

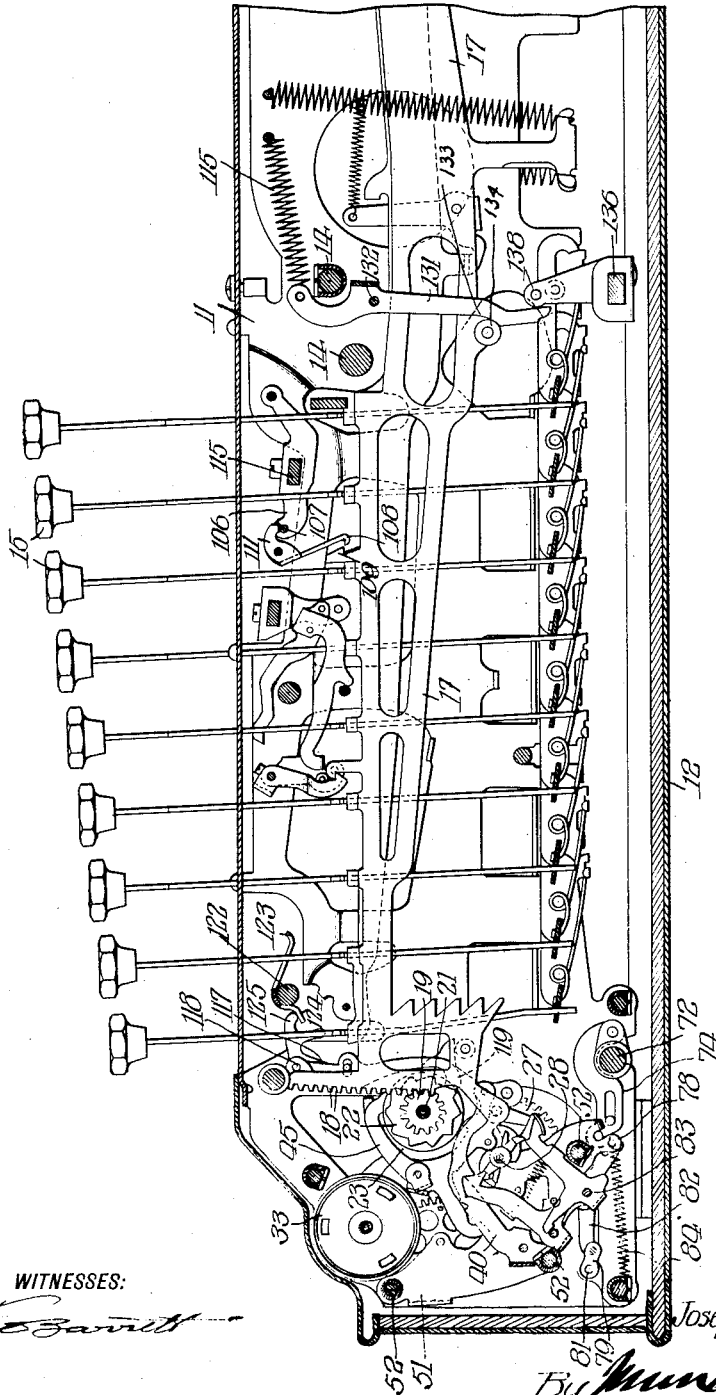
J. A. V. TURCK.
 CALCULATING MACHINE.
 APPLICATION FILED MAY 1, 1918.

1,357,747.

Patented Nov. 2, 1920.

5 SHEETS—SHEET 1.

Fig. 1



WITNESSES:

H. B. Smith

INVENTOR

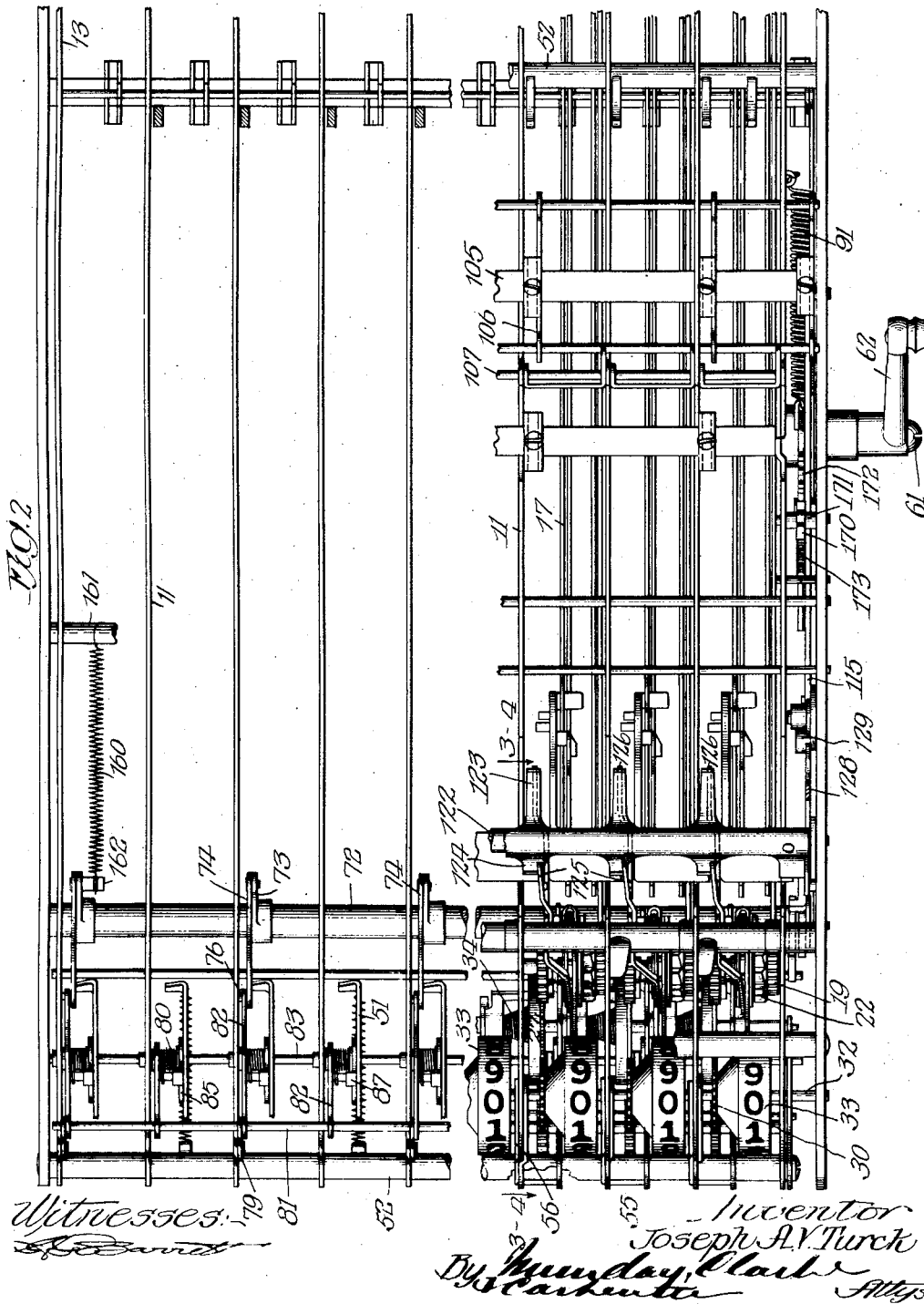
Joseph A. V. Turck

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5 SHEETS—SHEET 3.

Fig. 2

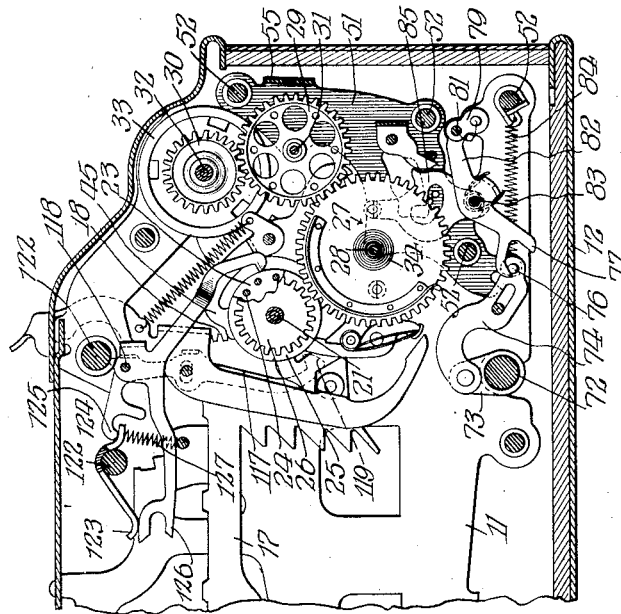
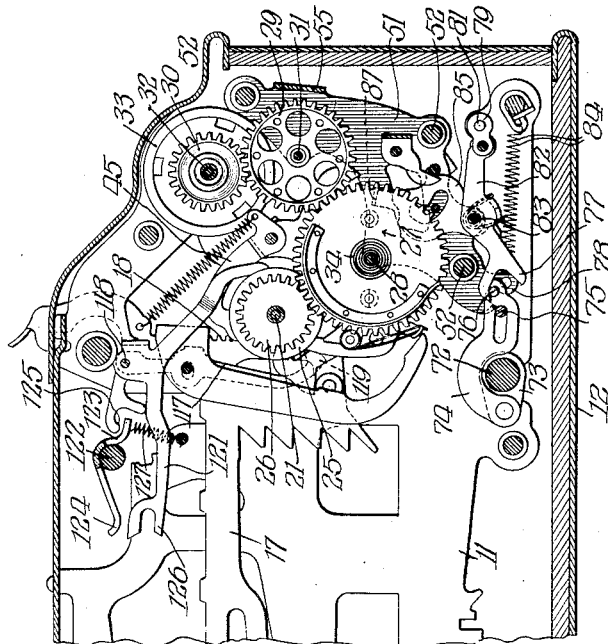


Fig. 3



WITNESSES:

[Signature]

INVENTOR

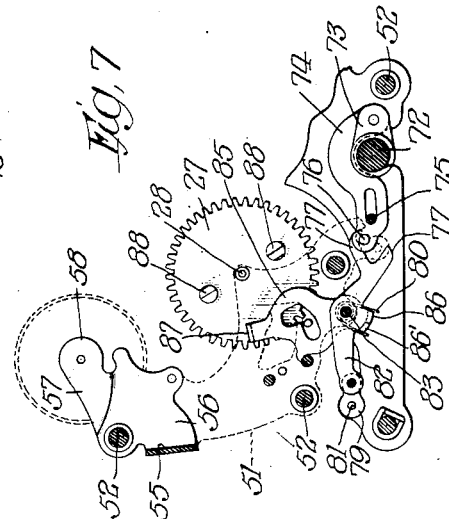
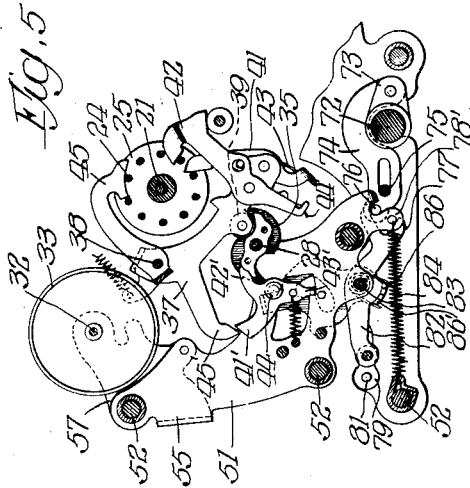
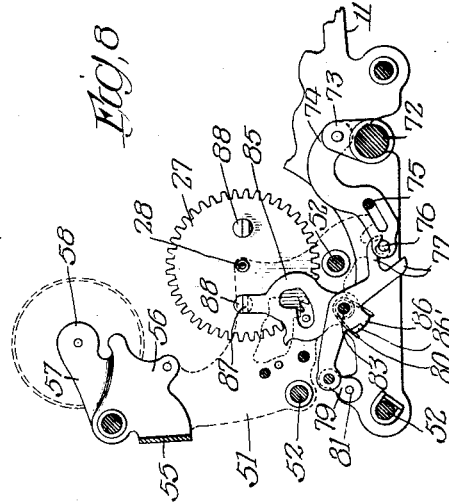
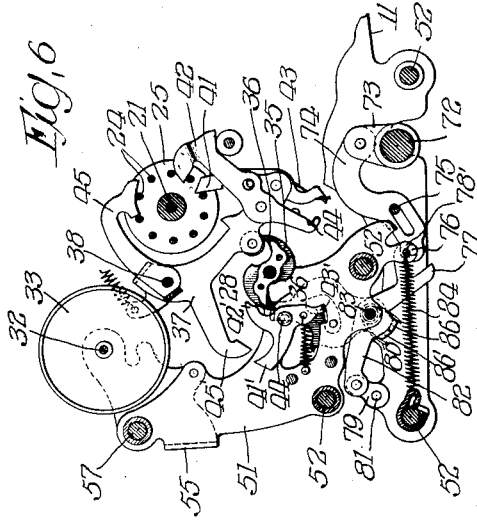
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Patented Nov. 2, 1920.
 5 SHEETS—SHEET 4.



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1,357,747.

Patented Nov. 2, 1920.
 5 SHEETS—SHEET 5.

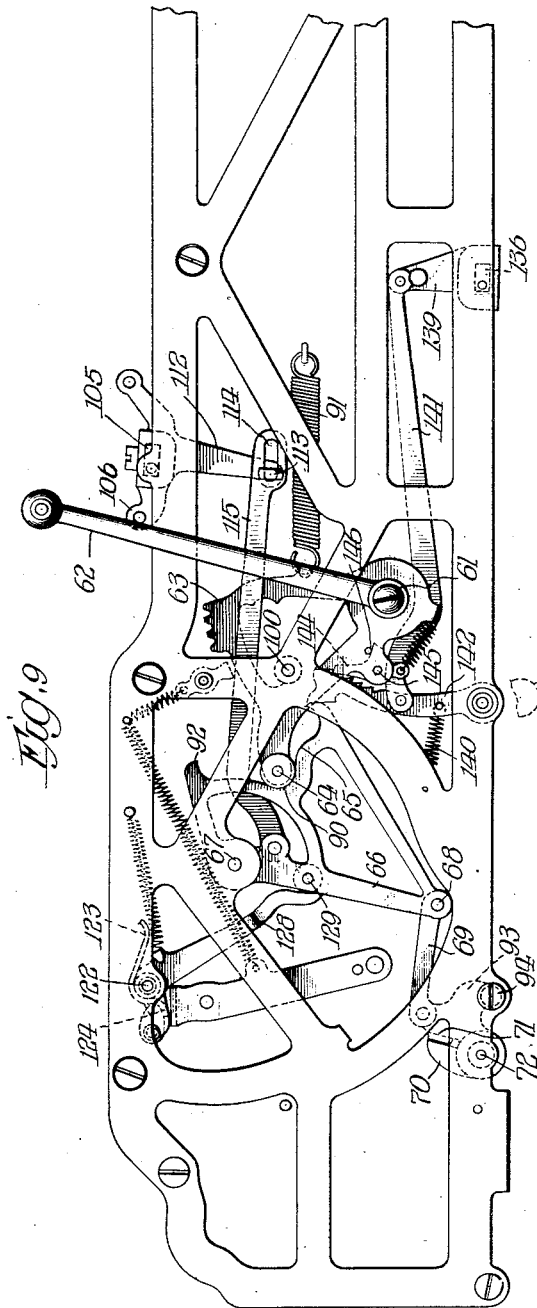


Fig. 9

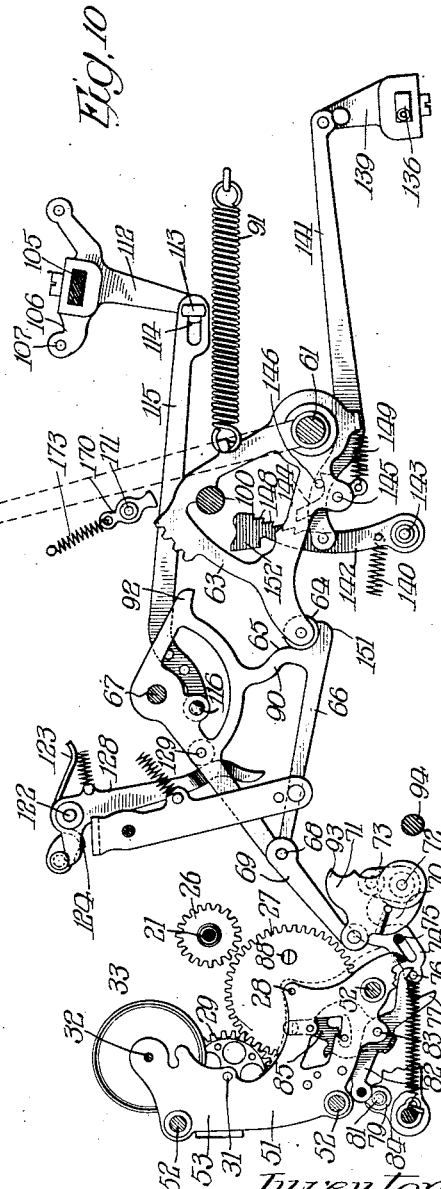


Fig. 10

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UNITED STATES PATENT OFFICE.

JOSEPH A. V. TURCK, OF WILMETTE, ILLINOIS, ASSIGNOR TO FELT & TARRANT M'FG CO., OF CHICAGO, ILLINOIS, A CORPORATION.

CALCULATING-MACHINE.

1,357,747.

Specification of Letters Patent.

Patented Nov. 2, 1920.

Application filed May 1, 1918. Serial No. 231,814.

To all whom it may concern:

Be it known that I, JOSEPH A. V. TURCK, a citizen of the United States, residing in Wilmette, in the county of Cook and State of Illinois, have invented a new and useful Improvement in Calculating-Machines, of which the following is a specification.

This invention relates to canceling or zeroizing devices for calculating machines, and although the invention is hereinafter described in connection with calculating machines of the key-driven multiple order type, it will be manifest as the invention is better understood that it has other valuable application.

A principal object of the present invention is the provision of a canceling or zeroizing device which will accurately and quickly return the numeral wheels from the divers positions they may have assumed to zero position, and this through the utilization of the power normally stored in the calculating machine.

A further and highly important object of the invention is the provision of devices of this character which will require merely initial actuation by the operator, the action beyond the starting operation being entirely automatic and consequently beyond the control or manipulation of the operator, so that invariably complete and accurate cancellation results.

Another object of the invention is the provision of canceling or zeroizing devices which may be actuated or started into operation by a short stroke action of the part moved by the hand of the operator and to arrange such part in easy accessible position. By reason of the short stroke of this readily accessible part the device permits of more rapid operation of the calculating machine.

Another object of the present invention is the provision of canceling or zeroizing devices which will not in their manipulation permit of any forcing of the action, thereby protecting the machine in large measure against misuse by the operator and also insuring against jamming or forcing of the parts should any of them from any cause have become disarranged.

A still further and highly important object of this invention is the provision of canceling or zeroizing devices in a calculating machine, which will involve in their operation a minimum number of the parts

of the machine. By reason of this feature a machine embodying my present invention may be provided with a greater number of ordinal places than has heretofore been found practical commercially.

A still further object of the invention is the provision of a canceling device in a calculating machine, which will not greatly complicate the calculating machine structure of which it is a part and which can be provided without interfering in any way with the normal action and functions of the several parts of said machine in performing the calculations for which the machine is designed.

Numerous other important objects and advantages of the invention will be apparent as it is better understood from the following description when considered in connection with the accompanying drawing illustrating a preferred embodiment thereof.

On the drawings,

Figure 1 is a partial vertical section taken from front to back through a machine of the multiple order key-driven type in which my present invention is embodied;

Fig. 2 is a partial top plan view, with parts broken away and parts removed, of such machine;

Figs. 3 and 4 are partial vertical sections taken just to the left of a numeral wheel and showing the parts in different positions they assume normally and during the canceling and zeroizing operation;

Figs. 5 to 8 are detail sections showing the movement of the parts in zeroizing and are to be considered in pairs 5-6 and 7-8;

Fig. 9 is a detail side elevation of the operating member or lever and the mechanism for starting and terminating the zeroizing operation; and

Fig. 10 is a detail section view showing the parts of Fig. 9 differently arranged and the relation of such parts and the intermediate devices to a numeral wheel.

The embodiment of the invention shown on the drawing and now about to be described in detail is particularly designed and adapted for use in calculating machines such as the well-known comptometer, disclosed in U. S. Letters Patent No. 1,072,933 to Dorr E. Felt issued Sept. 9, 1913 and other patents to said Dorr E. Felt, and also in U. S. Letters Patent No. 1,110,734 to Kurt F. Ziehm granted Sept. 15, 1914.

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The machine shown on the drawing, except for the canceling or zeroizing mechanism or devices and certain incidental changes in construction, need not be described in detail since its construction will be readily understood from the patents mentioned.

It may be mentioned, however, that the operating parts are carried in a frame mounted upon a base 12 and consisting of side bars or skeleton plates 13 and partitions 11, all held together by cross or tie rods or shafts 14.

In the machine shown on the drawing a number of banks of nine keys each are provided, one bank of such keys being indicated by the reference character 15 (Fig. 1), it being understood that the nine keys shown are duplicated for each numeral wheel and that the numeral wheels and banks of keys together with other actuating and attendant parts are provided in number in accordance with the desired number of columns of figures or ordinal places within the capacity of the machine to add. Each bank of keys forms a part of an actuating mechanism comprising a segment lever 17 pivoted at its rear end and adapted to be depressed, in amount in accordance with the particular key 15 moved by the operator. Each key 15 has a stem 16 extending down and bearing upon the segment lever 17, the key toward the left, being farther from the pivotal axis of the segment lever, moves it through a lesser arc than does the key 15 at the right, these keys being numbered one to nine from the front to back.

Each segment lever is adapted to impart calculating movement to an accumulator and at its forward end carries a rack 18 in mesh with an accumulator pinion 19 mounted upon a shaft 21, which shaft extends across the machine and has bearings in the frame. Each pinion 19 is fixed to the side of an internal ratchet 22 which is disposed alongside a rotating disk 23 which carries a pawl internally engaging the ratchet 22. This internal construction is not shown, since it is not believed to be necessary to an understanding of the present invention. It will, however, be understood that each time the segment lever is depressed the ratchet 22 moves idly and upon the return or upward movement of the segment lever after key actuation the ratchet engages the pawl of the disk 23 and the disk is rotated an amount determined by the arcuate travel of the segment lever. The disk 23 is a part of a lantern gear and has pins 24 fixed to it and to a disk 25 at the opposite side. The disk 25 carries a pinion 26, which pinion normally meshes with a gear 27 upon a shaft 28 extending across the front of the machine. The gear 27 meshes with a pinion or gear 29 upon a shaft 31 and the pinion 29 meshes

with the pinion 30 upon a shaft 32. The pinion 31 is fixed to and rotates the numeral wheel 33 so that at each key stroke the segment lever through the connections and devices mentioned causes a corresponding rotation of the numeral wheel.

Carrying mechanism is provided in each accumulator to actuate the accumulator of the next higher order each time a carry is to go over. This carrying mechanism includes a carrying spring 34 mounted upon the shaft 28 and fast at one end to the left hand face of the gear 27 and adapted to actuate a cam 35 indicated by shading in Figs. 5 and 6. The ratio of the gears and various parts is such that a complete rotation of a numeral wheel is accompanied by a one-half rotation of the gear 27, so that at each half rotation of the gear 27 it is essential that a carry go over to the next higher order. To this end the cam 35 is provided with two carry effecting portions 36 separated 180° apart. The carry is transmitted from the cam 35 by means of a lever 37 pivoted upon a rod 38 extending across the machine and secured in the skeleton side plates and partitions. This lever carries a roller 39 engaging the face of the cam and at its lower end has an actuating pawl 41 engaging between the teeth of the lantern gear of the next higher order and adapted under proper conditions to advance the mechanism of such next higher order one step at each passage of a high point of the cam 35. The lever 37 also carries an overthrow restraining member or lever 42, both the levers or arms 41 and 42 being spring held in place by springs 43 and 44. A dog having three arms 41', 42' and 43' pivoted at 44' forms a part of each accumulator mechanism and except during carrying and as later described during zeroizing is arranged with one of its arms 41' beneath a tail 45' pivoted upon the lever 37, this three-arm dog serving to give rigidity to the lever 37, when the pawl 42 is disposed between the pins 24 of the lantern gear, to prevent overthrow. If when a carry is to be received by the lantern wheel of an order from the mechanism of the next lower order the lantern wheel is advancing under the action of its own column actuator or segment lever, the delaying latch or lever 40 is moved to locking position so that the carry is delayed until the action of the segment lever is completed. A back stop 45 is provided to prevent rearward movement of the lantern gear and also of the devices driven by it under the unwinding tendency of the carrying springs for there is always stored an amount of power even when said devices are in their zero positions. So much of the structure described is of the character of that in the earlier patents and need not be described more in detail.

To clear the machine or zeroize,—that is, return the numeral wheels and other parts to the zero positions,—I have provided means for disconnecting the connections between the numeral wheels and the actuating devices so that the stored power in the springs may give to the numeral wheels a backward rotation, moving them from the divers positions they may occupy rearwardly and stopping them when they individually arrive at zero positions. In the present instance this is done by detrain-
 10 or disengaging the gears 27 from the pinions 26. The shaft 32 of the numeral wheels is mounted in bearings fixed in the frame of the machine. To effect this detrain-
 15 ing of the gears 26 and 27 the shafts 31 and 28 are carried by a swinging frame having a slight downward and outward pivotal movement about the shaft 32 on which these frames are pivoted. The swinging frame comprises partition plates 51 connected to-
 20 gether by tie rods 52. Each of the plates 51 comprises a main portion 53 fixed to the tie rods 52 carrying a laterally extending wing 55, upon which is a forwardly and upwardly extending end 56. This end 56 is bent in
 25 general parallelism with the part 53. This inwardly extending end also embraces and is fixed upon the upper tie rod 52 and has an offset part 57 pivotally supported on the shaft 32. The end 56 is notched inwardly at the offset to provide lips or projections
 30 58 and 59 disposed on opposite sides of the ends of the partition walls 11 so that the ends of these walls act as lateral guides for the swinging frame through engagement of the projections 58 and 59 with the several
 35 frame partition plates 11. This frame carries the shafts 28 and 31 which move with the frame when it swings away from the position shown in Fig. 3 with the gears 26 and 27 in mesh to the position shown in
 40 Fig. 4 with such gears detrain- or disconnected, this being the action incidental to clearing or zeroizing the machine. It will be understood that this motion relieves the
 45 carrying springs from the restraining influences by the various back stops, locks and devices provided to insure proper actuation of the machine as herein mentioned or de-
 50 scribed. All of which, however, in so far as they serve to restrain the movement of the spring are felt by the springs through the agency of the lantern gears or wheels. It will be apparent that the arrangement of the springs is such that their ends connected to the escapements are held by such escape-
 55 ment during zeroizing and it is therefore not necessary to bring into operation any stops in the zeroizing operation except of course the stops for halting the numeral wheels when they arrive at zero positions.

65 Extending out of the side of the casing is

a shaft 61 upon the end of which is mounted a hand lever 62. An arm 63 is fixed upon this shaft within the casing and is provided at its inner end with a dolly roll 64. This dolly roll engages a cam face 65 of a
 70 bell crank lever 66 pivoted upon a shaft 67 having suitable bearings within the frame. The bell crank lever 66 is connected at 68 with a link 69, which in turn is connected with an arm 71 upon a shaft 72 also mount-
 75 ed in the frame. This arm 71 might be fast on the shaft but for convenience of manufacture is loose thereon in the present instance and bears against a fixed arm 70 which is spring held, by the springs 84 and
 80 160 against the arm 71 so that the two arms 70 and 71 act together as a single member rigid with the shaft. The springs holding the arms together will be later herein de-
 85 scribed. Upon this shaft are other arms 73 connected to curved levers 74 having slotted shifting pivots upon a shaft 75. The other
 90 end of each curved lever 74 is provided with a pin 76 mounted between spaced jaws 77 of a toggle, one member 79 of which is
 95 pivoted upon a shaft 81, in the frame of the machine and the other member 82,—i. e. the member having the jaws,—is pivoted to a shaft 83 in the swinging frame. Springs
 100 84 are fastened to a suitable part of the frame of the machine and also to lugs 78 of the swinging frame to hold the toggles in each of their extreme positions. The tog-
 105 gles are normally in the extreme positions shown in Fig. 3 with the gears 26 and 27 in mesh. Upon actuation of the lever 62 for canceling,—i. e. toward the left viewing
 110 Figs. 9 and 10,—through the link and lever connection just described, the pin 76 pushes down upon the lower jaw 77 and throws the
 115 toggles past their dead centers, the springs 84 moving them to the other extreme position (as shown in Figs. 4 and 9) and such movement being accompanied by a down-
 120 ward and outward movement of the frame and a consequent detrain- of the gears 26 and 27. This action leaves the carrying springs free to unwind and such unwinding occurs until the numeral wheels arrive at
 125 zero. The unwinding action of the springs is terminated by stops which are projected into operative position. These stops com-
 130 prise arms 85 which are pivoted upon the pivots 83 of the toggle parts 82, said toggle parts having stops 86 coöperating with lugs
 135 86' on the arms 85, and held thereagainst by springs 80 so that the arms 86 are swung rearwardly from the inclined position shown in Fig. 7 to vertical position by the
 140 action of the toggle, each arm being provided with a lip 87 adapted to be engaged by either one of two fixed stops 88 appro-
 145 priately located upon the face of each gear 27. These stops 88, coming into position, terminate the unwinding action of the

springs and hold the numeral wheels in zero position.

The movement of the stops into operative position under the action of the toggles moves the arms 41' of the dogs cooperating with the levers 37 out of operative position to prevent the swinging frame being held by engagement with the tails 45' of the levers 37 and the arms 41' of the dogs. This movement of the dogs is accomplished by engagement of the arms 43' with the stops as they move from inoperative to operative position, swinging the dogs from the position shown in Fig. 5 to that shown in Fig. 6, return movement of the stops 88 returning the dogs to their normal positions.

The lever 62 after being moved forward is moved to the right either by the hand of the operator or by the spring 91 fixed to a suitable part of the frame at one end and at the other to the arm 63. This causes the roller 64 to move out of engagement with the cam face 65 of the arm or bell crank 66, this movement being accompanied by no action of the lever 66 until the roller encounters a projection or lug 92 located above the cam face, upward movement of which causes a reversal of the positions of the toggles, bringing the gears 26 and 27 into mesh and removing the zero stops.

A spring 160 fastened at one end of the frame at 161 and at the other to an arm 162 on the shaft 72 tends to move this shaft in a direction over and toward the rear of the machine, *i. e.* to move the toggles composed of the members 79 and 82 into their normal positions with the gears 26 and 27 in mesh. The link 69 and the lever or arm 66 constitute a toggle lock for restraining movement of the parts under the influence of this spring between the time that the dolly roll 64 moves out of engagement with the cam face 65 into engagement with the lug 92. This interval of time, short though it may be, gives ample opportunity for the numeral wheels to return to their zero positions. The dolly roll merely moves the lug 92 a distance sufficient to break the toggle lock formed of the link 69 and the arm or lever 66, the spring 160 thereafter moving the parts to normal position. This movement moves the link mechanism up until the dolly roll 64 rests in its normal position in the cam at 90 (as shown in Fig. 9). The return movement of the arm 63 is halted by engagement with a stop 100 just as or after the link 66 is moved sufficiently to let the spring 160 become operative. The stop 100 limits also the operative stroke of the operating lever stopping it just after the toggles have been moved up sufficiently to feel the influence of the springs 84, so that on both the forward and the return strokes the arm 63 under the action of the hand of the operator or under the influence of the spring 91

merely starts the movement of the toggles, the movement in both directions being completed by the various springs. Indeed, it may be said that the actuating arm 63 or the handle 62 merely breaks or unlocks the toggles. This arrangement renders the action automatic and wholly beyond the control of the operator, giving it a uniformity of action and preventing any mismanipulation or forced action disarranging the parts or jamming them if from any cause they have become disarranged. It also permits of the operating lever having a light short stroke. This return movement of the toggles is halted by engagement of a portion 93 of the arm 71 with a cross shaft or stop 94 of the frame.

In order to insure the lever 62 having a complete stroke in each direction, that is to prevent imparting to the lever a movement in one direction before it has completed a movement in the opposite direction, I provide a pawl 170 mounted on the frame at 171 and adapted to engage teeth 172 on the arm 63. The pawl 170 is loosely pivoted on the pivot 171 and is held by a spring 173 against the teeth 172 in each direction of movement of the arm riding idly over the teeth so long as the arm moves continuously in one direction. Should, however, the arm be started in the opposite direction before arriving at the end of the stroke the pawl 170 would engage the teeth and hold them until movement is resumed in the original direction.

The calculating machine shown on the drawing is provided with a number of devices for locking the various mechanisms against improper action. These devices include locks for preventing succeeding actuation of the segment levers of the various ordinal actuating devices after a key has been pressed partly down and then released until such mistake is corrected, locks preventing the movement of the accumulator devices under such imperfect stroke, locks for preventing a downward movement of the key until it has completed an up-stroke, forms of which devices are shown and described in detail in the patents to Felt and Ziehm mentioned by number earlier in this description.

It is desirable that after the clearing or zeroizing of the machine is effected by the zeroizing devices such locks be automatically released since mistakes made in the operation prior to zeroizing are no longer of importance and to this end my invention contemplates the provision of means for returning such locks to inoperative, normal positions, to the end that after the zeroizing is completed the calculating machine may be entirely ready for subsequent calculating operations. The complete mechanisms and devices for actuating the various locks need

not be described in detail in this application by reason of the complete disclosure of their construction in earlier patents.

The lock for preventing actuation of the segment levers of other ordinal actuating mechanisms when a key of one order is permitted to rise before reaching the bottom of its stroke, comprises a rock bar 105 extending across the machine and carrying on it arms 106 which support a latch releasing rod 107 for latches 108 adapted to engage beneath cooperating latches 109 on the segment levers. The bar 105 is normally in the inoperative position shown in Fig. 1 with the rod 107 engaged beneath tails 111 of the latches 108, holding these tails elevated and the latches out of engagement with the segment levers. It will be understood that when any key is permitted to rise after a partial down-stroke the rock bar 105 is moved in a counter-clockwise direction permitting the latches 108 to engage all of the segment levers except the one feeling the influence of the key thus improperly operated and normally remains in the operative, *i. e.*, locking, position until the mistake is corrected and the lock normally released. In order that it may be released by the mere action of zeroizing an arm 112 rigid with the bar 105 extends downwardly and carries a pin 113 at its lower end, which is disposed through a slot 114 in a link 115 pivoted at 116 on the lever or arm 66. The pin 113 normally rests in the left hand end of the slot (viewing Fig. 9) and when the rock bar 105 is moved from normal to operative position the arm 112 is of course moved to the right so that the pin rests near the right hand end of the slot. Zeroizing causes this arm, and through the arm the rock shaft and the parts carried by it, to be swung in a clockwise direction into normal position releasing and lifting the latches 108.

The locking devices for preventing the pressing of a key while the key or its column actuator or segment lever is making an up or operative stroke, comprise a plurality of accumulator locking levers 117 pivoted at 118 on the frame and arranged so that one of said levers is disposed adjacent each accumulator. The lower end of the lever is provided with a hook 119 adapted to engage the outer face of the ratchet 24 and during the up-stroke of a segment lever its locking lever 117 rides smoothly on the ratchet teeth. Should a key after being depressed be re-depressed before completing its up-stroke, the hook 119 engages the teeth of the ratchet to prevent actuation until the said key is permitted to finish the interrupted stroke. A locking detent lever (indicated on the drawings at 121) pivoted at 118, is provided for each set of ordinal actuating and accumulating devices, which detent through suitable mechanism (which

need not be described in this specification) is caused to enter between the pins of the lantern wheel during the downward movements of its segment lever to insure against movement of the accumulators.

Both the detents 121 and the locking levers 117 are adapted to be brought to inoperative positions at each canceling or zeroizing operation. This is accomplished by a rock bar 122 mounted in the frame and having a pair of oppositely extending arms 123 and 124 appropriately arranged adjacent each set of ordinal actuating and accumulator devices. One arm of this rocking lever is depressed beneath a tail 125 of lever 117 and the other above a tail 126 of detents 121, a spring 127 being provided to hold the rock bar 122 in the position shown in Fig. 3. At each zeroizing operation this rock bar is moved to the position shown in Fig. 4 arranging the locking lever 117 and the detent 121 positively in the inoperative positions indicated in this last mentioned figure. The movement of this rocking lever during zeroizing is accomplished by an arm 128 fast on the bar 122 and depending alongside a dolly roll 129 on the cam carrying lever or arm 66. At each actuation of the zeroizing or clearing lever 62 this arm is swung to the left (viewing Figs. 9 and 10) to impart the desired rocking movement of the rock shaft 122.

The various locking devices and other parts which from one cause or another may not be arranged in position to permit further calculation before zeroizing are thus by the action of the zeroizing devices brought into position to arrange all the sets of actuating and accumulating devices in position for use.

In order that clearing or zeroizing may not be incomplete by reason of one or more of the keys being held down during the operation or being pressed while the operation is occurring, I provide means for detaining the reengagement of the gears or pinions 26 and 27 until all of the keys of the several ordinal sets of keys and all of the segment levers are in upper normal position. In the mechanism provided for this purpose I make use of brake arms 131 pivoted on a shaft 132 supported by the frame of the machine and having cam parts 133 engaging dolly rolls 134 on the several segment levers, said dolly rolls pushing said arms in a counter-clockwise direction (viewing the drawings) against the force of springs 135. This mechanism has been merely formally employed, as shown by the patents mentioned, to steady the action of the segment levers under the influence of the keys, acting as brakes and shock absorbers and these parts have these functions also in the machine shown on the drawing in this application. A rock bar 136 is pivoted across

the bottom of the frame and is provided with an upwardly extending arm 137 adjacent the lower end of each arm 131. A shaft 138 passes through all the arms 137 and is adapted to be brought into engagement with the rear side of the lower ends of the arms 131. An arm 139 is fast on the ends of the rock bar 136 and shaft 138 adjacent the right hand side of the machine. The shaft 138 is connected by a link 141 adjacent the arm 139 with a curved lever 142 pivoted at 143 on the frame. A ratchet pawl 144 is pivoted on the lever 63 at 145 and this pawl is yieldingly held against a stop 146 by a spring 147. Ratchet teeth 148 are provided in the edge of the curved lever 142 in position to be engaged by the pawl 144 in its return stroke should a segment lever be in lowered position. Engagement of the pawl with the teeth 148 halts further movement of the arm or lever 63 toward the right and this before the roll 64 has engaged the lug 92. This prevents the release of the toggles and holds the gears 26 and 27 separated. Thus, should a key be held down, completion of the clearing or zeroizing operation is delayed until said key is released, when the pawl is automatically disengaged from the rack 48 by reason of movement of the rack away from the pawl and the lever or arm 63 is thereafter automatically pulled to the right by the spring 91, reestablishing normal conditions in the accumulators.

A spring 140 fast at one end to the curved lever 142 and at the other end at 150 to the frame, tends to pull the rock bar over so that the shaft 138 is in position to be engaged by the brakes 131. In order that the brake resistance may not be increased by spring 140, provision is made to hold rock bar 136 over to the right with the shaft 138 out of engagement with the brakes except during zeroizing. The rock bar 136 is moved to the right out of the way of the brakes 131 at the completion of each return stroke of the zeroizing mechanism and is so held. This is accomplished by engagement of a cam surface 151 on the cam member 66 engaging a projection 152 on the upper end of the lever 142. This action occurs after the lever 62 has ceased to be moved in its return movement and by the upward movement of the member 66 under the toggle spring.

It is thought that the invention and many of its attendant advantages will be understood from the foregoing description, and it will be apparent that various changes may be made in the form, construction and arrangement of the parts without departing from the spirit and scope of the invention or sacrificing all of its material advantages, the form hereinbefore described being merely a preferred embodiment thereof.

I claim:

1. In a calculating machine, in combination: a plurality of keys; accumulator numeral wheels; numeral-wheel actuating devices rendered operative upon operation of the keys; spring-escapement mechanisms cooperatively combined with said numeral wheels for performing carrying operations in the various orders thereof; controlling devices for preventing release of said spring-escapement mechanisms, except when the latter are performing their normal carrying functions, said controlling devices remaining at normal during zeroizing; and means, operable independently of said controlling devices, for temporarily relieving the spring-escapement mechanisms from the restraining influence of such devices, to permit the released spring-escapement mechanisms to turn the numeral wheels from various positions to zero positions.

2. In a calculating machine, in combination: a plurality of keys; accumulator numeral wheels; numeral-wheel actuating devices rendered operative upon operation of the keys; spring-escapement mechanisms cooperatively combined with said numeral wheels for performing carrying operations in the various orders thereof; controlling devices for preventing release of said spring-escapement mechanisms, except when the latter are performing their normal carrying functions, said controlling devices remaining at normal during zeroizing; and means for temporarily relieving the spring-escapement mechanisms from the restraining influence of such devices, while said controlling devices remain in their normal operative positions, to permit the released spring-escapement mechanisms to turn the numeral wheels from various positions to zero positions.

3. In a calculating machine, the combination of a plurality of keys, numeral wheels, actuating devices for said numeral wheels and rendered operative upon movement of the keys, driving connections between said devices and said numeral wheels, springs tensioned with the forward movement of said wheels under the action of said actuating devices, stops in said connections for restraining release of the springs, and means for disconnecting parts of said driving connections between said springs and said stops to permit reverse movement of said wheels under the action of said springs released to return said wheels to zero.

4. In a calculating machine, the combination of a plurality of keys, numeral wheels rotating about a fixed axis, actuating devices for said numeral wheels and rendered operative upon movement of the keys, springs wound with the forward movement of said numeral wheels, driving connections

between said numeral wheels and said actuating devices for actuating said numeral wheels and restraining unwinding of said springs, said connections comprising a train of driving intermeshing gears, and means for disenetraining two of the driving gears of said train to permit said springs unwinding to return said numeral wheels to zero.

5 5. In a calculating machine, the combination of a plurality of keys, numeral wheels, actuating devices for said numeral wheels and rendered operative upon movement of said keys, springs tensioned with the forward movement of the numeral wheels, connections between said wheels and said devices, means for disconnecting said wheels from said devices to release said springs and permit them to return said wheels to zero positions, said means after being started on its operative stroke being beyond the control of the operator to prevent jamming on the operative stroke.

6. In a calculating machine, the combination of a plurality of keys, numeral wheels, actuating devices for said numeral wheels and rendered operative upon movement of said keys, springs wound with the forward movement of said numeral wheels, connections between said wheels and said devices, means for disconnecting said connections to permit the springs unwinding to return the numeral wheels to zero, said means after being rendered operative by the operator being wholly beyond his control to prevent jamming on the operative stroke, and means automatically thereafter reestablishing said connections.

7. In a calculating machine, the combination of a plurality of keys, numeral wheels, actuating devices for said numeral wheels and rendered operative upon movement of the keys, connections between said devices and said wheels, springs tensioned with the forward movement of said numeral wheels, manipulative error preventing devices to render said calculating machine temporarily inoperative, and means utilizing the energy stored in said springs for returning said numeral wheels to zero, said means releasing said devices at each zeroizing operation.

8. In a calculating machine, the combination of a plurality of keys, numeral wheels, actuating devices for said numeral wheels and rendered operative upon movement of the keys, connections between said devices and said numeral wheels, springs wound with the forward movement of said numeral wheels, manipulative error preventing devices to render said calculating machine temporarily inoperative and means utilizing the energy stored in said springs to return said numeral wheels to zero, said means releasing said numeral wheels at each zeroizing operation.

9. In a calculating machine, the combination of a plurality of keys, numeral wheels, actuating devices for said numeral wheels and rendered operative upon movement of the keys, a plurality of sets of safety devices for insuring accurate operation of said keys and said numeral wheels, driving connections between said actuating devices and said numeral wheels for driving said numeral wheels in calculating, springs wound by said numeral wheels in their forward movement and means for utilizing the power stored in said springs for returning said numeral wheels to zero, said means releasing all of said safety devices at each zeroizing operation.

10. In a calculating machine, the combination of a plurality of keys, numeral wheels, actuating devices for said numeral wheels and rendered operative upon movement of the keys, a plurality of sets of safety devices for insuring accurate operation of said keys and said numeral wheels, driving connections between said actuating devices and said numeral wheels for driving said numeral wheels in calculating, springs tensioned with the forward movement of the numeral wheels, means for utilizing the power stored in said springs for returning said numeral wheels to zero, said means releasing all of said safety devices at each zeroizing operation.

11. In a calculating machine, the combination of numeral wheel actuating devices, numeral wheels actuated thereby, carrying springs wound with said wheels upon movement of said wheels by said actuating devices, stops for preventing the unwinding in either direction of said springs other than in the performance of their normal carrying functions, and means for freeing said numeral wheels from the stops acting to prevent movement in one direction, with all of said stops remaining in their normal operative positions, to permit said springs unwinding to return said numeral wheels from various positions to zero positions.

12. In a calculating machine, the combination of ordinal actuating devices, ordinal numeral wheels actuated by said devices, carrying springs, driving connection between each numeral wheel and its actuating device, each of said connections comprising driving intermeshing gears, and means for detrainning said driving intermeshing gears to permit said carrying springs unwinding to return said ordinal numeral wheels to zero.

13. In a key-driven calculating machine, the combination of key-actuated devices, numeral wheels actuated by said devices, carrying springs wound with the forward movement of said wheels under the action of said devices, stops for normally preventing reverse unwinding of said springs, and means for freeing said numeral wheels and said

springs from the influence of said stops while said stops remain in normal operative positions to permit said springs unwinding to return the numeral wheels reversely to zero.

14. In a key-driven calculating machine, the combination of key-actuated devices, numeral wheels rotatable about a fixed axis, carrying springs wound with the forward movement of said numeral wheels, driving connections between said numeral wheels and said devices for actuating said numeral wheels and restraining unwinding movement of said springs, said connections comprising a train of driving intermeshing gears, and means for disentraining two of said driving gears of said train to release said springs and permit them unwinding to return said numeral wheels to zero.

15. In a calculating machine, the combination of a plurality of keys, numeral wheels, actuating devices for said numeral wheels and rendered operative upon movement of the keys, zeroizing mechanism, safety devices for preventing actuation of the machine after improper key manipulation, and a control simultaneously rendering said zeroizing mechanism operative and safety devices inoperative.

16. In a calculating machine, the combination of a plurality of keys, numeral wheels, actuating devices for said numeral wheels and rendered operative upon movement of the keys, zeroizing mechanism, safety devices for preventing actuation of the machine after improper key manipulation, and a control simultaneously operating said zeroizing mechanism and moving said safety devices to normal unlocked positions.

17. In a calculating machine, the combination of a plurality of keys, numeral wheels, actuating devices for said numeral wheels and rendered operative upon movement of the keys, zeroizing mechanism, and means for maintaining zeroizing conditions until all of said keys are in inoperative positions.

18. In a calculating machine, the combination of a plurality of keys, numeral wheels, actuating devices for said numeral wheels and rendered operative upon movement of the keys, zeroizing mechanism, and means for maintaining zeroizing conditions until all of said actuating devices are in inoperative positions.

19. In a calculating machine, the combination of a plurality of keys, numeral wheels, actuating devices for said numeral wheels and rendered operative upon movement of the keys, normally restrained carrying springs tensioned with the forward movement of said numeral wheels, means for releasing said springs to permit the tension stored in them to return said nu-

meral wheels to zero positions, and means for preventing subsequent restraint of said springs until all said actuating devices are in normal positions.

20. In a calculating machine, the combination of a plurality of keys, numeral wheels, actuating devices for said numeral wheels and rendered operative upon movement of the keys, normally restrained carrying springs tensioned with the forward movement of said numeral wheels, means for releasing said springs to permit the tension stored in them to return said numeral wheels to zero positions, and means for preventing subsequent restraint of said springs until all said keys are in normal positions.

21. In a calculating machine, the combination of a plurality of keys, actuating devices, accumulating devices, zeroizing mechanism, said accumulating devices comprising parts having one arrangement relative to each other and to the actuating devices in calculating and a different arrangement relative to each other and to the actuating devices in zeroizing, means rigidly moving said parts out of either one arrangement and yieldingly into the other.

22. In a calculating machine, the combination of a plurality of keys, actuating devices, accumulating devices, zeroizing mechanism, said accumulating devices comprising parts having one arrangement relative to each other and to the actuating devices in calculating and a different arrangement relative to each other and to the actuating devices in zeroizing, and means yieldingly moving said parts from either arrangement to the other and positively and rigidly locking said parts in later arrangement.

23. In a calculating machine, the combination of a plurality of keys, actuating devices, accumulating devices, zeroizing mechanism, said accumulating devices comprising normally restrained springs tensioned with accumulations of said accumulating devices and upon release in zeroizing returning said accumulating devices to zero, said accumulating devices having parts arranged relative to each other and to the actuating devices in calculating and a different arrangement relative to each other and to the actuating devices in zeroizing and means rigidly moving said parts out of either one arrangement and yieldingly into the other.

24. In a calculating machine, the combination of a plurality of keys, actuating devices, accumulating devices, zeroizing mechanism, said accumulating devices comprising normally restrained springs tensioned with accumulations of said accumulating devices and upon release in zeroizing returning said accumulating devices to zero, said

accumulating devices having parts arranged relative to each other and to the actuating devices in calculating and a different arrangement relative to each other and to the

5 actuating devices in zeroizing, and means yieldingly moving said parts from either arrangement to the other and positively and rigidly locking said parts in later arrangement.

10 25. In a calculating machine, the combination of a plurality of keys, actuating devices, accumulating devices, zeroizing mechanisms, said zeroizing mechanism comprising toggle locks adapted to be broken

15 at the beginning of the zeroizing operation and established at its end, devices manually operated for releasing said toggle locks, and automatic devices for completing the zeroizing operation.

20 26. In a calculating machine, the combination of a plurality of keys, actuating devices, accumulating devices, zeroizing mechanisms, said zeroizing mechanisms comprising toggle locks adapted to be broken at the

25 beginning of the zeroizing operation and established at its end, devices manually operated for releasing said toggle locks, and automatic devices for completing the zeroizing operation, including yielding means for

30 reestablishing said toggle locks.

27. In a calculating machine, in combination: column actuators; numeral wheels; carrying springs coöperatively combined with said numeral wheels; accumulator

35 mechanisms including pawl and ratchet connections for transmitting calculating movement from the column actuators to the numeral wheels, said pawl and ratchet connections remaining at normal during zeroizing; and means for releasing said varying

40 springs, while said pawls are arranged in operative position to permit said springs to return said numeral wheels independently of said ratchets from various positions to

45 zero positions.

28. In a calculating machine, the combination of a plurality of keys, actuating devices, accumulator mechanisms, said accumulator mechanisms comprising numeral

50 wheels, driving connections, carrying springs connected to parts of said driving connections and zeroizing mechanism comprising means for isolating the portions of said accumulator mechanism, included with said

55 spring connected parts and said numeral wheels from the portions of the accumulator mechanism in advance of said spring connected parts to permit said springs to return said numeral wheels to zero.

60 29. In a calculating machine, the combination of a plurality of keys, numeral wheels, actuating devices for said numeral wheels and rendered operable upon movement of said keys, connections between said devices and said numeral wheels, carrying

springs, a swinging frame in which said numeral wheels, parts of said connections and said springs are mounted, and means for swinging said frame to disconnect said connections to permit said springs to return

70 said numeral wheels to position.

30. In a calculating machine, the combination of a plurality of keys, numeral wheels, devices for actuating said numeral wheels and rendered operative upon movement of said keys, gears fixed upon said numeral wheels, gears connected thereto and provided with carrying springs, and a swinging frame for moving said gears and said springs to release said springs and

80 permit them to return the numeral wheels to zero.

31. In a calculating machine, the combination of a plurality of keys, numeral wheels, actuating devices for actuating said

85 numeral wheels and rendered operative upon movement of the keys, zeroizing devices for moving parts of said actuating devices from normal operative calculating position to zeroizing positions and after zeroizing back

90 to calculating positions and comprising a control member adapted to be manipulated by the operator when it is desired to zeroize, a spring for returning said member to normal position, and a spring motor dissociated

95 from said member for returning the parts of said actuating devices to calculating positions after zeroizing.

32. In a calculating machine, the combination of a plurality of keys, numeral

100 wheels, actuating devices rendered operable upon movement of said numeral wheels, connections between said devices and said numeral wheels, zeroizing mechanism, said zeroizing mechanism comprising toggle

105 locks adapted to be locked during a portion of the zeroizing operation.

33. In a calculating machine, in combination: a plurality of keys; accumulator numeral wheels; numeral-wheel actuating devices rendered operative upon operation of the keys; spring-escapement mechanisms coöperatively combined with said numeral wheels for performing carrying operations in the various orders thereof; stops for preventing reverse release of said spring-escapement mechanisms, said stops remaining at normal during zeroizing; and means, operable independently of said stops, for temporarily relieving the spring-escapement mechanisms from the restraining influence of such stops to permit the released spring-escapement mechanisms to turn the numeral wheels from various positions to zero positions.

120 34. In a calculating machine, in combination: a plurality of keys; accumulator numeral wheels; numeral-wheel actuating devices rendered operative upon operation of the keys; spring-escapement mechanisms coöperatively combined with said numeral

125 130

wheels for performing carrying operations in the various orders thereof; controlling devices for preventing release of said spring-escapement mechanisms in both directions, except when the latter are performing their normal carrying functions; said controlling devices remaining at normal during zeroizing; and means, operable independently of said controlling devices, for temporarily relieving the spring-escapement mechanisms from the restraining influence of such devices acting to prevent reverse escapement of said mechanisms, to permit the released spring-escapement mechanisms to turn the numeral wheels reversely from various positions to zero positions.

35. In a calculating machine, in combination: accumulator mechanism including numeral wheels; spring-escapement mechanisms coöperatively combined with said numeral wheels for performing carrying operations in the various orders thereof; controlling devices, acting through the accumulator mechanism, for preventing release of said spring-escapement mechanisms except when the latter are performing their normal carrying functions, said controlling devices remaining at normal during zeroizing; and means for temporarily relieving the spring-escapement mechanism from the restraining influence of such devices, while the latter remain in their normal operative relation with respect to the accumulator mechanism, to permit the released spring-escapement mechanisms to turn the numeral wheels from various positions to zero positions.

36. In a calculating machine, in combination: accumulator mechanism including numeral wheels; carrying motor springs coöperatively combined with said numeral wheels for performing carrying operations in the various orders thereof and adapted to be wound co-incidentally with the accumulative movement of the numeral wheels; stops, acting through the accumulator mechanism, for preventing release of the carrying

motor springs except when the latter are performing their normal carrying functions, said stops remaining at normal during zeroizing; and means for temporarily relieving the carrying motor springs from the restraining influence of said stops, while the latter remain in their normal operative relation with respect to the accumulator mechanism, to permit the released carrying motor springs to turn the numeral wheels from various positions to zero positions.

37. In a calculating machine; in combination: keys; column actuators, numeral wheels; a spring operating in conjunction with each of said numeral wheels and adapted when released, to turn said numeral wheel backwardly; accumulator mechanisms including pawl and ratchet connections for transmitting calculating movement from the column actuators to the numeral wheels; a canceling crank; means operable, on movement of said canceling crank, for releasing said springs to permit them to return the numeral wheels from various positions to zero positions; and means, operable supplementally to the movement of the canceling crank, for preventing movement of said releasing means out of its spring-releasing position until the numeral wheels have been returned to zero; substantially as specified.

38. In a calculating machine, in combination: column actuators; numeral wheels; a spring operating in conjunction with each of said numeral wheels and adapted, when released, to turn said numeral wheel backwardly; accumulator mechanisms including pawl and ratchet connections for transmitting calculating movement from the column actuators to the numeral wheels; means for releasing said springs to permit them to return the numeral wheels from various positions to zero positions; and means for preventing movement of said releasing means out of its spring-releasing position until the numeral wheels have been returned to zero; substantially as specified.

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