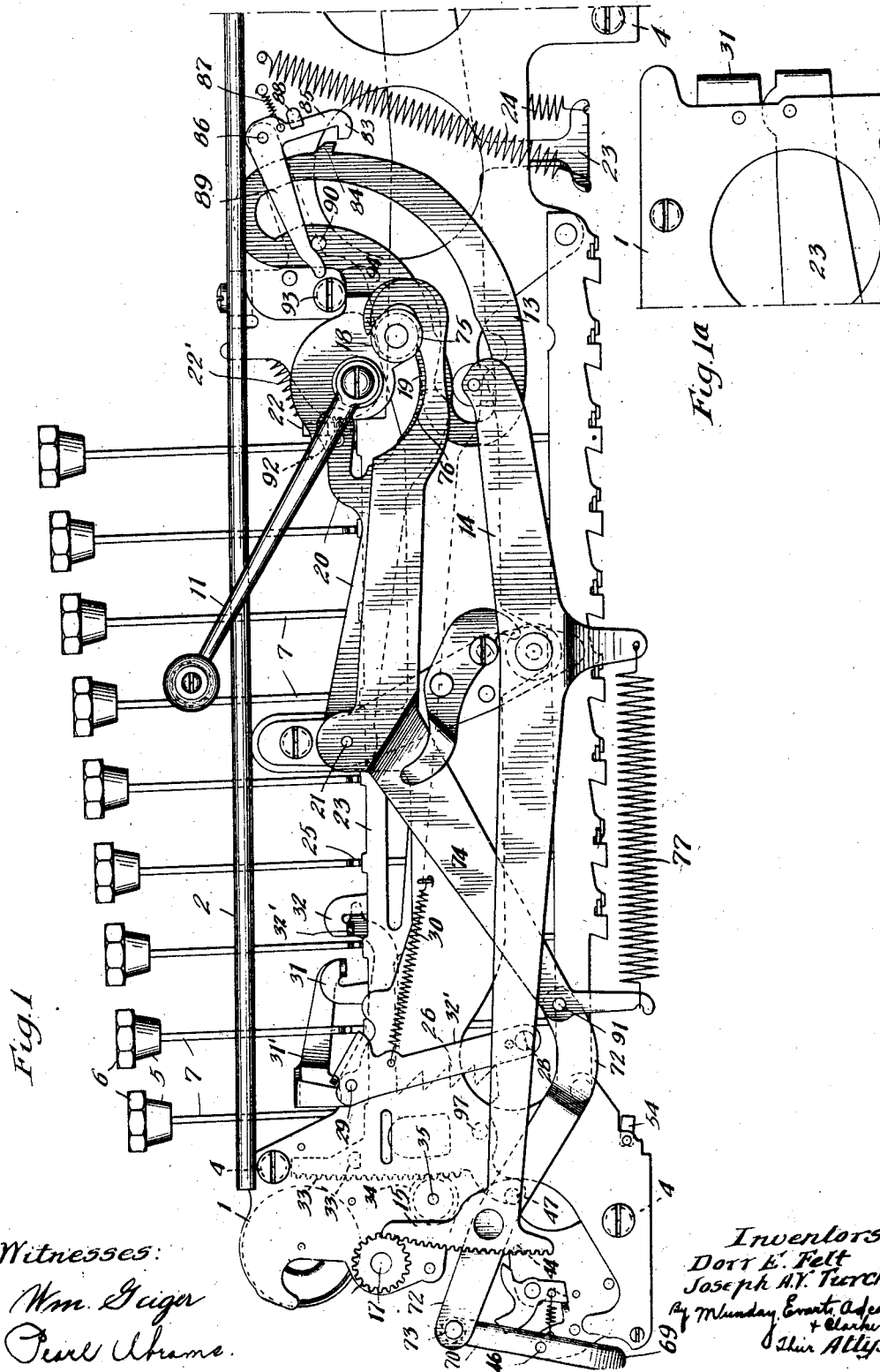


D. E. FELT & J. A. V. TURCK.
 CALCULATING MACHINE.
 APPLICATION FILED APR. 5, 1913.

Patented Sept. 9, 1913.

5 SHEETS—SHEET 1.

1,072,934.



Witnesses:
 Wm. Gaiger
 Paul Abrams.

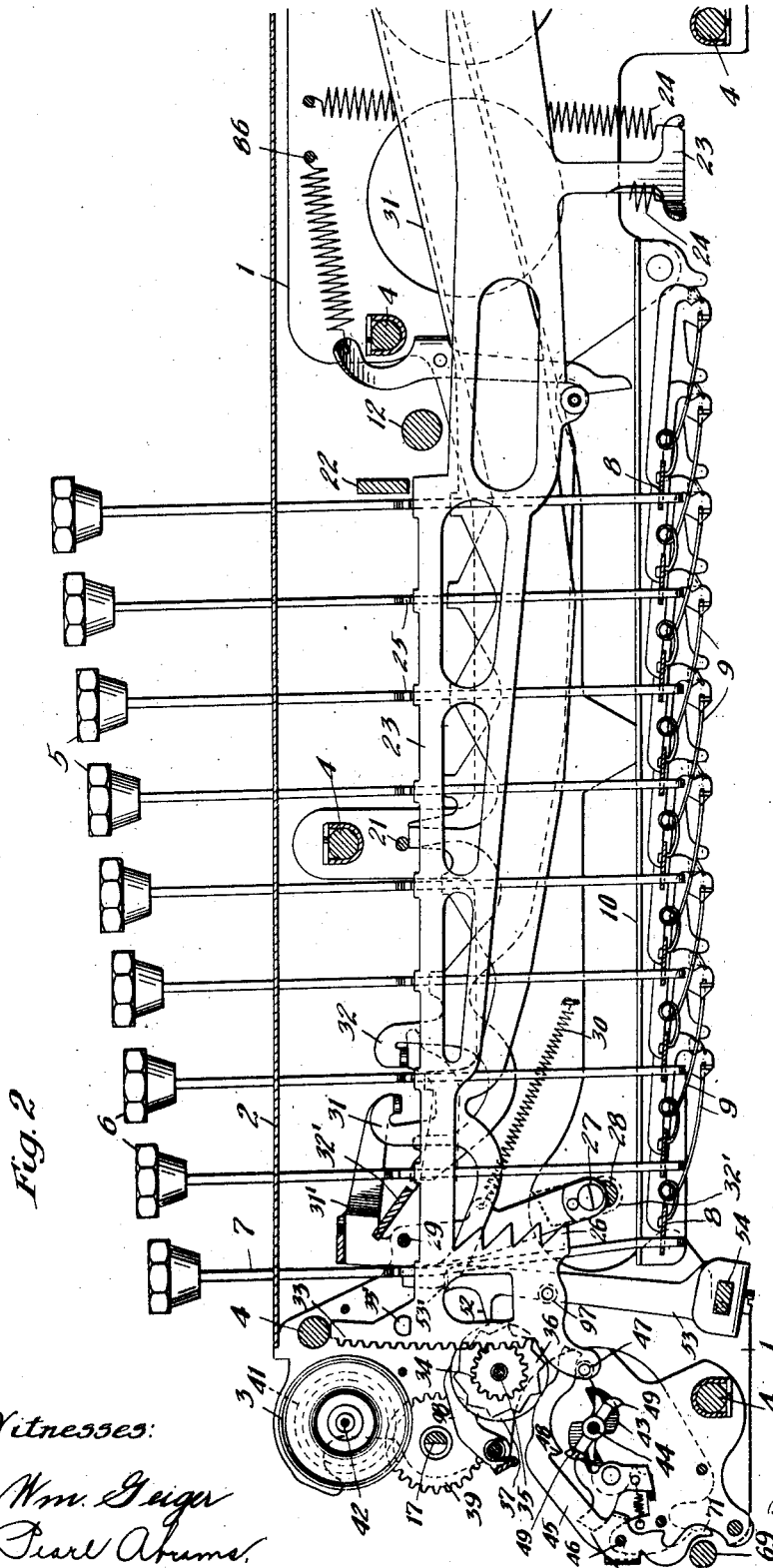
Inventors:
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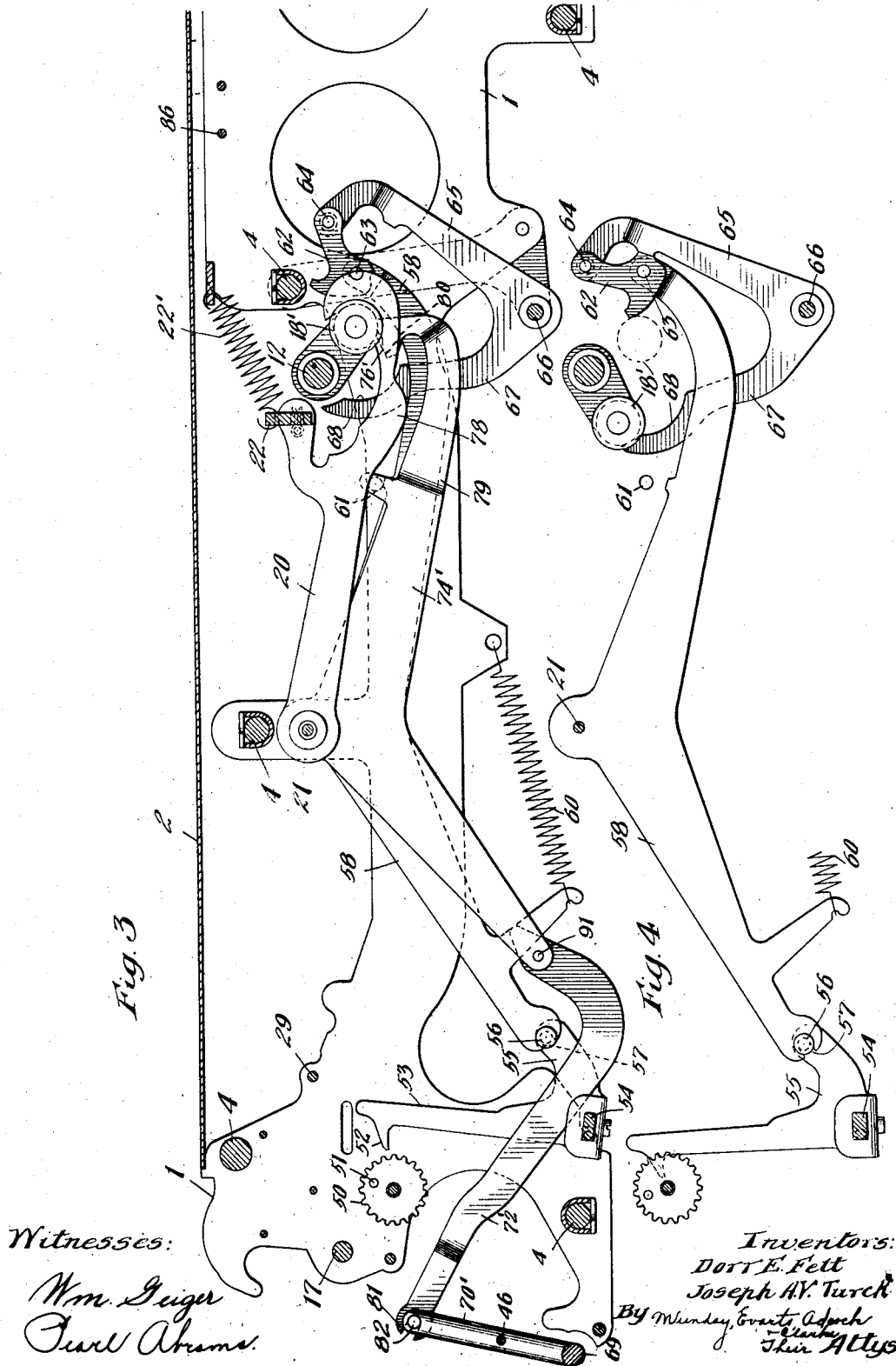
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5 SHEETS—SHEET 3.

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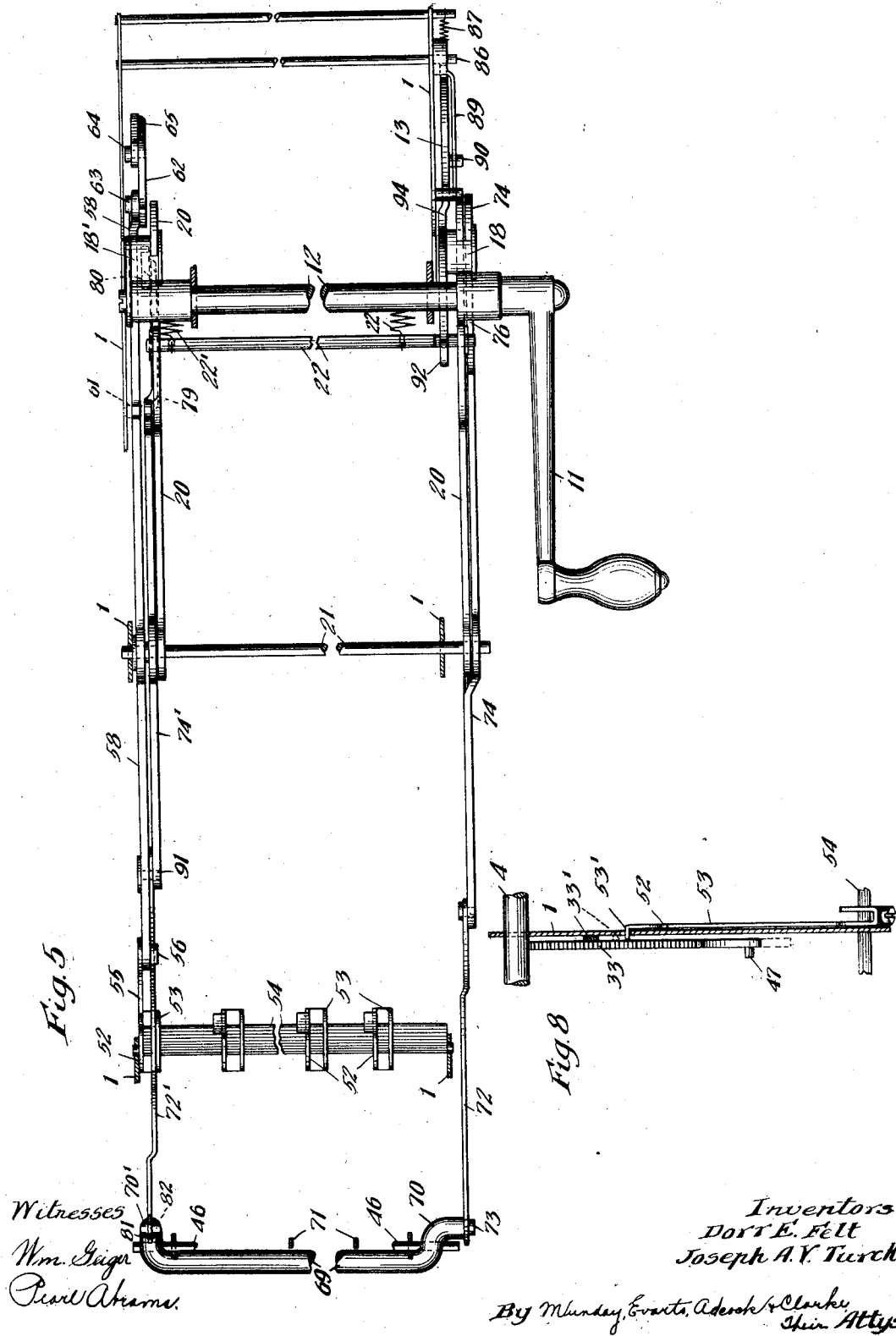


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5 SHEETS—SHEET 4.

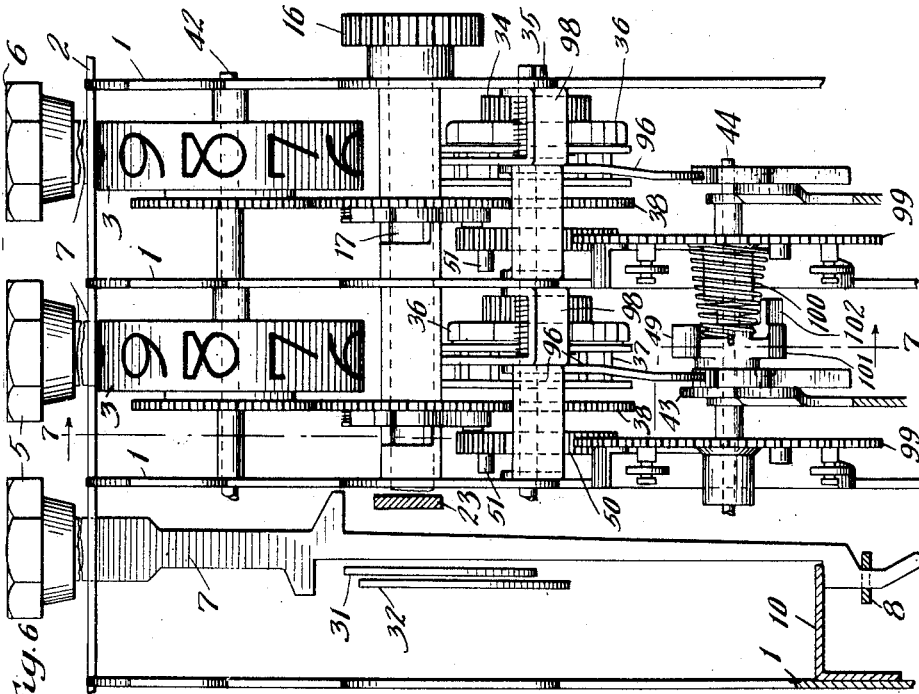
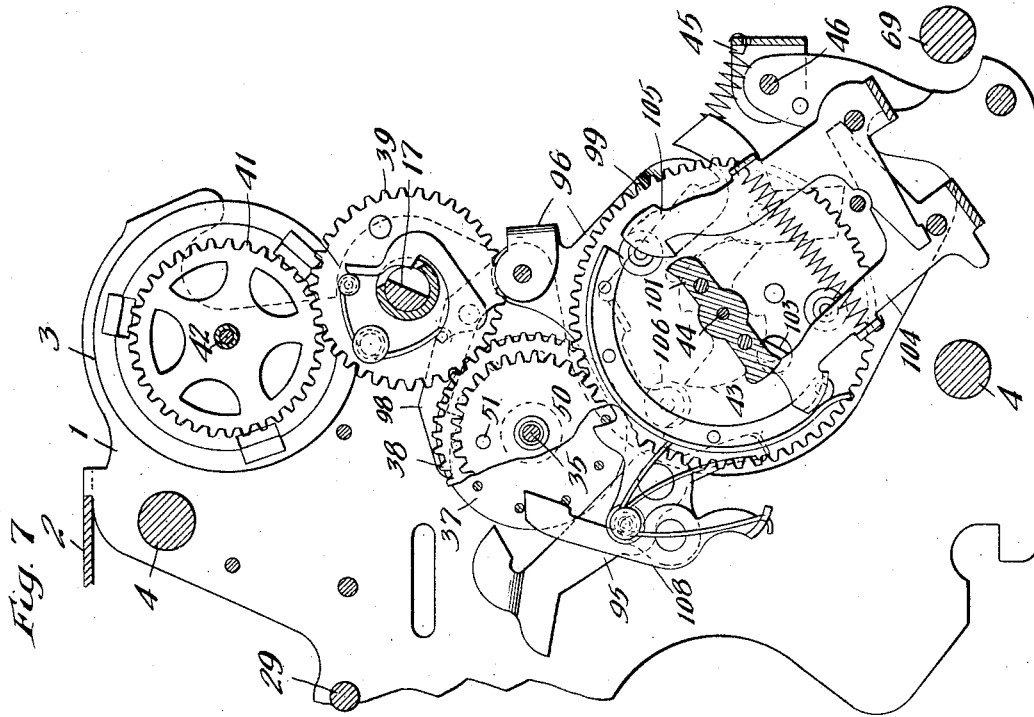


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5 SHEETS—SHEET 5.



Witnesses

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UNITED STATES PATENT OFFICE.

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CALCULATING-MACHINE.

1,072,934.

Specification of Letters Patent.

Patented Sept. 9, 1913.

Application filed April 5, 1913. Serial No. 759,193.

To all whom it may concern:

Be it known that we, DORR E. FELT and JOSEPH A. V. TURCK, citizens of the United States, residing at 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.

The invention relates to a multiple-order keyboard calculating machine, and more especially to key-driven machines of the general type of the well known "comptometer."

For the general character of this machine as known to the public we may refer to the Felt Patent No. 960,528, granted June 7, 1910 describing the duplex comptometer (which patent is also related to the prior Felt patents mentioned therein). The patents above referred to provide a calculating machine which gives exact results if properly operated, but improper operations and accidental displacements of the numeral wheels can be further guarded against, as will be hereinafter pointed out.

The present invention relates principally to the canceling mechanism, and has for its objects to improve the same, in accuracy of construction and operation; so as to make the machine proof against misoperation; also to prevent the jamming or locking of the carrying mechanisms, resulting from an improper manipulation of the keys, by accident or design.

The invention is especially characterized by a construction of canceling mechanism which positively holds the numeral wheels in predetermined position until late in the canceling operation, and which delays the release of the numeral wheels until the automatic carrying mechanism is to perform its function of bringing all of the numeral wheels to zero, or to initial position; thereby preventing any displacement of the numeral wheels which might occur from rapid and unduly forcible canceling manipulation, or from premature carrying caused by such manipulation, or from a slow canceling manipulation. By preference such release of the numeral wheels takes place abruptly, and substantially at the end of the final movement of the canceling rock shaft, or other canceling actuator.

It has been found by practical experience that it was possible to so wind up the car-

rying mechanisms, by intentional improper manipulation, producing undue tension of their moor springs, that means for releasing the carrying mechanisms during the canceling operation would become ineffective, the leverage required to release them being so great as to need more time for the operation of the releasing means than was afforded.

One of the objects of the present invention is to overcome this difficulty, by giving more time for the operation of the said releasing means, and by causing it to occur before the canceling stops have been positioned to engage the numeral wheel mechanisms.

It is a further object of the invention to insure that, in the canceling or zeroizing operation, the column actuators shall not be held down at too low a point, which would add more than one to the numeral wheels on the rising of such actuators. And the invention has for further objects to effect all other improvements in structure or function that may be found to obtain in the mechanism hereinafter described or claimed.

In order to make the invention more clearly understood there are shown in the accompanying drawings means for carrying the same into practical effect, without limiting the improvements, in their useful applications, to the particular constructions which, for the purpose of explanation, have been delineated.

In the said drawings—Figure 1 is a side view, of so much of a calculating machine embodying the invention as is necessary for an understanding of the latter, the casing and base being removed. Fig. 1^a is a side view showing the rear part of the machine omitted from Fig. 1. Fig. 2 is a vertical longitudinal section of the same. Fig. 3 is a similar view, showing the principal actuating parts of the canceling mechanism, in their normal or initial position. Fig. 4 is a similar view, showing certain of the same parts in the position which they occupy at the end of the first half of the canceling operation, or after the canceling or resetting lever or handle has been caused to make its rearward movement. Fig. 5 is a plan view, partly in horizontal section, showing the principal actuating parts of the canceling mechanism. Fig. 6 is a front view of the carrying mechanism, and related parts. Fig. 7 is a sectional view looking from the

left, on line 7—7 of Fig. 6. Fig. 8 is a detail front view showing the relation of the column actuator and canceling stop.

Referring to the drawings, 1 indicates the vertical retaining plates constituting a part of the frame of the machine, and 2 the top plate thereof. The frame preferably comprises vertical side or retaining plates, such as is shown at 1, and similar intermediate plates one of which is arranged in each of the spaces between the numeral wheels 3. All of these vertical plates are secured to a base (not shown) and are or may be rigidly connected by suitable cross bars or tie rods 4, and by the top plate 2.

The numeral wheels are caused to be actuated, in the calculating operation, by the finger keys 5, each comprising a top 6 and stem 7. Each key stem is mounted to reciprocate vertically in a guide aperture or bearing in the top plate 2, and its lower end is pressed upward by a lever 8 and spring 9 carried by lower frame parts 10. In Fig. 1 is shown the units, or right hand order of nine keys, and it will be understood that as many orders of such keys and accumulator mechanisms are arranged side by side transversely of the machine in multiple-order as are necessary for the calculating operations to be performed. In said patents eight orders of keys are shown.

For convenience we will recapitulate certain of the parts, and their functions, known in and by the prior patents above mentioned; but it is not necessary to an explanation of the present improvements to repeat all of the description and illustration of said patents.

11 is the handle of the cancellation controlling means or cancelling actuator, in this instance a crank lever, movable backward and forward, and fixed on a rock shaft 12 mounted in the plates 1; 13 is the slotted cam fixed on the shaft 12 and which actuates the canceling segment lever 14; 15 is the segment of the lever 14, which meshes with and rotates forward and backward the canceling pinion 16 fixed on the canceling shaft 17; on this shaft are loosely mounted the intermediate gears 39 of the numeral wheel mechanism.

18, 18' indicate dolly rolls, of which there is one at each side of the machine, whose stud shafts are connected fixedly with the shaft 12, so as to oscillate therewith. These dolly rolls operate cams 19, and the cam arms 20, one at each side of the machine, on which the cams are formed or attached, the said arms being pivoted on a cross rod 21 mounted in the frame of the machine.

22 is the column actuator cross bar carried and moved down and up, by the cam arms 20, to depress and release the column actuator segment levers 23. The cam arms are actuated by springs 22' in a known man-

ner to draw the bar 22 upward and press cams 19 against the dolly rolls 18, 18'. Each lever 23 is yieldingly held upward by a pair of springs 24. The column actuators 23, respectively impart the prime actuations to the numeral wheel mechanism of each column or order of the keyboard, and are directly engaged and depressed by shoulders 25 on the key stems 7. Each column actuator 23 is provided with coarse spaced stop detent teeth 26, which may be engaged by one or the other of the two forward and backward oscillating stop detents 27 and 28, pivoted at 29 on the frame. What is termed the odd detent 27 is brought forward into stopping position by the depression of the odd numbered keys, and the even detent 28 is likewise positioned by the even numbered keys. The detents 27 and 28 are positioned by the said keys through the media of odd and even stop levers 31, 31', and 32, 32', arranged at the side of each of the column actuators 23, and depressed by stops on the left sides of the key stems 7. By the above means each column actuator may be more or less depressed and stopped, and each numeral wheel may be turned one space, or any number of spaces up to nine, according to which key is depressed, each column or order of keys being provided with a set of the above described parts, 23, 27, 28, 31, 31', 32 and 32'. Springs 30 return each detent 27, 28 and stop levers 31, 31', 32, 32' to normal rearward and raised position, respectively, the cross rod 21 serving as a stop for such return movement.

33 is a toothed segment, with which each column actuator lever 23 is provided, meshing with a pinion 34 (one for each order of keys) on a cross accumulator shaft 35. On the downward movement of the segment 33 the pinion 34 and ratchet 36 attached thereto turn idly with respect to the ratchet pawl. On the forward movement of the pinion 34 and ratchet 36, caused by the raising of the segment 33 by reason of the motor-actuation of the springs 24, the ratchet 36 acts in a known manner on the pawl, which is mounted on the lantern wheel 37, and thereby turns the latter forward. The accumulator gear 38 is affixed to one of the disks which form the lantern wheel 37 and meshes with the intermediate gears 39 and drives the same backward. The gears 39 (one for each column) are mounted loosely on the cross rotatable canceling shaft 17 and turn freely thereon during the accumulating operation, but are connected with and turned by the shaft during the canceling operation. Each gear 39 meshes with a numeral gear 41 which is affixed to its numeral wheel 3, and turns loosely with its numeral wheel on the cross shaft 42. The return or upward movement of the column actuators is limited by engagement of the upper ends of

the segments 33 with the under side of the upper front tie rod 4, or with an adjustable eccentric stop sleeve of known form on said tie rod. All of the intergeared parts of each accumulator mechanism are locked from rotation, except at times when such rotation is desired, by a locking detent 95 which is pivotally mounted on a carrying lever 96, is spring pressed away from the lantern wheel 37, but is caused to engage and lock the lantern wheel and intergeared parts by the upward pressure of a stud 97 which is on the column actuator 23. A back stop pawl 98 also engages the lantern wheel to hold the accumulator mechanism from backward rotation.

The automatic carrying mechanism, by which ten steps of rotation or one complete rotation of any numeral wheel is caused to be accompanied by one step of rotation of the numeral wheel of the next higher order, is or may be in its principal features of construction and operation similar to that described in the said patent. It comprises carrying pinions 50 fixed on the hubs of the accumulator gears 38, carrying gears 99 to which the carrying pinions impart one half of a rotation for every whole rotation imparted to the numeral wheel gears 41; power-storing carrying motor springs 100 which connect the carrying gears with carrying escapement members 101 whose arm 102 is adapted to engage a limiting stud 103 on the carrying gears, and is also engaged alternately by releasing detents 104, 105; a dolly roll 106 on the carrying gear by which the releasing detents are alternately moved outward and caused to release the arm 102 and permit a half revolution of the escapement member under the force of the carrying spring; a two armed cam 43 which is fixed on the escapement member 101 and which raises the carrying lever 96 twice at each revolution of the carrying gear; and a carrying pawl 108 pivoted on the carrying lever and engaging the lantern wheel 37 of the accumulator mechanism, to impart one step of rotation to the numeral wheels; the construction and operation of these parts being set forth in the Felt Patent No. 996,009, dated June 20, 1911. One set of such devices is operatively arranged between each numeral wheel and the numeral wheel of the next higher order.

The machine is of the duplex type; that is to say, two keys side by side, in different orders, may be simultaneously depressed and each key will have its proper and full effect in the accumulation. That such full effect of the depression of the key of lower order be attained it is necessary that any carrying, which may be due to take place from the lower numeral wheel to the higher numeral wheel, shall not be lost by reason of the higher numeral wheel having such forward

motion that the carrying mechanism may not affect it. 45 is the latch pivotally mounted on the cross rod 46 of the frame and extending over the carrying mechanism and resting at its inner or rear end on the stud pin 47 of the column actuator 23. The latch has a tooth 48 which is adapted to engage either (whichever may first encounter it) of the two projections 49 on the rotary hub or sleeve of the carrying mechanism. When any key of the order to which a carry is to be made is struck the actuator 23 of that column and its pin 47 moves down, allowing the latch 45 to drop where its tooth 48 may engage a projection 49 and arrest any rotation of the carrying devices which might at that time be ineffective. The carrying devices continue to be so held until the column actuator 23 rises, and the key and numeral wheel of the higher order have completed or substantially completed their operation, whereupon the pin 47 lifts the latch 45, and releases the carrying mechanism, and allows the latter to be actuated by its carrying spring to effect the proper carry which may be due to occur. The carrying mechanism of each column or order is provided with a set of the described parts 45, 47, 48.

The canceling operation.—For accuracy in bringing the numeral wheels from their various positions all to the "0" position, those of the second and higher orders are first brought to the "8" position, and the units wheel is brought to the "9" position; then the cross bar 22 and the column actuators, having been depressed, rise and move all of the wheels one step, the wheels of higher order than units to the "9" position and the units wheel to the "0" position, the said movement of the units wheel causing the carrying mechanisms to operate, successively but practically instantaneously, across the machine from right to left to bring the said wheels of higher order to the "0" position and complete the canceling operation.

51 indicates stop studs, one on each of the carrying pinions 50, which may engage the under side of stops 52 on canceling stop levers or arms 53. The latter are affixed to a transverse canceling stop rock bar 54 mounted to oscillate in the lower part of the frame. When the stops 52 are rocked forward into the paths of the stop studs 51 they are adapted to arrest the carrying pinions 50 in such position that each numeral wheel of higher order than units is held positively in the "8" position, the units wheel stopping at the "9" position by reason of a little later (36 degrees) positioning of its stud 51 on its pinion.

Referring to Fig. 1, and to Figs. 3 and 4 which latter show the parts located at the left side of the machine but which are viewed from the right side of the machine, 120

55 is an arm extending from the rock bar 54 and having affixed thereto a pin 56. This pin is engaged by a jaw 57 at the forward end of a lever 58 pivoted at 21 to the frame of the machine. 60 is a spring connecting the lever 58 with the frame of the machine and acting to pull the forward arm of the lever, and the rock bar arm 55, backward and downward and the rear arm of the lever upward. 61 is a stop on the frame which limits such movement of the lever. 62 is a link pivoted at 63 to the rear arm of the lever and at 64 to the rear stop arm 65 of a bell lever, which is pivoted at 66 to the frame and has a forward cam arm 67 formed with a cam 68. The bell lever is adapted to be turned forward until the pivot point passes the straight line of the points lock against the pull of the spring 60, and, depressed by the described movement of the parts 65 and 62, hold the canceling stops 52 in the paths of the carrying pinion stop studs 51.

The bell lever is so turned forward by the dolly roll 18' at the left of the machine, which on the backward movement of the canceling handle operates on the cam 68 as well as on the cam of the left arm 20 above mentioned. When the canceling handle lever 11 is turned forward and the dolly roll backward the said dolly roll 18' leaves the cam 68; but the parts 67, 62, 58 and 53 remain in their toggle locked positions, with the stops 52 in engagement with the studs 51, until the lever 11 reaches its forward normal position and the dolly roll presses upward and backward slightly on the link 62 (see dotted lines in Fig. 4). Thereupon the link 62 is turned over backward and the pivot 64 carried across the toggle line, the toggle lock is broken and the spring 60 instantly restores the parts to the position shown in Fig. 3 and releases the stops 52 from the carrying pinions, and, in effect, from the numeral wheels connected with said pinions. In the construction illustrated this instantaneous tripping of the parts occurs at substantially the end of the operative part of the return or forward movement of the canceling actuator 11, and this is the time preferred for such tripping. At substantially the same time the column actuator cross bar 22 is raised by the springs 21' and the column actuators 23 rise and cause the numeral wheels to be turned one step, which, with the final carrying, effects the final cancellation or zeroizing.

The canceling stop 52 for the units wheel is made somewhat longer than the corresponding stops for the wheels of higher order; so that the latter may receive the final one space adding movement of their column actuators and all advance from 8 to 9 before the units wheel is released to advance from 9 to 0; and such turning of the units wheel

one step, from 9 to 0, by the up stroke of its column actuator, then effects a carry of 1 which turns each numeral wheel of higher order to zero.

In rapid cancellation the numeral wheels move at very high speed, with corresponding momentum; and, the withdrawal of the canceling stop having been formerly at the will of the operator and according to the force and velocity applied to the canceling crank handle, stops might be withdrawn before the wheels had lost all rotation and momentum, and there was a possibility of overrunning, or rebound or other relative displacement of some of the numeral wheels, with an erroneous result of the canceling operation, some of the wheels not standing at zero. Hence the general importance of holding the canceling stops and the accumulator mechanisms and numeral wheels immovable until immediately before the end of the canceling operation: also it is of importance to hold the canceling stops in operative position until the accumulator mechanisms and their stopping and locking means (in this instance the detents) are in mutual position so that the former can be completely controlled by the latter, without allowing a misplacement of the numeral wheels from any cause, whether such detents actually engage the accumulator mechanisms before the canceling stops are withdrawn or, as illustrated, immediately as the latter are withdrawn; separately and additionally it is of advantage to withdraw the said stops with uniform force and speed by the retraction of the spring 60, as in the present invention, and not according to, but independent of, the force and violence applied by the operator to the cancellation controlling means. Where the canceling stops are withdrawn by an independent motor device more lapse of time or dwell, proportionally to the speed of the handle, between the times when the accumulator mechanisms should arrive at their predetermined limit and their release from the canceling stops, is allowed when the canceling handle is moved violently than when it is moved slowly or with normal speed.

When the canceling or zeroizing operation is to be performed, the teeth 48 of some of the latches 45 may, from undue tension in the column actuator motor springs due to improper manipulation of the keys, be caught on the projections 49 of carrying mechanisms. For instance, this may result from holding down a key of the highest order, say the 9 key, and then repeatedly depressing the 9 key in the next lower order until the motor carrying spring between the said two orders is completely wound up. This can be done because the holding down of the key in the highest order has prevented any carrying to that order from the next

lower order. Then, still holding down the first mentioned key, the 9 key in the second order from the highest may be similarly depressed repeatedly until the second motor spring has been wound up; and so across all of the orders of the key board, finally obtaining such motor spring pressure that some of the teeth 48 are tightly held by the projections 49, and the machine is jammed so as to be inoperative.

In the said Felt Patent No. 960,528, a release bar engaging the latches 45 was designed to disengage latches which had been caught and jammed in inoperative position, which was effective so far as the releasing of the jammed parts was concerned, but it was found that under certain conditions, or with certain positions of the carrying pinions, the canceling hooks, which were thrown forward to engage the stop studs of the carrying pinions during cancellation, and were so thrown forward at the same time as the release bar was operated, would prevent the carrying incidental to the unwinding of the motor springs from taking place; and when a carrying mechanism was jammed or locked up the cam had raised the inner part of the carrying lever, and the carrying pawl with it, into a position where it could not be engaged by the subtraction lever even though the latter was thrown forward by the canceling stop lever. Also, carrying mechanisms and column actuators could be jammed or locked up in an inoperative position by holding down a key of a high order, then repeatedly depressing the second key to the right of the first mentioned key so as to wind up the two intervening carrying motor springs to their full extent, and then depressing the intervening key; the column actuator of such intervening key will thus be depressed and cannot rise, because its pinion cannot turn forward owing to the said winding up of its carrying mechanism. In such position the stop 33' on the side of the segment of the improperly depressed and held column actuator is lower than the lateral lip 53' at the top of the carrying stop lever. If, in such position of the parts, the canceling stops were moved forward into operative position the said stop on the column actuator will be under and overhung by the lip 53' of the canceling stop and prevented from rising under the action of the actuator spring; and would be held at a point by rising from which it would add 3. The result was that, the wheels being brought to the predetermined point of 8 and the canceling stops withdrawn, allowing the column actuators to rise, bringing the numeral wheels one step forward and the units wheel from 9 to 0 and causing the carrying to take place for the final zeroizing, the column actuator having been held down far

enough to add 3 instead of 1 in rising, the final cancellation did not occur, but one wheel showed 2 instead of zero. Other errors could similarly occur by mis-manipulation of other keys. It is therefore found necessary, in order to make the machine proof against such improper manipulation, to delay the operative positioning of the carrying hooks until after the carrying, incidental to the release of the jammed parts, has taken place; and until after the column actuators have been allowed, by such release, to rise so that they cannot be held down by the lateral lip at the tops of the canceling stop levers. According to the present improvements the release mechanism is caused to operate early in the canceling operation and before the canceling stop mechanism becomes effective; and preferably considerably before the operation of said stop mechanism; and by preference the release bar and the canceling stops are actuated by independent connections from the canceling shaft, or from any other canceling actuator which may be employed.

69 is the latch releasing device, preferably a swinging release bar, already referred to, which releases the caught or jammed latches 45 and connected carrying mechanisms and over-wound carrying motor springs. It is formed with arms 70, 70' pivoted to the frame on the cross rod 46 and is arranged to engage the tail pieces 71 of the latches 45 at a point below the pivot cross rod 46 of the latches and force them backward to lift the latch teeth 48.

72, 72' indicate links which pivotally connect with the arms 70, 70' of the release bar at 73, 82 above the pivot rod 46 and connect with the forward ends of release levers 74, 74' at 91. These release levers, one at each side of the machine, are pivoted to the frame at 21.

The rear arm of the lever 74 is provided with a cam 75 formed to be depressed by the dolly roll 18 at the beginning of the rearward movement of the canceling actuator, and before said roll operates the cam 68 to throw forward the canceling stops 52. Such depression of the cam 75 raises the forward arm of the lever 74 to move the pivot 73 nearer to the straight line of the pivots 21 and 46, thereby causing a strong toggle action which forces the link 72 and release bar arm 70 forward, and the release bar 69 backward against the tail pieces 71 of the latches, releasing the latter; early in the canceling operation. Also the release bar is so held pressing on the latches during the ensuing forward and backward movement of the dolly roll 18, by the action of the latter on the concentric part 76 of the cam 75, until near the end of the forward movement of the canceling actuator. The lever 74 is drawn backward and down-

ward to keep its cam in contact with the dolly roll by a spring 77, which is connected with the canceling segment lever 14 to cause its roll to closely follow the cam 13. The arm 70' of the release bar at the left of the machine is formed with a vertical slot in which fits the rear forked end 81 of the link 72', said forked end engaging a pin 82 fixed in the end of the arm 70' across the slot. This enables the link 72' to co-operate with the link 72 to push the release bar strongly and evenly against the latches without any yielding or twisting of the release bar 69. For the withdrawal of the release bar the link 72 is sufficient. The loose and readily separable connection of the link 72' with the release bar arm 70' prevents any binding in the action of the three parts, and is of advantage in assembling and disassembling: The rear arm of the lever 74' is not formed with so long a cam surface as is the cam 76, but it has a short cam surface 76' operated on and pressed down by the dolly roll 18', and which coöperates fully with the cam 76 in the forcing inward of the release bar 69. After this has been done the roll 18' may leave the cam 76', the rear end of the lever 74' being held down by the part 78 of the arm 20, for which purpose the arm of said lever is offset at 79 a little inward and to the right to bring it in vertical line under the part 78. Leading to the cam 76' is an incline 80 which will guide the dolly roll 18', as it swings backward, on to the said cam.

The series of movements or operations in canceling is as follows, as the canceling actuator is rocked: First, the release bar 69 is caused to press inward on the tails of the latches 45 to release any of them that may be caught, and allow any carrying that is due to take place on the first succeeding depression and rising of the column actuators; then, and partly at the same time, the cross bar 22 is moved down, to depress the column actuators 23 one step; then the canceling stops 52 are moved forward into position to arrest the carrying pinions 50, and their connected numeral wheels; then, the cross bar rises one step and the column actuators cause the numeral wheels to advance one step (excepting any wheel higher than units which may already stand at 8, and excepting the units wheel if it already stands at 9); the canceling actuator is now at the end of its backward rock; then on the forward rock of the canceling actuator, the cross bar 22 is again depressed, putting the column actuators down one step and ready to rise and advance the numeral wheels one step, and also relieving the locking detents 95 from the pressure of the studs 97 so as to allow said detents to be pressed by their springs out of the lantern wheels 37 and the

accumulator mechanisms to be set free for forward canceling rotation; then, and partly at the same time as the last mentioned movement, the canceling segment lever begins to descend, turning the pick-up or canceling shaft 17 backward and causing it to pick up and turn forward to the 8 position (the 9 position in case of the units wheel) any numeral wheel not already in such position; then, the release bar 69 begins to move forward, allowing the latches 45 to engage the studs 47 on the column actuators, and the cross bar rises away from the column actuators to allow them to spring up as soon as the stops 52 have been withdrawn; then the toggle mechanism 62, 65 which holds the canceling stops 52 in stopping position is tripped (the canceling actuator is now substantially at the end of its forward rock) and said stops are instantly withdrawn; then, instantly thereafter, the carry of one step is flashed across the orders of wheels from the units to the highest order, all numeral wheels are at zero, and the cancellation is completed; then a slight forward movement of the canceling actuator completes the forward movement of the release bar 69. It is evident from the foregoing that no appreciable duration of time is required for the release of the numeral wheels, by the withdrawal of the canceling stops, and that consequently they may remain in engagement so much longer, and until very nearly the end of the canceling operation, giving a dwell which promotes the accuracy of that operation.

A means for preventing any possible rebound of the canceling actuator, and any consequent forward turning of one or more of the numeral wheels, comprises a positive stop for said actuator. In the construction illustrated it is shown as consisting of a stop, tooth or hook 83 adapted to be moved momentarily into the path of a corresponding stop 84 on some part which is moved by or with the rock shaft 12. In this instance the stop 84 is formed with the slotted cam 13, and is arranged to be a little higher than the stop 83 at the instant when the canceling actuator is arrested at the end of its forward movement. The stop is carried by an arm 85 pivoted at 86 to the frame of the machine, and is normally and when it is out of operation drawn back by a spring 87 against a fixed stop 88. Connected with the arm 85 is an arm 89 which extends across the upper part of the path of a pin 90 fixed on some part which turns with the canceling actuator, in this instance on the said slotted cam 13. The pin 90 is so positioned that it will, just before the end of the forward movement of the canceling actuator and slotted cam, raise the arm 89 and throw the stop 83 forward under the corresponding stop 84 on the slotted cam. Any rebound of

the canceling actuator at this instant is positively prevented by the interlocking of the said two stops. When the canceling actuator comes to rest in its forward and normal position (seen in Fig. 1) the spring 89 withdraws the stop 83 out of the path of the stop 84. The rearward rock of the canceling actuator 11, 12 is arrested by a stop arm 92 on the slotted cam, which encounters a fixed stop 93 on the frame. The forward rock of the said actuator is arrested by a part 94 on the slotted cam, which encounters the under side of the said stop 93. When the canceling actuator rocks forward normally and without violence the arm 89 need not be lifted enough to throw the stop 83 under the stop 84.

The above described means for preventing possible rebound is not essential to a successfully operative machine, and is not claimed herein, being a sole invention of the applicant, Dorr E. Felt, and is reserved to be claimed in a separate application.

In the jamming or locking of parts, heretofore referred to as occurring from improper manipulation of the keys, a considerable number of parts may be involved. Thus where a column actuator has been depressed and cannot rise, its springs 24 are pressing it upward and the column actuator is acting successively on and through a chain of mechanism comprising the pinion 34, ratchet 36, ratchet pawl, lantern wheel 37, carrying pinion 50, carrying gear 99, pin 103, arm 102, cam 43, the dolly roll and carrying lever, the carrying pawl, and the pins of the lantern wheel of the next higher order; and thence, through the next higher order or orders of carrying mechanism, to the latch 45 whose under-cut tooth 48 is caught on the projection 49. In this transmission of power from the springs 24 there is increase of leverage, and the cams act as wedges under their dolly rolls, making the parts difficult to release.

What is claimed is:

1. In a calculating machine, in combination: multiple-order accumulator mechanisms and locking devices therefor; a series of column actuators; automatic carrying mechanisms; a canceling device adapted to advance a plurality of the orders from diverse positions to a predetermined limit; cancellation controlling means to operate the said canceling device and effect a column-actuator adding movement and a carrying-mechanism adding movement; canceling stops for stopping the said accumulator mechanisms at the predetermined limit; and connections whereby the cancellation controlling means withdraws the canceling stops of the accumulator mechanisms and defers such withdrawal until other action of the canceling handle has been so far completed that the numeral wheels can be controlled by normal stopping action of the

accumulator mechanism locking devices; substantially as specified.

2. In a calculating machine, in combination: multiple-order accumulator mechanisms and locking devices therefor; a series of column actuators; automatic carrying mechanisms; a canceling device adapted to advance a plurality of the orders from diverse positions to a predetermined limit; cancellation controlling means to operate the said canceling device and effect a column-actuator adding movement and a carrying-mechanism adding movement; canceling stops for stopping the said accumulator mechanisms at the predetermined limit; and connections whereby the cancellation controlling means withdraws the canceling stops of the accumulator mechanisms and operates to cause a dwell between the final positioning of the accumulator mechanisms at said predetermined limit and the withdrawal of the said stops, substantially as specified.

3. In a calculating machine, in combination: multiple-order accumulator mechanisms and locking devices therefor; a series of column actuators; automatic carrying mechanisms; a canceling device adapted to advance a plurality of the orders from diverse positions to a predetermined limit; cancellation controlling means to operate the said canceling device and effect a column-actuator adding movement and a carrying-mechanism adding movement; canceling stops for stopping the said accumulator mechanisms at the predetermined limit; and connections whereby the cancellation controlling means withdraws the canceling stops of the accumulator mechanisms and operates to defer such withdrawal until after the stopping of all forward momentum imparted to any numeral wheel of the accumulator mechanisms by the preceding part of the canceling actuation; substantially as specified.

4. In a calculating machine, in combination: multiple-order accumulator mechanisms and locking devices therefor; a series of column actuators; automatic carrying mechanisms comprising motor springs; a canceling device adapted to advance a plurality of the orders from diverse positions to a predetermined limit; cancellation controlling means to operate the said canceling device and effect a column-actuator adding movement and a carrying-mechanism adding movement; canceling stops for stopping the said accumulator mechanisms at the predetermined limit; and connections whereby the cancellation controlling means withdraws the canceling stops of the accumulator mechanisms and defers such withdrawal until other action of the canceling handle has been so far completed that the numeral wheels can be controlled by normal stopping action

of the accumulator mechanism locking devices; substantially as specified.

5. In a calculating machine, in combination: multiple-order accumulator mechanisms and locking devices therefor; a series of column actuators; automatic carrying mechanisms comprising motor springs; a canceling device adapted to advance a plurality of the orders from diverse positions to a predetermined limit; cancellation controlling means to operate the said canceling device and effect a column-actuator adding movement and a carrying-mechanism adding movement; canceling stops for stopping the said accumulator mechanisms at the predetermined limit; and connections whereby the cancellation controlling means withdraws the canceling stops of the accumulator mechanisms and operates to cause a dwell between the final positioning of the accumulator mechanisms at said predetermined limit and the withdrawal of the said canceling stops; substantially as set forth.

6. In a calculating machine, in combination: multiple-order accumulator mechanisms and locking devices therefor; a series of column actuators; automatic carrying mechanisms comprising motor springs; a canceling device adapted to advance a plurality of the orders from diverse positions to a predetermined limit; cancellation controlling means to operate the said canceling device and effect a column-actuator adding movement and a carrying-mechanism adding movement; canceling stops for stopping the said accumulator mechanisms at the predetermined limit; and connections whereby the cancellation controlling means withdraws the canceling stops of the accumulator mechanisms and operates to defer such withdrawal until after the stopping of all forward momentum imparted to any numeral wheel of the accumulator mechanisms by the preceding part of the canceling actuation; substantially as specified.

7. In a calculating machine, in combination: multiple-order accumulator mechanisms and locking devices therefor; a series of column actuators; automatic carrying mechanisms adapted to permit said accumulator mechanisms to receive prime actuations in a plurality of orders simultaneously; a canceling device adapted to advance a plurality of the orders from diverse positions to a predetermined limit; cancellation controlling means to operate the said canceling device and effect a column-actuator adding movement and a carrying-mechanism adding movement; canceling stops for stopping the said accumulator mechanisms at the predetermined limit; and connections whereby the cancellation controlling means withdraws the canceling stops of the accumulator mechanisms and defers such withdrawal until other action of the canceling

handle has been so far completed that the numeral wheels can be controlled by normal stopping action of the accumulator mechanism locking devices; substantially as specified.

8. In a calculating machine, in combination: multiple-order accumulator mechanisms and locking devices therefor; a series of column actuators; automatic carrying mechanisms adapted to permit said accumulator mechanisms to receive prime actuations in a plurality of orders simultaneously; a canceling device adapted to advance a plurality of the orders from diverse positions to a predetermined limit; cancellation controlling means to operate the said canceling device and effect a column-actuator adding movement and a carrying-mechanism adding movement; canceling stops for stopping the said accumulator mechanisms at the predetermined limit; and connections whereby the cancellation controlling means withdraws the canceling stops of the accumulator mechanisms and operates to cause a dwell between the final positioning of the accumulator mechanisms at said predetermined limit and the withdrawal of said canceling stops; substantially as specified.

9. In a calculating machine, in combination: multiple-order accumulator mechanisms and locking devices therefor; a series of column actuators; automatic carrying mechanisms adapted to permit said accumulator mechanisms to receive prime actuations in a plurality of orders simultaneously; a canceling device adapted to advance a plurality of the orders from diverse positions to a predetermined limit; cancellation controlling means to operate the said canceling device and effect a column-actuator adding movement and a carrying-mechanism adding movement; canceling stops for stopping the said accumulator mechanisms at the predetermined limit; and connections whereby the cancellation controlling means withdraws the canceling stops of the accumulator mechanisms and operates to defer withdrawal until after the stopping of all forward momentum imparted to any numeral wheel of the accumulator mechanisms by the preceding part of the canceling actuation; substantially as specified.

10. In a calculating machine, in combination: multiple-order accumulator mechanisms and locking devices therefor; a series of column actuators; automatic carrying mechanisms; a canceling device adapted to advance a plurality of the orders from diverse positions to a predetermined limit; cancellation controlling means to operate the said canceling device and effect a column-actuator adding movement and a carrying-mechanism adding movement; canceling stops for stopping the said accumulator mechanisms at the predetermined limit

arranged to be in stopping position before the said canceling device acts to advance the said orders; and connections whereby the cancellation controlling means withdraws the canceling stops of the accumulator mechanisms and defers such withdrawal until other action of the canceling handle has been so far completed that the numeral wheels can be controlled by normal stopping action of the accumulator mechanism locking device; substantially as specified.

11. In a calculating machine, in combination: multiple-order accumulator mechanisms and locking devices therefor; a series of column actuators; automatic carrying mechanisms; a canceling device adapted to advance a plurality of the orders from diverse positions to a predetermined limit; cancellation controlling means to operate the said canceling device and effect a column-actuator adding movement and a carrying-mechanism adding movement; canceling stops for stopping the said accumulator mechanisms at the predetermined limit arranged to be in stopping position before the said canceling device acts to advance the said orders; and connections whereby the cancellation controlling means withdraws the canceling stops of the accumulator mechanisms and operates to cause a dwell between the final positioning of the accumulator mechanisms at said predetermined limit and the withdrawal of the said stops; substantially as specified.

12. In a calculating machine, in combination: multiple-order accumulator mechanisms; a series of column-actuators; automatic carrying mechanisms; carry-detaining latches; a device for releasing the said latches; a canceling device adapted to advance a plurality of the orders from diverse positions to a predetermined limit; cancellation controlling means to operate said canceling device; means for stopping the said accumulator mechanisms at the predetermined limit; and independent connections between the cancellation controlling means and the said latch-releasing device and accumulator stopping means; substantially as specified.

13. In a calculating machine, in combination: multiple-order accumulator mechanisms; a series of column-actuators; automatic carrying mechanisms; carry-detaining latches; a device for releasing the said latches; a canceling device adapted to advance a plurality of the orders from diverse positions to a predetermined limit; cancellation controlling means to operate said canceling device; means for stopping the said accumulator mechanisms at the predetermined limit; and connections between the cancellation controlling means and said latch-releasing device and accumulator stopping means, whereby the said stopping

means are engaged after the said latches have been released and are released when the automatic carrying mechanisms are ready to perform their functions of bringing all of the accumulator mechanisms to initial position; substantially as specified.

14. In a calculating machine, in combination: multiple-order accumulator mechanisms; a series of column actuators; automatic carrying mechanisms; carry-detaining latches; a device for releasing the said latches; a canceling device adapted to advance a plurality of the orders from diverse positions to a predetermined limit; cancellation controlling means to operate said canceling device; means for stopping the said accumulator mechanisms at the predetermined limit; and connections between the cancellation controlling means and the said latch releasing device and accumulator stopping means, whereby the said stopping means are engaged after the latches have been released and are released substantially at the end of the final movement of the said cancellation controlling means; substantially as specified.

15. In a calculating machine, in combination: multiple-order accumulator mechanisms; a series of column-actuators; automatic carrying mechanisms; carry-detaining latches; a device for releasing the said latches; a canceling device adapted to advance a plurality of the orders from diverse positions to a predetermined limit; cancellation controlling means to operate said canceling device; means for stopping the said accumulator mechanisms at the predetermined limit; and connections between the cancellation controlling means and the said latch-releasing device and accumulator stopping means, whereby the said stopping means are engaged after the said latch-releasing device has performed its functions; substantially as specified.

16. In a calculating machine, in combination: multiple-order accumulator mechanisms; a series of column actuators; automatic carrying mechanisms; carry-detaining latches; a device for releasing the said latches; a canceling device adapted to advance a plurality of the orders from diverse positions to a predetermined limit; cancellation controlling means to operate said canceling device; means for stopping the said accumulator mechanisms at the predetermined limit; and independent connections between the cancellation controlling means and the said latch-releasing device and accumulator stopping means, whereby the carry-detaining latches are released before the said stopping means of the accumulator mechanisms becomes operative; substantially as specified.

17. In a calculating machine, in combination: multiple-order accumulator mechanisms; a series of column actuators; automatic carrying mechanisms; carry-detaining latches; a device for releasing the said latches; a canceling device adapted to advance a plurality of the orders from diverse positions to a predetermined limit; cancellation controlling means to operate said canceling device; means for stopping the said accumulator mechanisms at the predetermined limit; and connections between the cancellation controlling means and the said latch-releasing device and accumulator stopping means, whereby the said stopping means are engaged after the said latches have been released and are released when the automatic carrying mechanisms are ready to perform their functions of bringing all of the accumulator mechanisms to initial position; substantially as specified.

- nisms; a series of column actuators; an independent canceling device adapted to advance a plurality of the orders from diverse positions to a predetermined limit; cancellation controlling means to operate said canceling device; means for stopping the said accumulator mechanisms at the predetermined limit; and a motor device, which is set free by the operation of the said cancellation controlling means and which operates with a force independent of that exerted on said controlling means, for removing the said stopping means to release the accumulator mechanisms; substantially as specified.
18. In a calculating machine, in combination: multiple-order accumulator mechanisms; a series of column-actuators; an independent canceling device adapted to advance a plurality of the orders from diverse positions to a predetermined limit; cancellation controlling means to operate said canceling device and effect a column-actuator adding movement; means for stopping the accumulator mechanisms at the predetermined limit; and a device for abruptly removing the said stopping means when the said cancellation controlling means has been operated to a certain point; substantially as specified.
19. In a calculating machine, in combination; multiple-order accumulator mechanisms; a series of column-actuators; an independent canceling device adapted to advance a plurality of the orders from diverse positions to a predetermined limit; cancellation controlling means to operate said canceling device and effect a column-actuator adding movement; means for stopping the said accumulator mechanisms at the predetermined limit; and a motor device for abruptly removing the said stopping means at substantially the end of the operation of the said cancellation controlling means; substantially as specified.
20. In a calculating machine, in combination: multiple-order accumulator mechanisms; a series of column actuators; an independent canceling device adapted to advance a plurality of the orders from diverse positions to a predetermined limit; cancellation controlling means to operate said canceling device and effect a column-actuator adding movement; means for stopping the said accumulator mechanisms at the predetermined limit; a motor-controlled lock for holding the stopping means in operative position during a further movement of the cancellation controlling means, and means for tripping the said lock by a still further movement of the said controlling means; substantially as specified.
21. In a calculating machine, in combination: multiple-order accumulator mechanisms; a series of column actuators; an independent canceling device adapted to advance a plurality of the orders from diverse positions to a predetermined limit; cancellation controlling means to operate said canceling device and effect a column-actuator adding movement; means for stopping the said accumulator mechanisms at the predetermined limit; a toggle lock for holding the stopping means in operative position, and means for tripping the said toggle operated by the said cancellation controlling means; substantially as specified.
22. In a calculating machine, in combination: multiple-order accumulator mechanisms; a series of column actuators; an independent canceling device adapted to advance a plurality of the orders from diverse positions to a predetermined limit; cancellation controlling means to operate said canceling device and effect a column-actuator adding movement; means for stopping the said accumulator mechanisms at the predetermined limit; a spring controlled lock for holding the stopping means in operative position, and means for tripping the said lock operated by said cancellation controlling means; substantially as specified.
23. In a calculating machine, in combination: multiple-order accumulator mechanism; a series of column actuators; an independent canceling device adapted to advance a plurality of the orders from diverse positions to a predetermined limit; cancellation controlling means to operate said canceling device and effect a succeeding adding movement in the series of column actuators; means for stopping the said accumulator mechanisms at the predetermined limit; and a motor device, which is set free by the operation of the said cancellation controlling means and which operates with a force independent of that exerted on said controlling means, for removing the said stopping means to release the accumulator mechanisms; substantially as specified.
24. In a calculating machine, in combination: multiple-order accumulator mechanisms; a series of column-actuators; an independent canceling device adapted to advance a plurality of the orders from diverse positions to a predetermined limit; cancellation controlling means to operate said canceling device and effect a succeeding adding movement in the series of column actuators; means for stopping the accumulator mechanisms at the predetermined limit; and a motor device for instantly removing the said stopping means when the said cancellation controlling means has been operated to a certain point; substantially as specified.
25. In a calculating machine, in combination: multiple-order accumulator mechanisms; a series of column-actuators; an independent canceling device adapted to advance a plurality of the orders from diverse

positions to a predetermined limit; cancellation controlling means to operate said canceling device and effect a succeeding adding movement in the series of column actuators; means for stopping the said accumulator mechanisms at the predetermined limit; and a motor device for instantly removing the said stopping means at substantially the end of the operation of the said cancellation controlling means; substantially as specified.

26. In a calculating machine, in combination: multiple-order accumulator mechanisms; a series of column actuators; an independent canceling device adapted to advance a plurality of the orders from diverse positions to a predetermined limit; cancellation controlling means to operate said canceling device and effect a succeeding adding movement in the series of column actuators; means for stopping the said accumulator mechanisms at the predetermined limit; a motor controlled lock for holding the stopping means in operative position during a further movement of the cancellation controlling means, and means for trip-

ping the said lock by a still further movement of the said controlling means; substantially as specified.

27. In a calculating machine, in combination: multiple-order accumulator mechanisms; a series of column-actuators; an independent canceling device adapted to advance a plurality of the orders from diverse positions to a predetermined limit; cancellation controlling means to operate said canceling device and effect a succeeding adding movement in the series of column actuators; means for stopping the said accumulator mechanisms at the predetermined limit; a toggle lock for holding the stopping means in operative position, and means for tripping the said toggle operated by the said cancellation controlling means; substantially as specified.

Signed by us on the 27 day of March 1913, in the presence of two subscribing witnesses.

DORR E. FELT.
JOSEPH A. V. TURCK.

Witnesses:

H. N. Low,
PHILIP E. KUNTZ.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."

Corrections in Letters Patent No. 1,072,934.

It is hereby certified that in Letters Patent No. 1,072,934, granted September 9, 1913, upon the application of Dorrr E. Felt and Joseph A. V. Turck, of Chicago, Illinois, for an improvement in "Calculating-Machines," errors appear in the printed specification requiring correction as follows: Page 4, line 18, after the word "point" insert the reference-numeral 64; same page and line, the after word "points" insert the reference-numerals and words 63 and 66 and the arm 65 engages the rear side of the link 62, or other suitable abutment, whereupon the parts form a toggle; same page, line 19, after the word "and" insert the words and reference-numeral the rear arm of the lever 58 having been; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 9th day of December, A. D., 1913.

[SEAL.]

J. T. NEWTON,

Acting Commissioner of Patents.