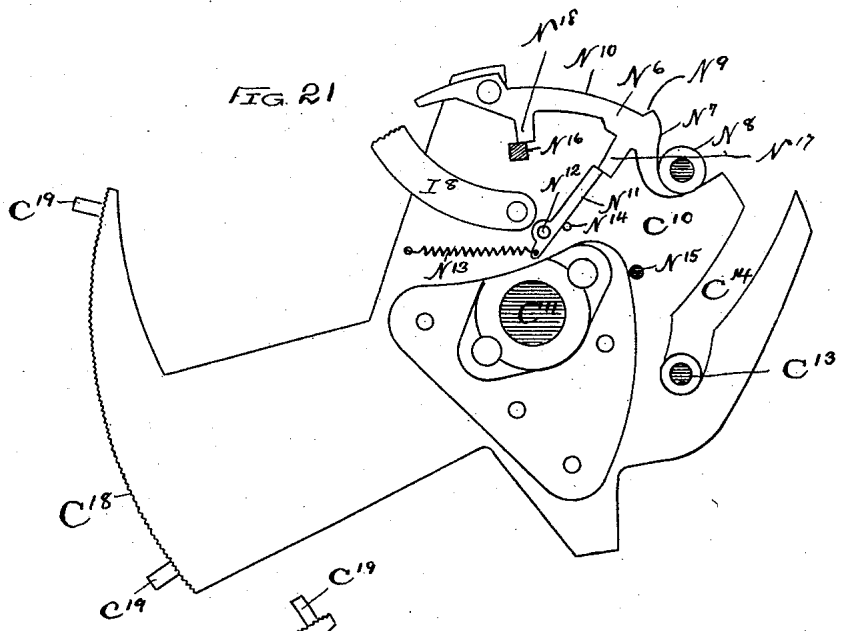

FIG. 22

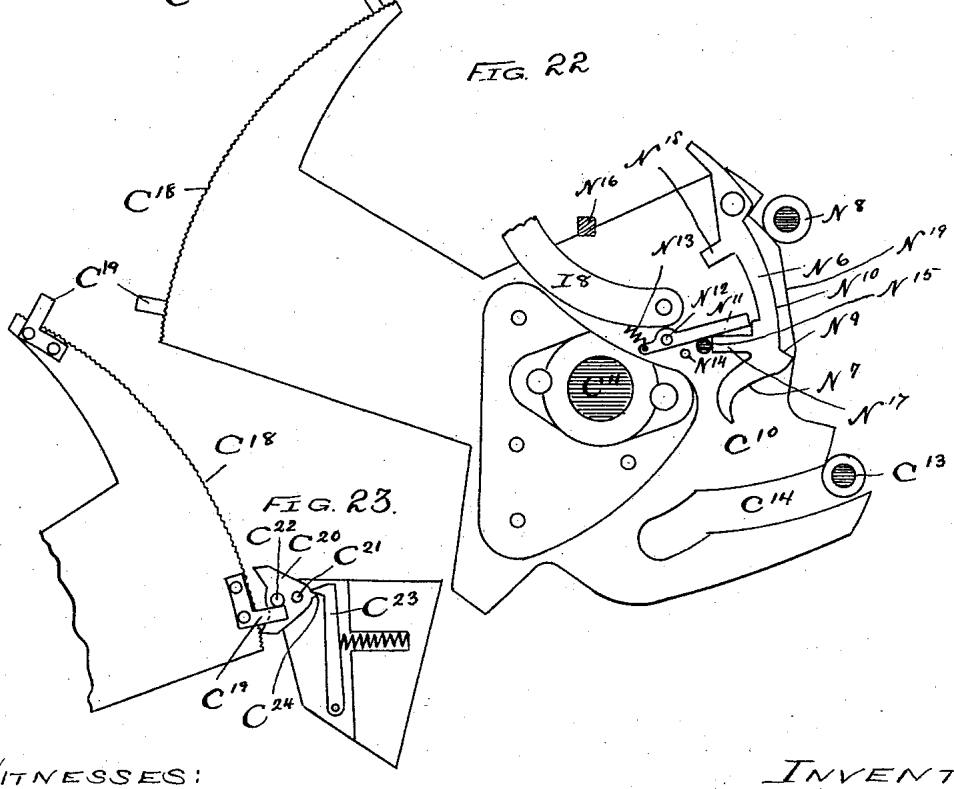

FIG. 23.

WITNESSES:
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(No Model.) 12 Sheets—Sheet 11.

D. E. FELT.

PRINTING AND CALCULATING MACHINE.

No. 568,021. Patented Sept. 22, 1896.

FIG. 24

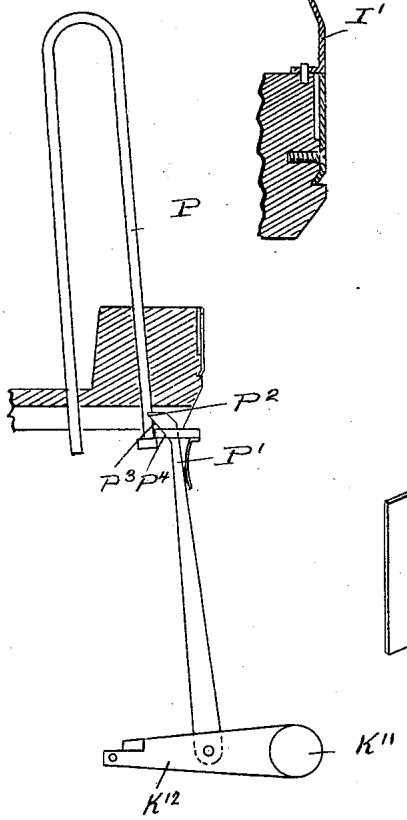


FIG. 26

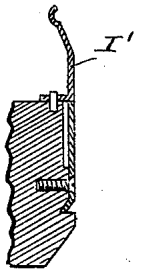


FIG. 25

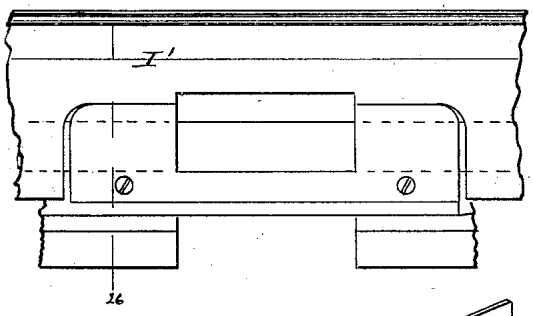


FIG. 28

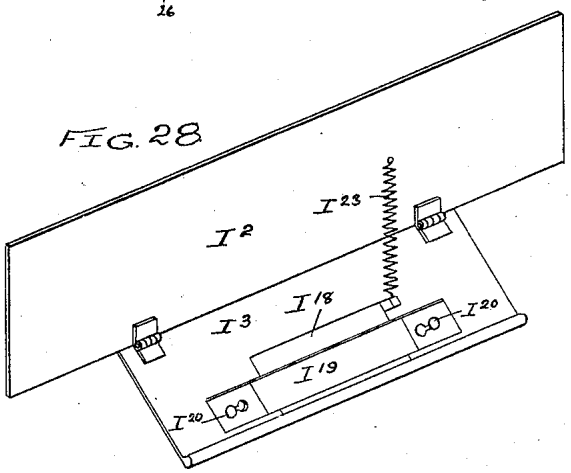
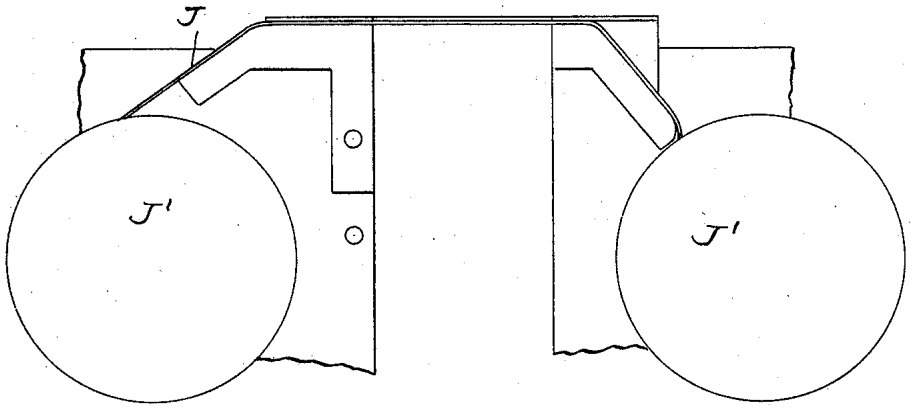


FIG. 27



WITNESSES:
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INVENTOR:
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HIS ATTORNEYS.

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No. 568,021. Patented Sept. 22, 1896.

FIG. 29.

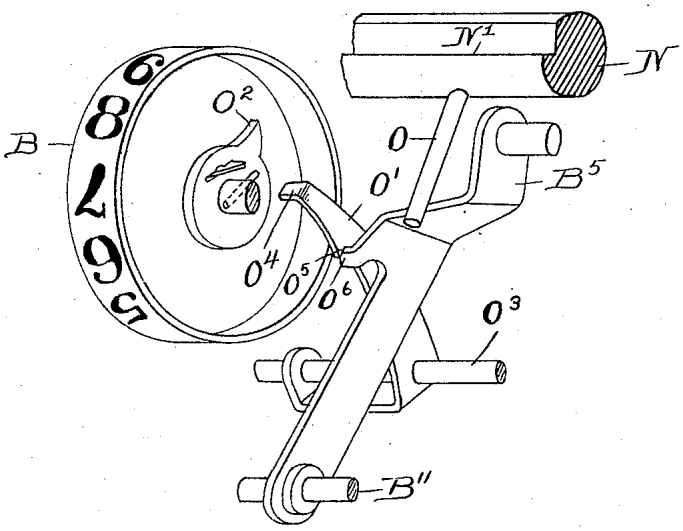
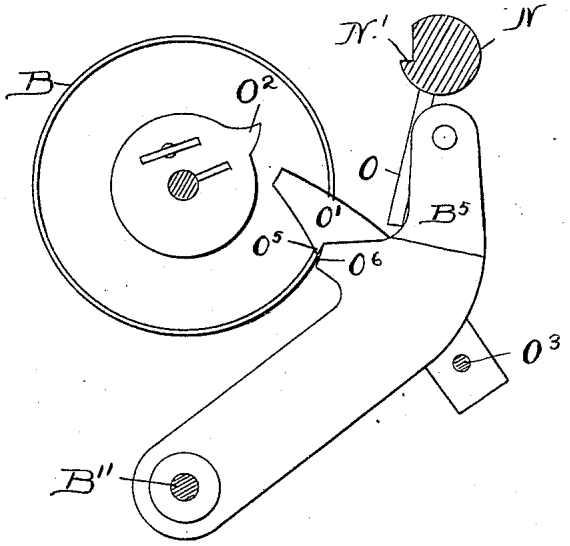


FIG. 30.



WITNESSES:
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A. D. Munday

INVENTOR:
DORR E. FELT
BY Munday, Evarts & Adcock,
HIS ATTORNEYS

UNITED STATES PATENT OFFICE.

DORR E. FELT, OF CHICAGO, ILLINOIS.

PRINTING AND CALCULATING MACHINE.

SPECIFICATION forming part of Letters Patent No. 568,021, dated September 22, 1896.

Application filed June 14, 1895. Serial No. 552,777. (No model.)

To all whom it may concern:

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

This invention relates to an improved machine adapted to the same work as the machine described in the patent to me, No. 465,255, of December 15, 1891. In the patented machine the operating of the numeral-wheels other than in carrying was done by the operator in the act of manually depressing the keys, which were made to actuate the segment-levers; but in my present machine I first set the keys without moving the levers, and in so doing couple the keys with a vertically-vibrating frame which is actuated by a hand-lever located at one side of the machine and serves to operate the segment-levers of all the set keys simultaneously and at one operation. The hand-lever, in the same operation in which it causes the actuation of the numeral-wheels, also acts to cause the printing of the figures represented in the keys which were set, the movement of the ink-ribbon, and the feed of the paper. Said lever further assists in the carrying operations.

The invention consists in the novel construction of the devices hereinafter described, and pointed out in the claims.

In the accompanying drawings, which form a part of this specification, Figure 1 is a plan. Fig. 2 is a front elevation; Fig. 3, an elevation of one of the sides; Fig. 4, a central longitudinal vertical section; Fig. 5, an elevation of the other side, and Fig. 6 a rear elevation. Fig. 7 is an enlarged partial vertical longitudinal section. Fig. 8 is a detail section of one of the numeral-wheels and its actuating and controlling devices; Fig. 9, a partial elevation of the same. Fig. 10 is a view similar to Fig. 8, looking in the opposite direction. Fig. 11 is a side view of one of the numeral-wheels. Fig. 12 is a partial horizontal section showing the vibrating frame. Figs. 13 and 14 are detail sections on the lines 13 13 and 14 14 of Fig. 7. Fig. 15 is a perspective of the printing-plunger and adjacent parts. Figs. 16 and 17 are vertical sections of the hammer and paper-controlling mechanism, showing the parts in different positions. Fig. 18 is a plan of the swinging frame for causing the tripping of the hammers. Fig. 19 is a partial vertical section of the rear end of the machine. Fig. 20 is a horizontal section on the line 20 20 of Fig. 16, and Fig. 20^a is an enlarged detail perspective of the hammer-pawl. Figs. 21 and 22 are inside face views of the main cam, showing the parts in different positions. Fig. 23 shows the safety-latch for preventing reversal of motion during a stroke of the hand-lever. Fig. 24 is a vertical section showing the paper-guard. Fig. 25 is a front elevation of the ribbon and paper guides. Fig. 26 is a section on the line 26 26 of Fig. 25. Fig. 27 is a plan of the ribbon-spools and guide. Fig. 28 is a perspective of the impression-strip and frame. Fig. 29 is a perspective of the numeral-wheel-carrying mechanism. Fig. 30 is a sectional view of the same mechanism. In Figs. 2, 3, 5, and 6 the casing is omitted.

In the drawings, X represents the surrounding case of my improved printing and calculating machine. Y Y are side plates supporting most of the parts, and A A are the keys arranged in denominational rows, with nine in each row, in the usual manner. B B are the numeral-wheels, B′ B′ the segment-levers pivoted at *b* and operating the wheels, and B^2 B^2 the pinions meshing with the segment-levers and suitably connected to the wheels so they may serve to rotate them in the forward direction only.

In the present invention the segment-levers are not operated immediately by striking, as in former machines patented by me, but instead thereof the depression of the keys is a mere setting operation in which the keys are permitted to descend only a short distance and for a portion only of their stroke, sufficient to bring about engagement with the channel-bars, as hereinafter explained, and in this setting operation the levers which are to be operated are coupled to said bars which form part of a vibrating frame located below the series of segment-levers and adapted to move simultaneously such of them as may correspond to the keys which are set. This frame is composed of a series of channel-bars C C, one for each row of keys, secured to-

gether by cross-bars C′ C′ and longitudinal plates C^2 C^2, so as to form a rigid and strong structure. The frame is supported upon four horizontal crank-arms, two, C^3 C^3, of which are mounted upon cross-shaft C^4 under the rear of the frame, and the other two, C^5 C^5, are upon a second rocking cross-shaft C^6, which receives power from shaft C^4 by means of the upstanding arms C^7, one upon each of said shafts, and a bar C^8, connecting the upper ends of said arms. (See Figs. 4, 7, and 12.) The cranks C^3 and C^5, located at the same side of the machine with said arms C^7, may be and desirably are in one piece with the latter, forming bell-crank levers. The ends of the cranks C^3 and C^5 are pivotally joined to cross-bars C^9, passing through downward extensions of the longitudinal plates C^2, as seen at Fig. 4. It will be seen from this construction that the cranks C^3 and C^5 will all move in unison, so that the frame will vibrate up and down without losing its horizontality. Power for giving this movement is applied to the cross-shaft C^4 by the cam C^{10}, pivoted upon a stud-shaft C^{11}, inserted in the side plates of the machine, the shaft C^4 having an upstanding arm C^{12}, provided with a pin C^{13}, which enters a slot C^{14} in said cam and is forced toward the front of the machine by the turning of the cam. (See Fig. 3.) A hand-lever C^{15} is secured to the cam, as shown, and after the proper keys have been set the operator imparts a downward stroke to said hand-lever and thereby operates the cam, which causes the vibrating frame to descend and carry with it the segment-levers whose keys have been set. In so doing the numeral-wheels corresponding to said segment-levers are turned either to show the amount represented by the keys which were set or to add that amount to the amount already represented by the wheels. In addition to this I also, through the same stroke of the hand-lever, cause the actuation of the printing mechanism hereinafter described and record the sum represented in the keys which were set. The segment-levers B′ are each provided with retracting-springs C^{25}, as seen at Fig. 4.

The keys themselves are made the means of carrying motion from the vibrating frame to the segment-levers by the following construction: The stems of the keys are extended downward and passed through openings in the bottom or horizontal web of the channel-bars C, the extension being carried below the lowest plane touched by the vibrating frame in its downward movement. The stems pass down at the sides of the segment-levers, as at Fig. 13, and above the levers each key-stem is provided with a lateral offset, projection, or shoulder A′, (shown in same figure,) adapted to bear upon the segment-lever and force it down when the stem is drawn down by the vibrating frame. As the frame always moves to the same extent, the shoulders A′ upon the key-stems are located in different horizontal planes, so they may come in contact with the segment-levers at an early or late stage in the movement, according to the power of the key. Thus the "9" key will engage the segment-lever very soon after it commences to descend in the setting movement, while the "1" key will not engage until near the close of its stroke. In this manner the proper amount of movement is communicated to the segment-levers. I prefer to form the shoulders by bending the key-stems, as clearly indicated at Fig. 13, that being a very simple operation, and moreover the upper sides of the bends may be made to engage the stops A^2, which hang down from the top of the machine and act to limit the upward movement of the keys received from the retracting-springs A^3. Instead of a bend or offset, the shoulders may obviously be otherwise formed. When the keys are depressed by hand, their stems are automatically coupled to the vibrating frame by means of the dogs or latches A^4, of which there is one for each key. The dogs or latches are pivoted in channel-bars C, and are actuated by springs A^5, so that they engage the notches or shoulders A^6 in the key-stems whenever the stems are moved down in the setting operation. The stems are also provided with other shoulders A^7, adapted to engage the bottom of the channel-bars C and to limit the down movement in setting. In Fig. 4 one of the keys is shown as depressed with this shoulder resting against the surface of the channel-bar and with the latch engaging notch A^6. I prefer that the portion of the stems which passes through and below the channel-bars should be reduced in size from the upper portions, as shown at Fig. 7, and preferably by flattening the same, so as to prevent the key from turning. With this construction, when the vibrating frame is forced down the key whose stem is engaged by its latch will be drawn down with the frame, and such key will also cause its corresponding segment-lever to move with it to the extent necessary to impart an amount of rotation to the numeral-wheel which shall agree with the power of the key.

To release the keys from the vibrating frame, a supplemental light frame, (best shown at Figs. 4, 7, and 12,) consisting of longitudinal bars D and cross-wires D′, one of the latter being located immediately behind each transverse row of the latches A^4, is employed, and this frame is supported at one end by arms D^2 upon the cross-shaft D^3, having bearings in the plates C^2 of the vibrating frame and at the other end by arms D^4, pivoted to said plates. The releasing-frame moves with the vibrating frame, being supported upon the latter, but it is also capable of a horizontal motion, which it receives from the rocking of said shaft D^3, in which it moves the entire series of latches sufficiently to release any of them which may be in engagement with the keys. The rocking of the shaft is due to the crank-arm D^5 upon its outer end, as shown

at Fig. 3. This crank-arm has a pin D^6, which, when the vibrating frame carries the crank-arm and its shaft down, is engaged by the latch D^7, stationarily pivoted to the side of the machine. A spring D^8 is attached to the latch and acts to force it into its engaging position whenever the latch is free to yield to it. The crank-arm also carries a pin D^9, which sets under the rearwardly-extending arm D^{10} of the latch, and normally holds the latch away from its acting position.

With the mechanism just described, and which is most fully shown at Fig. 3, the operation will be as follows: When the vibrating frame moves down, it carries the crank-arm D^5 with it and thereby allows the latch D^7 to swing in obedience to its spring D^8 into position, where it will engage the pin D^6 when the parts rise in their return movement. This engagement causes a momentary detention of the outer end of D^5 while the shaft and other parts continue to rise. Thus a slight rocking movement of the shaft ensues, which imparts a horizontal movement to the releasing-frame, whereby the key-coupling latches are released. Before the upward movement has ceased, however, the pin D^9 will carry the arm D^{10} to a sufficient height to force the latch away from pin D^6 and thus release the crank-arm from the latch. The releasing-frame is also made operable by an independent lever, in order to enable the operator to correct mistakes made in depressing the keys before adding or printing. This lever, which is shown at E, Fig. 3, resembles an inverted **T** in shape, and is stationarily pivoted at E′. One arm of the lever carries a projection E^2, adapted to bear down upon and depress the crank-arm D^5 when the upper end of said lever is moved toward the rear of the machine, such movement releasing the key-coupling latches and allowing the keys to resume their normal positions, as will be understood from what is written above. A spring E^3 acts on this lever E to draw it toward the front, and a catch E^4 normally holds the lever in the position shown at Fig. 3. The end of the other arm, E^5, of the lever is rounded, as shown, in order that it may be made to keep the latch D^7 out of engagement with the crank-arm D^5 whenever the operator desires to repeat any number without resetting the keys for such numbers. In order to accomplish this repetition, the operator releases the catch E^4 and the lever immediately swings toward the front of the machine, carrying the rounded end E^5 into position, where it will prevent the latch D^7 from assuming its operative position. The hand-lever C^{15} may, while the latch is thus held, receive any number of strokes desired, and with each one it will add and record the sum represented by the set keys without releasing the keys. This release is readily effected at any time, however, by moving the lever E back in the same manner as in releasing the keys in correcting mistakes in setting.

The catch E^4 is provided with a spring E^6 for returning it to position, and it is automatically forced out of the way by lever E when the latter is swung back to release the keys. The vibrating frame is returned to its normal position after each operation by spring C^{16}, attached to one of the upstanding arms C^7. The releasing-frame is returned by the springs A^5, which are strained by the horizontal movement of the frame, and the return of the frame causes the rocking of shaft D^3 back to its original position, and the cam C^{10} is returned after each stroke of the hand-lever by the spring C^{17}, attached to said cam and the casing.

In order to prevent injury to the apparatus, as well as mistakes, I provide a mechanism whereby only full strokes can be given to the hand-lever. In other words, there is no possibility after a stroke in either direction is once begun of reversing the direction of the movement before that stroke is fully completed. This mechanism (fully shown at Fig. 23) consists of the segment C^{18} upon the rear face of the cam C^{10}, having fine teeth cut in its edge, the projecting dogs C^{19} at top and bottom of the segment, and a double-pointed pawl C^{20}, pivoted centrally upon a stationary pivot C^{21}, and having a stud C^{22} projecting from its side face into the path of the dogs C^{19} and acting with said dogs in reversing the pawl at the end of each up-and-down movement of the segment. One point of the pawl prevents downward movement and the other prevents upward movement, and when the pawl is positioned by either of the dogs and the stud it is retained in the position thus given it by the spring-pressed trigger C^{23}, located in the rear of the pawl and having a **V**-shaped point adapted to engage with either side of the similarly-shaped point C^{24} upon the rear face of the pawl. Upon the completing of the stroke the pawl is reversed by the contact of the other dog with the stud, and the trigger then acts in a similar manner to hold the pawl in the reversed position.

Corresponding to each segment-lever is a swinging segmental type-head F, which, by the descent of the lever, is lifted into position to present the proper type to the impression devices. All the type-heads are loosely supported and swung upon the stationary cross-shaft F′, and the connections between them and the levers are suitable for carrying motion from one to the other. These connections desirably consist of links F^2, pivoted at their lower ends to the segment-levers, and cranks F^3, to which the links are also pivoted at their upper ends. The cranks are rigidly connected to the type-heads, either directly, as in the case of the two cranks and type-heads at the middle of the series, (said two cranks being bent laterally, as shown at Fig. 1,) or indirectly, in the case of the type-heads other than the center ones, by means

of a connecting-bar F^4, rigidly secured in risers or projections F^5 and F^6, one upon the crank and the other upon the type-head.

G G are the impression-hammers, all loosely hung upon a shaft G′, and each is provided with an actuating-spring G^2 and a controlling-pawl G^3. Each pawl is likewise provided with a spring G^4, the tendency of which is to keep the pawl in engagement with the hammer. The hammers are released from their pawls, preparatory to a printing operation, by mechanism as follows: Each of the segment-levers carries a bar or lever II, (shown at Fig. 4,) extending downwardly and rearwardly in a diagonal direction and pivotally attached to the segment-lever. At its lower end this bar passes between two stationary cross bars or rods II' II^2, which serve as guides in its movements, one being above the bar and the other below it. The under side of the bar is also cut away, so as to form a shoulder at H^3, and this shoulder is normally in engagement with a stud H^4, carried upon the lower end of an elbow-lever H^5, pivoted upon the cross-bar H^6. The descent of the segment will, through the lever II, shoulder H^3, and stud H^4, cause the elbow-lever to rock on its pivot, but before the rocking has proceeded far the stud will slip from under the shoulder and during the remainder of the down movement of lever II it will simply ride on the stud without communicating further motion to the elbow-lever.

The rocking of lever H^5, received as just described, carries its upper end inward from the position given at Fig. 4 and into close proximity to the lower end of the corresponding pawl G^3 of hammer G. The lever H^5 also carries an elbow-like projection H^7, (shown at Figs. 16, 17, and 18,) the upper point of which engages the rear or cross bar of a swinging frame H^9, secured to a rock-shaft H^{10}, when the described inward movement of the upper end of said lever occurs, and thus limits temporarily that movement. In the interior of said swinging frame, and secured to the same rock-shaft therewith, is a comb H^{11}, the teeth of which act as guides to the rocking elbow-lever and insure its striking the proper hammer-pawl. The further motion of the elbow, in which it acts to release the pawl, is received from the downward swing of the frame H^9, whereby its rear bar, by which the elbow-lever was arrested, is carried into the inclined slot H^{12} upon the interior of the elbow projection of lever H^5, and this action results in forcing the upper extremity H^{13} of the lever against the hammer-pawl and releases the latter, so that the hammer is freed and makes an impression.

The movement of the swinging frame H^9 and its shaft H^{10} is received from the main cam C^{10} through the medium of a slotted lever H^{14}, a stud H^{15} upon the cam and working in the slot of the lever, and a crank H^{16} upon the shaft H^{10}, and to which crank the lever is pivoted, as will be understood from Fig. 3. The slot permits the cam-stud to move nearly through its range of oscillation before it will give motion to the shaft H^{10}, so that the frame H^9 is not actuated until near the conclusion of the downstroke of the hand-lever. This gives time for the type-heads to arrive at their proper positions before the hammers are released.

The hammer-pawls are each provided, as shown at Figs 4, 6, 20, and 20^a, with a flange G^5, which extends laterally to the right and over the next pawl in order upon that side. By means of these flanges, when any pawl is released by the mechanism above described it also causes the release of all the pawls in the series lying to the right of the one released by the mechanism, and in this respect these flanges serve the purpose of the flanges designated by the number 94 in my said patent, No. 465,255, which is to cause the automatic printing of the zeros to the right of any pawl released by the operator through one of the levers H^5.

The paper ribbon or strip W is passed, as indicated at Figs. 4, 16, and 17, from the spool W′ down between the front shield or guide I′ and rear plates I^2 and I^3, the former being stationary and the plate I^3 being hinged to the plate I^2 and depending therefrom. The paper then enters first into the bite of the rollers I^4 and I^{6a}, and is deflected by guides I^6 around said roller I^4 and between it and roller I^5. Roller I^4 is actuated between the successive printing operations by the pawl I^7 upon the lever I^8, pivotally joined at its lower end to the main cam and at its upper end to a crank I^9 upon the shaft G′, and the ratchet-disk I^{11} upon the shaft of the central roller I^4. A second pawl I^{12} also engages disk I^{11} and is yieldingly held against it by a spring I^{13} and serves to prevent over or too free rotation. The actuation of roller I^4 draws the paper from the spool and forces it up again past the printing-center, as plainly illustrated, and it may also be actuated independently of the mechanism described by the thumb-nut I^{14} upon one end of its shaft. At the other end the shafts of rollers I^4, I^5, and I^{6a} are provided with intermeshing gears I^{15}, I^{16}, and I^{17}, so that the actuation of one gives motion to the other two.

The swinging or hinged plate I^3 is cut away at the printing-center, as shown at I^{18}, Fig. 28, and across this opening I stretch a thin rubber sheet I^{19}, which softens the blow of the hammers against the type, and also improves the character of the impression. The rubber is caught at each end upon the buttons I^{20}. I also move this plate close up against the paper just before the printing takes place by means of a swinging frame, (best seen at Figs. 16 and 17,) consisting of arms I^{21} upon shaft G′ and a cross-bar I^{22}, connecting the arms, said shaft being actuated in the early stages of the stroke of hand-lever C^{15} in a direction which swings plate I^3 and moves it from the position given at Fig. 16 to that given at Fig. 17, thereby forcing the

two thicknesses, the up and down courses of the paper, closely together, a desirable result, as better impressions can be obtained usually when two thicknesses of paper in close contact are interposed between the hammer and type than with one. A light spring I^{23} retracts the plate after it is released by arms I^{21}, so as to normally keep it out of the way when putting in new strips of paper. The hammers, or such of them as have been released in the printing operation, are, at the conclusion of the printing, returned to their normal positions by the swinging frame I^{21} I^{22}, above described, which extends across the series of hammers, and is actuated in this function by the springs I^{25}. As the frame I^{21} I^{22} returns to its normal position the plate I^3 returns, under the power of the spring I^{23}, to the position shown in Fig. 16. In order that the frame may be swung when the totals are printed, as hereinafter set forth, the lever I^8 is slotted at I^{24}, as shown.

The ink-ribbon J is carried upon spools J', which may be actuated intermittently by any suitable gearing, as, for instance, by mechanism shown at Figs. 3, 4, and 27 and consisting of bevel-gears J^2 J^3, one of which is upon shaft J^4, carrying a ratchet-wheel J^5, receiving motion from the pawl J^6, borne upon the lever I^8. The shaft J^4 is carried by the swinging arms J^7 and is movable by hand, so as to permit it to be brought into engagement with the shaft of either spool, as desired, and J^8 is the lever for changing the engagement from one spool to the other, which it does by lifting or depressing the shaft J^4, the gears J^2 upon the spool-shafts being located in different horizontal planes in the manner indicated at Fig. 11 of my Patent No. 441,232. I have thought it unnecessary to illustrate this ribbon-controlling mechanism fully, as no part of that shown is new at this time.

In the printing of the answers or sums of the numbers added the operator depresses the plunger K. This plunger is located near the front of the machine and is provided with a longitudinal feather K', the lower end of which is normally in engagement with a pin K^2, projecting laterally from the side of a cam K^3, secured upon the end of the rock-shaft K^4, and through such pin rocks said shaft when the plunger is moved down. Shaft K^4 is angular in cross-section, and when rocked as just stated (and near the beginning of the stroke of the plunger) it acts to force the series of stop-pawls K^5, of which there is one for each numeral-wheel, into locking engagement with the pins B^3, projecting from the sides of the wheels and serving as ratchets whereby the wheels may be moved in carrying by the pawls B^4, mounted upon carrying-levers B^5, and also as a means whereby the wheels may be engaged by the oppositely-acting pawls B^7 and B^8. The stop-pawls K^5 are pivoted on the cross-shaft K^6 and are all held normally out of engagement by springs K^7.

When the plunger actuates the cam-shaft K^4, it also moves the adjacent shaft K^8 longitudinally through the engagement of said cam K^3 with a notch in shaft K^8, as will be understood from Figs. 2, 4, and 15, and this longitudinal movement carries the plates K^9 upon said shaft into such position that they lock against action the pawls B^6, whose office it is to carry motion from the pinions B^2 to the numeral-wheels, so that no motion will be given the wheels during the printing operation and while the pawls remain locked. The descent of the plunger also operates a lever K^{10} upon shaft K^{11}, Fig. 5. This shaft carries a series of arms K^{12}, one for each segment-lever. Said arms are joined by springs K^{13} to their corresponding segment-levers, and when the shaft is rocked by means of the plunger the arms and springs will draw the segment-levers down. This downward movement of the segments positions the type-heads, through the medium of links F^2 and cranks F^3, in proper position so they will print the figures corresponding to those indicated by the numeral-wheels at the sight-opening Z. At this time it will be remembered that the numeral-wheels are all locked by their pawls K^5, and the pinions which mesh with the segments and through which the wheels are actuated in their forward rotation are, through the medium of the mechanism such as is shown in Figs. 17, 13, 15, and 10 of my Patent No. 465,255 of December 15, 1891, disengaged from the wheels and allowed to turn with the segments under the power of the springs K^{13} until the segments have reached a position corresponding to that of the wheels. Further movement of the pinions and segments is then arrested by the engagement of pawls similar to the pawls 167 of my said patent, with shoulders corresponding to the shoulders 170 of the patent. Any further movement of the arms K^{12} will be accommodated by the stretch of springs K^{13}. More complete details of the plates K^9 and their action are given in the patent to me, No. 465,255, of December 15, 1891. It will be understood that the segment-levers of such of the wheels as stand at zero are not changed at the time the answer is printed.

The operation of the segment-levers imparts the initial or positioning movement to the tripping-levers H^5, as already set forth, and by means of the plunger and lever K^{10} I also actuate the frame H^9, through which and said tripping-levers the hammers are released and allowed to print. For this latter purpose an upstanding arm L is applied to the pivoted end of lever K^{10}, and the upper end of said arm acts as a striker against the depending crank-arm L', upon the end, at the side of the machine (shown at Fig. 5) of the shaft H^{10}, and imparts the same movement to said frame and its shaft as they receive from the actuation of the hand-lever C^{15} through the mechanism located upon the opposite side of the machine. A lever L^3 also extends from the pivoted end of lever K^{10} to

the frame or housing L^3, in which the hammers are supported, as seen in Fig. 5. This house or frame is provided with depending flanges L^5, and these are pivoted upon the cross-bar L^4, supported in the main frame. The front of this housing is given a slight upward movement by the lever L^2 at each actuation of the plunger. The purpose of this feature is explained in my application, Serial No. 522,572, filed September 10, 1894, and is to bring the hammer and type into proper alinement at the time of making the impression.

Adjacent to each of the stop-pawls K^5 is a slotted link K^{14}, whose function it is to draw the stop-pawls K^5 into locking engagement with the numeral-wheels at the conclusion of the adding operation. To this end each pawl is provided with a pin K^{15}, which enters the slot of the link, and the links are all joined one to each channel-bar C of the vibrating frame, so they are forced down with said frame. The slots are of such length as to insure their acting upon the pawls at the conclusion of their down movement. In this manner the wheels are prevented from overrotation.

I find it desirable to employ friction-brakes with the numeral-wheels and show such devices at Fig. 8. They are in the form of spring-depressed or weighted levers M, riding upon the tops of the wheels and pivoted on shaft K^6 between the stationary plates M^2, interposed between each pair of segment-levers and supported upon a cross-bar M^3. These brakes exert only the slight power due to their gravity or a suitable spring. They are normally kept out of contact with the wheels and are released for action only at the beginning of each stroke of the hand-lever C^{15}, so that they are all bearing upon the wheels at the time the latter are actuated by the lever, but are lifted so as not to bear on the numeral-wheels while they are being turned by the tens-carrying levers. For thus controlling them the following devices are employed: N is a rock-shaft placed in front of the wheels and having a shoulder or feather N′, upon which the forward ends of the brake-levers normally rest, as shown at Figs. 7 and 8. A rocking of this shaft lifts and lowers the brake-levers to the extent necessary to relieve the brakes from action or to put them in action, and such rocking motion is derived from the main cam C^{10} by means of an elbow-lever N^2, actuated by the cam, a link N^3, and crank N^4, the latter upon shaft N. A spring N^5, attached to crank N^4, acts constantly on the shaft N and returns it to its normal position during the upstroke of hand-lever C^{15}. The elbow-lever N^2 does not receive its actuation directly from cam C^{10}, but instead thereof from an auxiliary or movable cam-piece N^6, pivoted upon the vertical side face of cam C^{10}. The acting face of this cam-piece is nearly vertical at its forward end N^7, and at the beginning of the stroke of the hand-lever the roller N upon the elbow-lever rides up this surface N^7, and the crank N^4 is moved to its farthest extent. Immediately after passing the vertical surface N^7 the roller descends the slope N^9 upon the cam, thereby allowing the spring N^5 to move the crank-arm partially back toward its normal position and thus to rock the shaft N to a slight degree, but not sufficiently to lift the brake-levers from the wheels. The purpose of this partial return rocking of the shaft will be explained later on. After passing the slope N^9 the roller rides around the long portion N^{10} of the cam-piece, but does not thereby move the elbow-lever, inasmuch as that portion of the cam-piece is concentric with the axis of the main cam. The cam-piece N^6 is retained in its acting position (shown at Fig. 21) during the downstroke of hand-lever C^{15} by a pawl N^{11}, pivoted to the main cam and having a spring N^{13}, tending to keep the pawl N^{11} under the leg N^{17} of the cam-piece N^6, thereby holding the cam-piece N^6 in its acting position until a stop N^{15}, secured in the side of the machine, encounters the pawl N^{11} near the conclusion of the oscillating movement of the main cam caused by the descent of the hand-lever and forces the pawl N^{11} from under the leg N^{17}, so that the cam-piece is then free to swing on its pivot to the position given at Fig. 22. It remains in this position until the return oscillation of the main cam is nearly ended, when the leg N^{18} of the cam-piece N^6 encounters another stationary stop N^{16}, fixed in the side of the machine, which lifts the cam-piece N^6 into its acting position and allows the pawl N^{11} to drop into position to hold it there until again released by the pawl N^{11} coming into contact with the pin N^{15}.

The rocking shaft N is also given an additional office, which I now describe. It carries a series of projecting pins or stops O, (shown at Figs. 8, 9, 29, and 30,) one for each tens-carrying lever, and when the shaft is rocked, as already described, these pins are brought against the tens-carrying levers and force them back toward the front of the machine and against the power of their springs B^{10} to the position in which they are caught by the spring-actuated retaining-latches O′. The latches hold the levers against action in the same manner as the like devices act in my Patent No. 465,255 until released from the latches by the cams O^2, borne by the numeral-wheels. There is a carrying-lever B^5 for each numeral-wheel, except that the numeral-wheel of the highest order need not be provided with one. Each lever is pivoted upon a shaft B^{11}, and each lever is provided with a pawl B^4, which is normally pressed to engage the pins B^3 of the next higher numeral-wheel B by a spring B^{10}, as best shown in Figs. 7, 8, and 9.

O′ indicates a series of spring-actuated detents, as best shown in Figs. 7 and 9, one for each tens-carrying lever B^5. Each detent O′ is pivoted upon a shaft O^3 at one end, and has a projection O^4 at its other end extending over the cam O^2 on the corresponding nu-

meral-wheel. Each detent is also provided with a latch O^5, as best shown in Figs. 7 and 29, adapted to engage with a catch O^6 on its corresponding tens-carrying lever B^5.

The engagement of a latch O^5 with its carrying-lever holds the latter back against the pressure of the spring B^{10} until by the rotation of the numeral-wheel the high point on the cam O^2 of the corresponding numeral-wheel engages the projection O^4 on the detent O', thereby lifting the latch O^5 out of engagement with the tens-carrying lever B^5 and allowing the carrying-lever to swing toward the numeral-wheel under the power of its spring B^{10}.

The rocking shaft N carries a series of projecting pins or stops O, (shown at Figs. 8 and 9,) one for each carrying-lever, and when the shaft is rocked these pins are brought against the tens-carrying levers and force them back toward the front of the machine against the power of their springs B^{10} to a position in which they are caught by the latches O^5. Each latch holds the tens-carrying lever, which it engages from backward movement under the power of said spring, until released from its retaining-latch by the cam O^2, borne by the numeral-wheel.

As already explained, the rocking motion of the shaft N is derived from the main cam C^{10} by means of the elbow-lever N^2, actuated by the cam, a link N^3, and crank N^4, the latter fast on the shaft N, while the elbow-lever N^2 receives its actuation from an auxiliary or movable cam-piece N^6, pivoted upon the vertical side face of cam C^{10}, having a nearly vertical forward end N^7, upon which at the beginning of the stroke of the hand-lever the roller N^8 of the elbow-lever rides, and the crank N^4 is moved to its farthest extent, causing the pins O on the rock-shaft N to press against the tens-carrying levers and force them back toward the front of the machine.

As already described, the shaft N is partially returned toward its normal position immediately after receiving its full rocking movement and before the hand-lever C^{15} has completed its downstroke, and in its partial return the pins O fall away from the tens-carrying levers B^5 a short distance, so that when any latch or latches O' are forced out of engagement with a lever or levers such lever or levers will swing under the power of their springs B^{10} until they encounter said pins O in the intermediate position of the latter, as shown at Fig. 7. This is but a limited movement, but is sufficient to prevent reëngagement with the latches. As the main cam nearly completes its oscillation, the stop-pin N^{15} engages the pawl N^{11} and forces it out from under the leg N^{17} of the cam-piece N^6, allowing the latter to drop down past the face of the main cam, and on the upstroke of the hand-lever the lever-roller N^8 rides upon the edge of the main cam down the inclined part N^{19}, thus allowing the pins O to swing farther away from the tens-carrying levers, permitting those which have been released from the retaining-latch to swing forward under the power of their springs B^{10}, and through the pawls B^4 each advances a numeral-wheel one tooth, thus effecting the carrying of the tens. The stop-pin N^{14} may be employed, if desired, to limit the movement of the pawl N^{11}. By the construction detailed the carrying is postponed and does not take place until after the upstroke of the hand-lever has commenced, and not until the numeral-wheels have been released from the locking action of the stop-pawls upon the raising of the vibrating frame C C and the slotted links K^{14}.

When adding a long list of figures or sums, the rising end of the paper containing the numbers becomes extended for a considerable distance above the machine and is liable to bend over toward the front of the machine and cover some of the keys. To prevent this, I provide the machine with a movable guard P, preferably made of wire bent into **U** form, which can be readily lifted by the operator into position in front of the papers, as seen at Figs. 2, 4, and 24, whenever necessary. A spring-catch P' engages the guard by entering a notch at P^2, near the foot thereof, and holds it when lifted to its acting position. The automatic release of this device is desirable, as when raised it is so near the paper as to interfere somewhat with the tearing off of the part containing the printed numbers, and hence I mount the catch upon one of the arms K^{12}, already described, and incline the under side of its acting point, as seen at P^3, so that when the supporting-arm is moved down in obedience to the plunger of the answer-printing mechanism the inclined side P^3 will be drawn against the stationary guide P^4, located near the top of the catch, and force the catch out of its engagement with the guard. By this means the guard is permitted to fall by its gravity to the position in which it is shown at Figs. 3 and 5. The frame I^{21} I^{22}, whereby the hammers are reset and the paper-moving plate I^3 is actuated, is also operated in printing the answers by the slotted lever Q, pivoted to lever K^{10}, and a crank Q' upon the shaft G', carrying the frame. The slot Q^2 in the lever permits the operation of the frame by the impulse derived from lever C^{15} in the same manner as slot I^{24} in lever I^8 permits the frame to move with lever Q. This will be understood readily from Figs. 3 and 5.

For the purpose of regulating the tension of the hammer-springs I attach those springs to an adjustable frame R, mounted so as to rock on the bar R', and rock the frame whenever the springs need regulating by means of the vertical screws R^2. (See Figs. 6, 16, and 17.) The paper-spool is supported upon a threaded shaft W^2 and upon which

it may be adjusted laterally. This shaft is let into a stationary bearing-block W^3 in the outside frame at one end, and at the other end a thimble W^4 is slipped upon it. This thimble is movably inserted in a sleeve W^6, supported in the frame X, and both it and the sleeve have opposing shoulders, between which a spring W^5 is confined. With this construction, which is fully shown at Fig. 6, the thimble and shaft are constantly forced toward the stationary bearing by the spring, but the spring allows the shaft to be moved far enough away from the stationary bearing to draw it from that bearing whenever a fresh spool of paper is to be placed on the shaft.

I claim—

1. The combination in a calculating-machine of a denominational numeral-wheel, a series of denominational keys corresponding to said wheel, a device for actuating said wheel, a vibrating frame normally detached from said wheel-actuating device and serving to give motion to it when coupled thereto, means independent of the keys for actuating said frame, and means whereby the operator can couple said wheel-actuating device to said frame at will, substantially as specified.

2. The combination in a calculating-machine of the numeral-wheels each representing one denomination, devices for actuating the wheels, a vibrating frame normally detached from said wheel-actuating devices but common to all of them and serving to give motion to them when coupled thereto, and keys whereby the operator may attach the actuating devices of any wheel to said frame at will, substantially as specified.

3. The combination in a calculating-machine of the numeral-wheels, devices for actuating the wheels, a vibrating frame normally detached from said wheel-actuating devices and serving to give motion to them when coupled thereto, keys whereby the actuating devices of any wheel may be attached to said frame at will, and devices independent of the keys for releasing such attachment, substantially as specified.

4. The combination in a calculating-machine of the keys, the numeral-wheels, and the wheel-actuating devices, with a vibrating frame for giving motion to said actuating devices, the keys themselves serving as a means whereby the wheel-actuating devices are attached to said frame, substantially as specified.

5. In a calculating-machine, the combination with the numeral-wheels and their operating segment-levers, of movable keys for actuating the levers, a vibrating frame for actuating the keys, and means for coupling the keys to the frame, substantially as specified.

6. In a calculating-machine, the combination with the keys, the numeral-wheels, and their operating segment-levers, of a vibrating frame, means independent of the keys for operating the frame, and means for coupling the levers to the frame, substantially as specified.

7. The combination in a calculating-machine, of the numeral-wheels and their segment-levers, a vibrating frame, and the keys, the latter serving to couple the frame to the levers, and the frame acting when thus coupled to actuate the levers, substantially as specified.

8. The combination with the segment-levers, and the vibrating frame, of keys having projections or shoulders for engaging the levers, means for coupling the keys to the frame, and means independent of the keys for operating said frame, substantially as specified.

9. The combination with the segment-levers and vibrating frame, of keys set by depressing them through a portion of their stroke, said keys having projections or shoulders for engaging the levers, and means for coupling the keys when they are set to the frame, substantially as specified.

10. The combination of the segment-levers and the vibrating frame, of the keys set by depressing them through a portion of their stroke, said keys having projections or shoulders for engaging the levers, means for coupling the keys when they are set to the frame, and means for releasing the keys from the frame, substantially as specified.

11. The combination with the segment-levers and the vibrating frame, the keys for engaging the levers, and spring-latches for attaching the stems of the keys to the frame, substantially as specified.

12. The combination with the segment-levers and the vibrating frame, of the keys for engaging the levers, spring-latches for attaching the stems of the keys to said frame, and a movable frame for releasing the latches, substantially as specified.

13. The combination with the segment-levers and the vibrating frame, of the keys for engaging the levers, spring-latches for attaching the stems of the keys to the frame, and a movable device borne upon the vibrating frame and acting to release the latches, substantially as specified.

14. The combination with the segment-levers and the vibrating frame of the keys for engaging the levers, spring-latches for attaching the stems of the keys to said vibrating frame, a releasing-frame for releasing the latches, means for actuating the releasing-frame, and means for actuating the vibrating frame, substantially as specified.

15. The combination with the segment-levers and the vibrating frame, of the keys for engaging the levers, spring-latches for attaching the stems of the keys to the frame, and a horizontally-movable frame for releasing the latches, substantially as specified.

16. The combination with the segment-levers and the vibrating frame, of the keys for engaging the levers, spring-latches for attach-

ing the stems of the keys to the frame, and a frame for releasing the latches mounted and movable horizontally on the vibrating frame, substantially as specified.

17. The combination with the segment-levers and the vibrating frame, of the keys for engaging the levers, spring-latches for attaching the stems of the keys to the frame, a movable frame for releasing the latches, and a hand-lever for operating said releasing-frame, substantially as specified.

18. The combination with the keys, the vibrating frame for operating the keys and the latches for coupling the keys to the frame, of releasing mechanism for uncoupling the keys, mechanism for actuating said releasing mechanism, and means for holding said actuating mechanism out of action at will so that repeated impulses may be given the keys without releasing them from the vibrating frame, substantially as specified.

19. The combination with the numeral-wheels, their actuating devices, the vibrating frame and devices for attaching the frame to the actuating devices, of mechanism for releasing such attachment, mechanism for actuating said releasing mechanism, and means whereby the last-mentioned actuating mechanism may be locked against action, substantially as specified.

20. The combination with the keys, the vibrating frame, and coupling devices whereby they are coupled together, of mechanism for releasing said coupling devices, operable either automatically or at will, substantially as specified.

21. The combination with the key-releasing mechanism, of a hand-lever E and mechanism connecting it to said releasing mechanism, said lever being movable to one position for operating the releasing mechanism and being also movable to another position for locking said releasing mechanism against action, substantially as specified.

22. The combination of the key-releasing frame, the vibrating frame upon which the releasing-frame is mounted, the rocking shaft D^3 also carried by the vibrating frame, and connected to the releasing-frame so as to give it a horizontal motion, and means for rocking the shaft, substantially as specified.

23. The combination of the vibrating frame, the key-releasing frame, the rock-shaft D^3 having the crank-arm D^5, and the latch D^7 for momentarily detaining the free end of said crank-arm and thus rocking said shaft, substantially as specified.

24. The combination of the vibrating frame, the key-releasing frame, the rock-shaft D^3 having the crank-arm D^5, provided with the pins D^6 and D^9, and the latch D^7 having an arm D^{10}, substantially as specified.

25. The combination of the vibrating frame, the releasing-frame, the rock-shaft D^3 having the crank-arm D^5, and the latch D^7 for momentarily detaining the free end of said crank-arm, and thus rocking said shaft with the hand-lever E for operating said crank-arm D^5, substantially as specified.

26. The combination of the vibrating frame, the key-releasing frame, the rock-shaft D^3 having the crank-arm D^5, and the latch D^7 for momentarily detaining the free end of said crank-arm and thus rocking said shaft, with the hand-lever E acting to hold said latch out of action, substantially as specified.

27. The combination of the vibrating frame, the key-releasing frame, the rock-shaft D^3 having the crank-arm D^5, and the latch D^7 for momentarily detaining the free end of said crank-arm and thus rocking said shaft with the hand-lever E having one arm acting to operate said crank-arm, and also having an arm acting to hold said latch out of action, substantially as specified.

28. The combination with the keys having offsets and segment-levers engaging such offsets, of a horizontal vertically-moving frame below the levers and provided with devices whereby it may be coupled to the stems of the keys at will, and with means for releasing the keys, substantially as specified.

29. The combination with the hammers and their controlling-pawls, of the elbow-levers H^5 and the swinging frame H^9, substantially as specified.

30. The combination with the hammers and their controlling-pawls, of the elbow-levers H^5 having the elbow projections H^7, and the swinging frame H^9, substantially as specified.

31. The combination with the hammers and their controlling-pawls, of the elbow-levers H^5 having the slotted elbow projections H^7, and the swinging frame H^9, substantially as specified.

32. The combination with the hammers and their controlling-pawls, of levers H^5 having slotted elbow projections H^7, said projections engaging the swinging frame H^9 when the latter is in its position of rest, and receiving and being actuated by said frame when it moves down, said frame, mechanism for actuating the levers and mechanism for actuating the frame, the levers being actuated in advance of the frame, substantially as specified.

33. The combination with the hammers and their controlling-pawls, of the levers H^5 for tripping the pawls, and the swinging frame H^9 controlling said levers and provided with a guide-comb, substantially as specified.

34. The combination with the hammers and their controlling-pawls, of tripping-levers H^5, mechanism connecting said levers to the segment-levers, said segment-levers and their actuating devices, the swinging frame actuating said tripping-levers, the answer-printing plunger and connecting mechanism between said plunger and said frame, substantially as specified.

35. The combination with the type and hammer controlling devices of the printing mechanism of a hand-lever C^{15} for causing the printing of the sums or numbers to be added, and a hand device K for causing the printing of

the answers, both said hand-lever and said hand device being mechanically connected to the type and the hammer controlling devices of the printing mechanism, substantially as specified.

36. The combination with the paper guiding and feeding devices, of a movable plate I^3 for forcing the upwardly and the downwardly moving courses of paper together at the printing center, substantially as specified.

37. The combination with the paper guiding and feeding devices, of a movable plate I^3 for forcing the upwardly and the downwardly moving courses of paper together at the printing center, and means for moving said plate just prior to each printing operation, substantially as specified.

38. The combination with the hammers and the movable plate I^3, of the frame I^{21} I^{22}, serving both to lift the hammers and to actuate the plate, and means for actuating the frame, substantially as specified.

39. The combination with the hammers and the movable plate I^3, of the frame I^{21} I^{22}, serving both to lift the hammers and to actuate the plate, the slotted lever I^8 and crank I^9 upon shaft I^{10} carrying the frame, said shaft I^{10} and the main cam, substantially as specified.

40. The combination with the hammers and the movable plate I^3, of the frame I^{21} I^{22}, serving both to lift the hammers and to actuate the plate, the slotted lever Q joined to lever K^{10}, the crank Q′ upon the shaft I^{10} carrying the frame, said shaft I^{10}, and said lever K^{10}, substantially as specified.

41. The combination with the numeral-wheels and the stop-pawls, of the vibrating frame, the slotted links K^{14}, and means for actuating said frame downward so as to draw the pawls into action, substantially as specified.

42. The combination with the numeral-wheels and their actuating devices of intermittently-acting pivoted levers M riding on the wheels and means for holding the levers out of action except when said actuating devices are moving the wheels, substantially as specified.

43. The combination with the numeral-wheels and their actuating devices of pivoted levers M riding on the wheels, and the rock-shaft N for holding the levers normally out of action, substantially as specified.

44. The combination with the numeral-wheels, the segment-levers and the main cam, of the friction-levers, the shaft N for controlling the levers, the movable cam-piece N^6 upon the main cam and the connecting mechanism between the cam and the shaft, substantially as specified.

45. The combination with the shaft N of the main cam, the movable cam-piece N^6 mounted on the main cam and having the nearly vertical surface N^7, and means for supporting the cam-piece while it is acting, substantially as specified.

46. The combination with the carrying-levers and their latches of the shaft N and its pins for moving said levers, and means for rocking said shaft, substantially as specified.

47. The combination with the carrying-levers and their latches, of devices for moving the levers into position for carrying, such devices being also retracted partially immediately after thus moving the levers to allow the levers released from the latches to escape reëngagement therewith, substantially as specified.

48. The combination with the carrying-levers and their latches, of devices for moving the levers into position for carrying, such devices being also retracted partially immediately after thus moving the levers to allow the levers released from the latches to escape reëngagement therewith, and a cam device for controlling the movement of said devices for moving the levers, substantially as specified.

49. The combination with the carrying-levers and their latches, of the rock-shaft N and its pins, and a cam for rocking said shaft in moving the carrying-levers, and also acting to allow it to rock back partially to give opportunity to the levers which may be released from their latches to move far enough to escape reëngagement, substantially as specified.

50. The combination with a printing-calculator, of a movable guard P located in front of the issuing paper and adapted to be raised into position to sustain the loose end of the paper, means for supporting said guard when raised, and means for releasing it from said supports, said means being operated by the printing mechanism, substantially as specified.

51. The combination with the numeral-wheels, segment-levers and vibrating frame, of keys passing through the frame and having shoulders A^7 to engage the frame and thus limit the descent of the keys in setting, means for coupling the set keys to the frame, and means for actuating the frame, substantially as specified.

52. In a calculating-machine, the combination of the numeral-wheels, the carrying-levers, a rock-shaft controlling said levers, and a hand device or lever whereby said shaft is rocked, substantially as specified.

53. The combination with the frame I^{21} I^{22} of the slotted levers I^8 and Q, one connecting the frame to the hand-lever C^{15} and the other to the printing-plunger, said hand-lever and said plunger, substantially as specified.

54. The combination with the series of hammers and their springs, of the rocking frame R, to which the series of springs are attached and screws R^2 for adjusting the tension of the springs, substantially as specified.

DORR E. FELT.

Witnesses:
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EDW. S. EVARTS.