A. A. HORTON.

ADDING MACHINE.

APPLICATION FILED MAY 19, 1914.

1,180,398.

Patented Apr. 25, 1916.

5 SHEETS—SHEET 1.

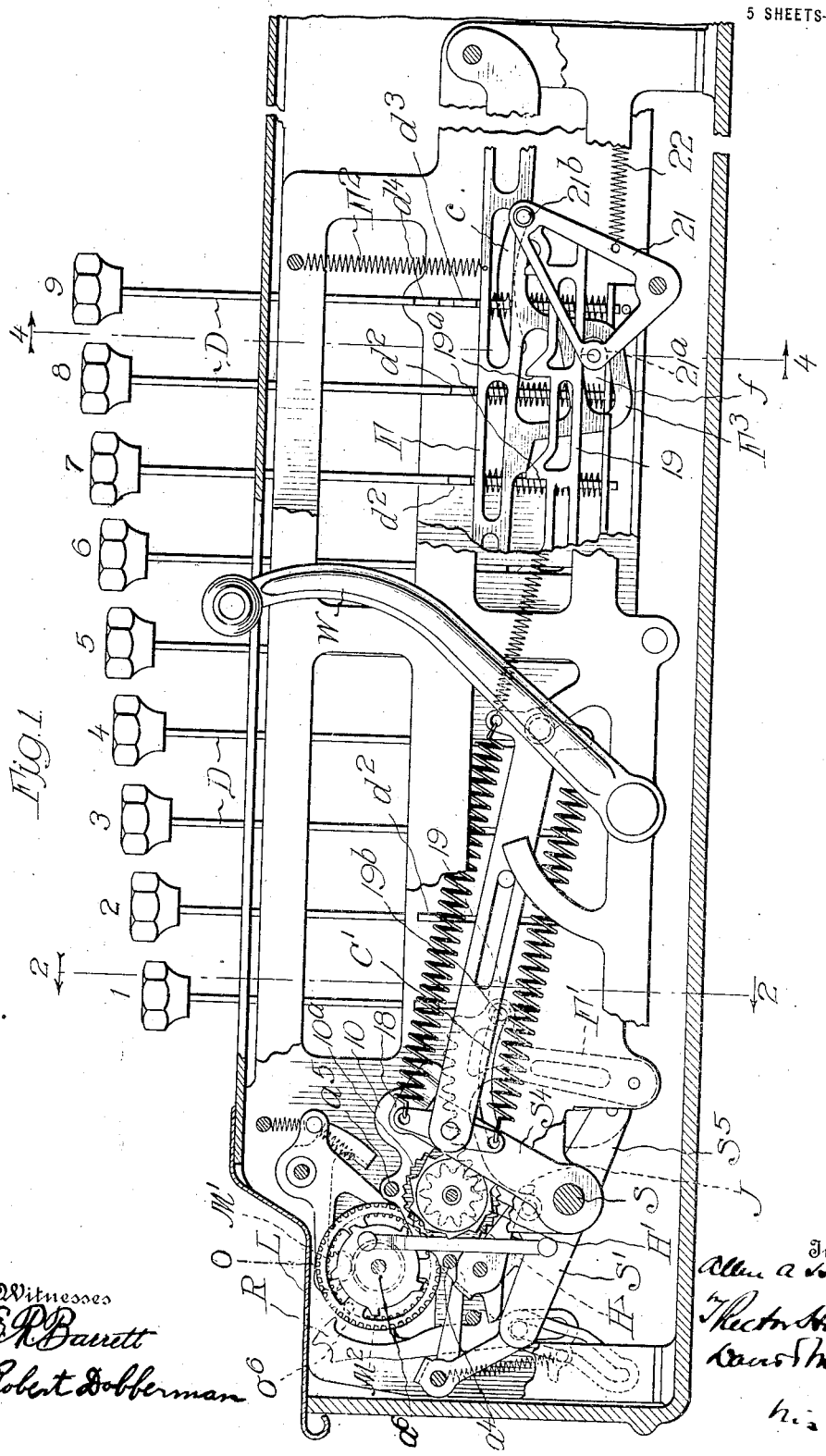

Fig. 1.

Witnesses

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5 SHEETS—SHEET 2.

Fig 2.

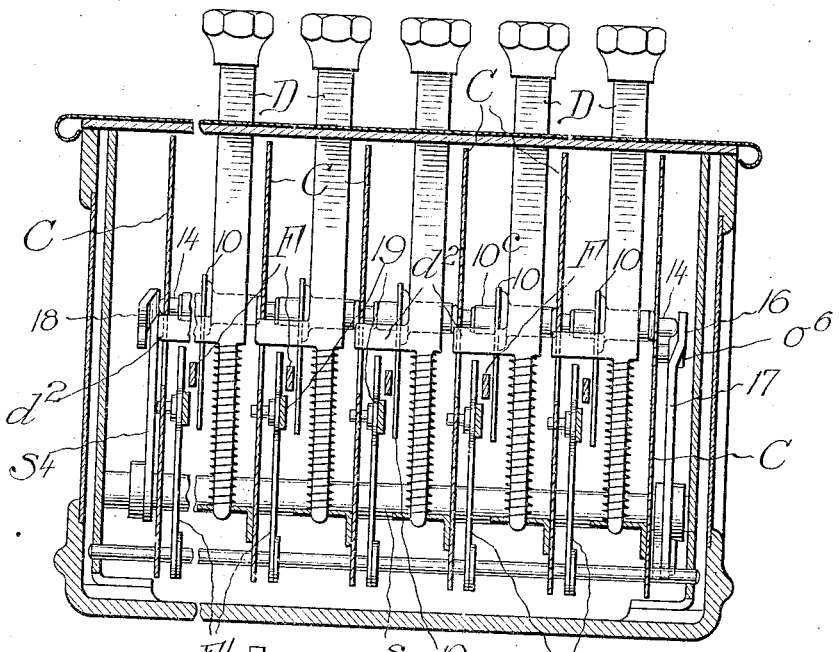
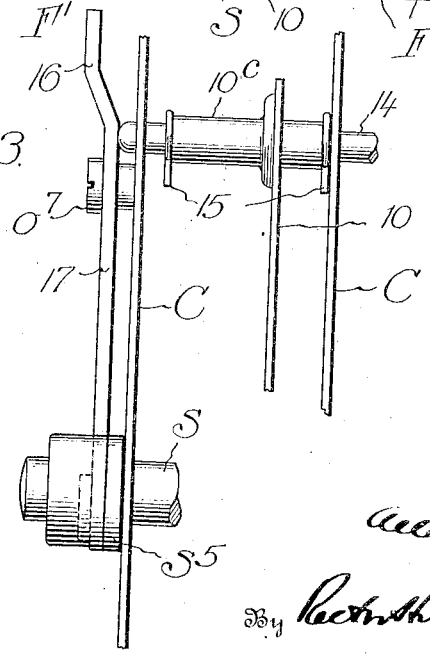


Fig. 3.



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5 SHEETS—SHEET 3.

Fig. 4.

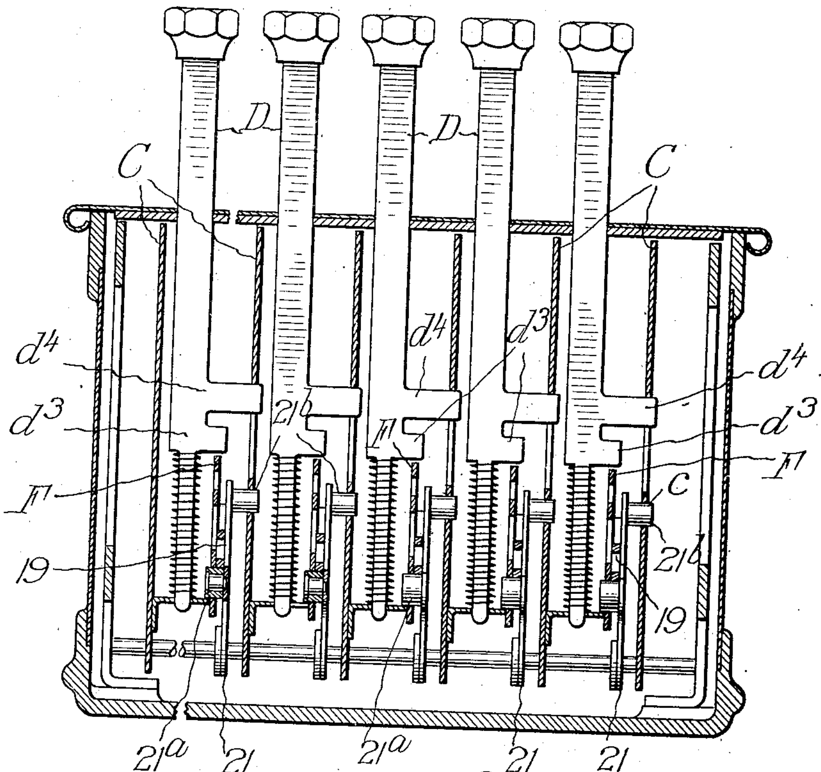
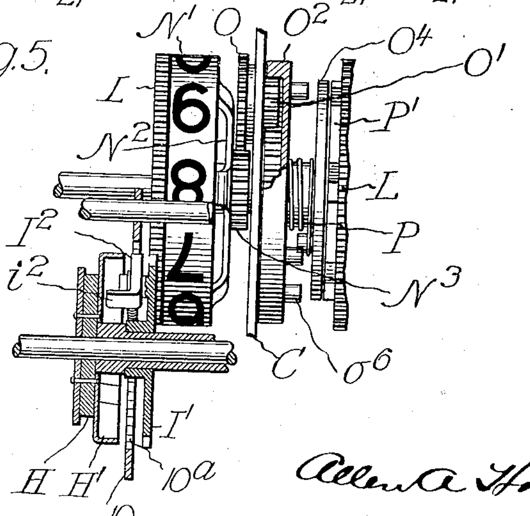


Fig. 5.



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5 SHEETS—SHEET 4.

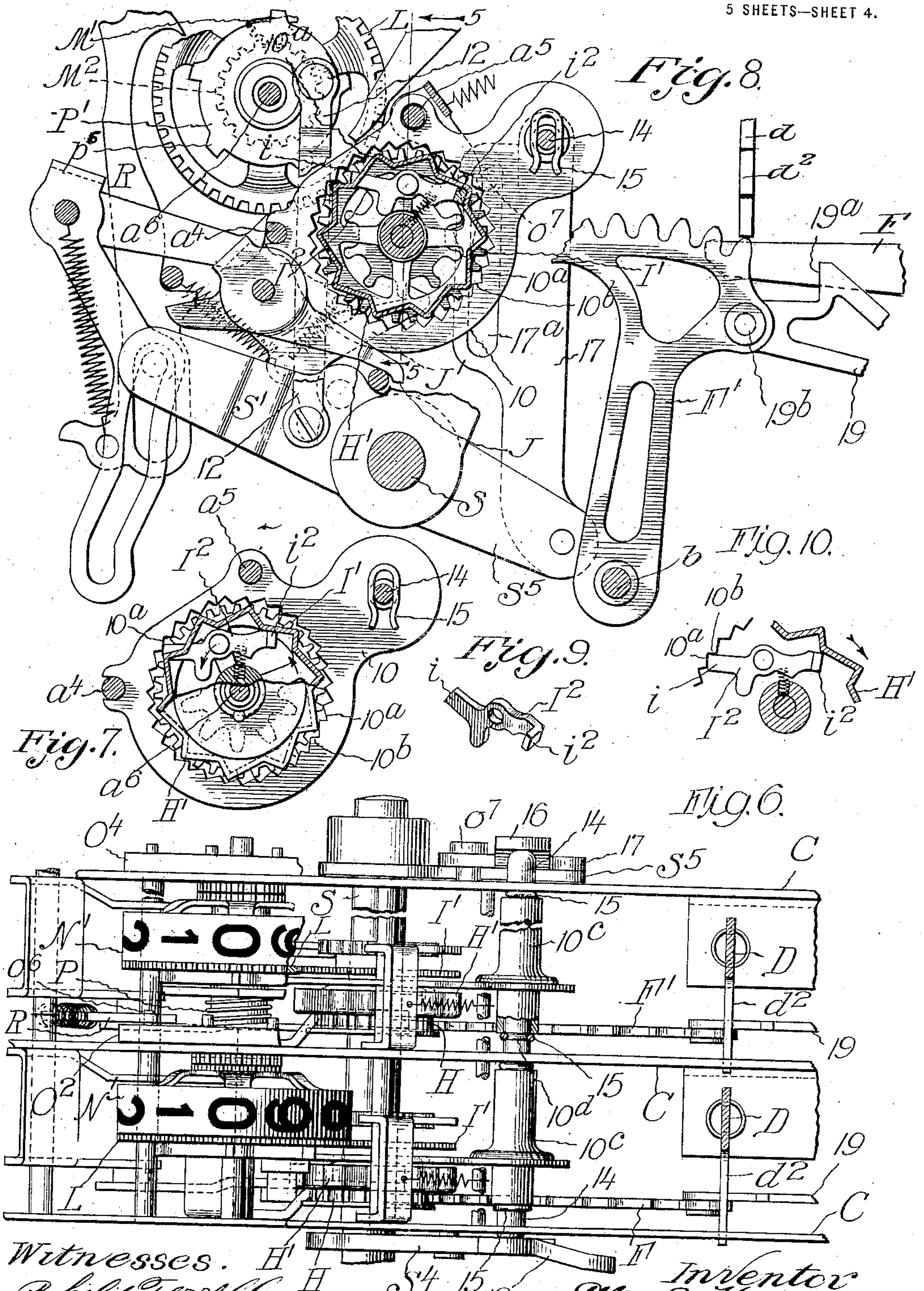

Fig. 8.

Fig. 7.

Fig. 9.

Fig. 10.

Fig. 6.

Witnesses.
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5 SHEETS—SHEET 5.

Fig. 12.

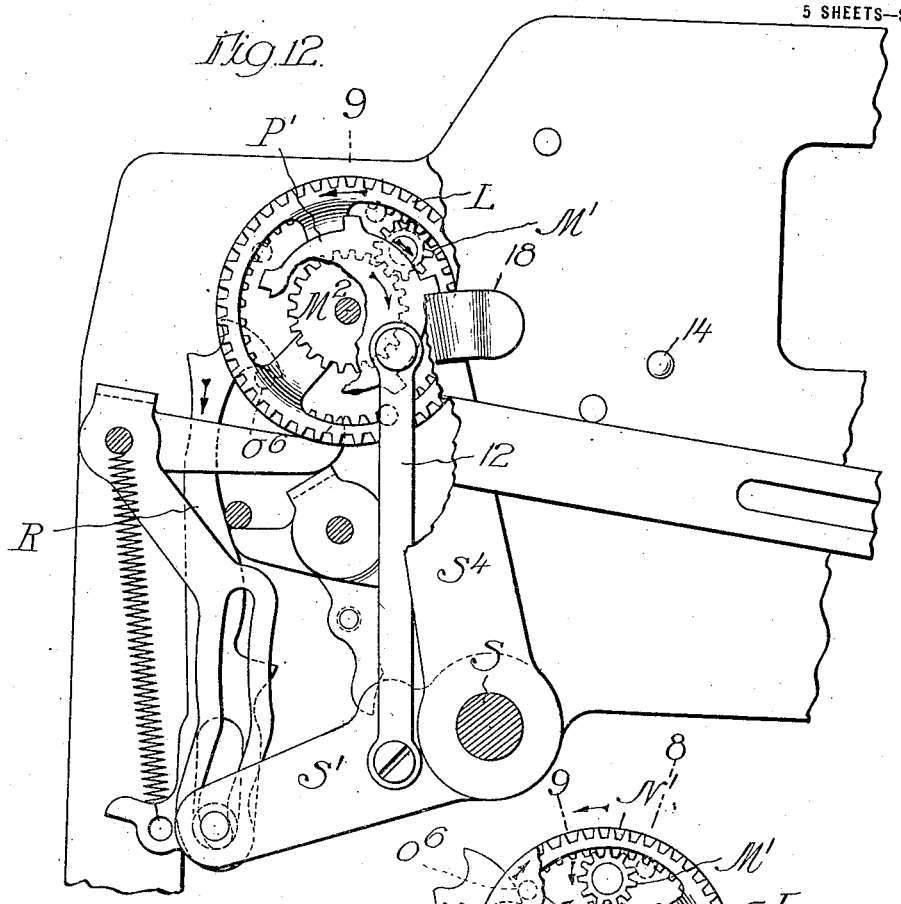
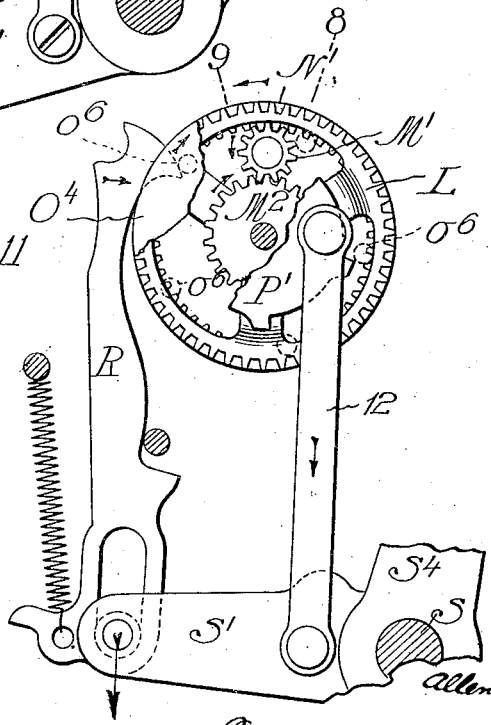


Fig. 11



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UNITED STATES PATENT OFFICE.

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ADDING-MACHINE.

1,180,398. Specification of Letters Patent. Patented Apr. 25, 1916.

Application filed May 19, 1914. Serial No. 839,563.

To all whom it may concern:

Be it known that I, ALLEN A. HORTON, a citizen of the United States, residing at Detroit, in the county of Wayne and State of Michigan, have invented certain new and useful Improvements in Adding-Machines, of which the following is a specification.

The present invention relates to adding or calculating machines of the type shown in my prior Patent No. 1,016,501, issued February 6, 1912, and the Pasinski Patent No. 1,023,168, issued April 16, 1912, wherein levers are employed to turn forwardly a series of registering wheels, said levers being depressed varying degrees by keys arranged in rows and the keys of each row inscribed from "1" to "9", and the levers being normally upheld by springs, and the character of operating connections between them and the wheels being such that the wheels are turned forward when the levers are returned to normal position by their springs after having been depressed by the keys. In this type of adding or calculating machine there is no rearward turning of registering wheels, canceling or zeroizing being accomplished by advancing the wheels to the "9" position and then stepping the units wheel on to "0" whereby the higher order wheels are successively brought to "0" through the medium of transfer or carrying mechanism. In the machines of said prior patents the stepping of the units wheel from "9" to "0" in a zeroizing operation is done by the lever of the units order.

One object of the present invention is to provide for stepping the units wheel from "9" to "0" in the zeroizing operation independently of the units order lever. Thus manipulative means of the character shown in said prior patents for picking up all wheels not already at a "9" position and advancing them to such position, serve subsequently to step the units wheel from "9" to "0", not by operation upon a device which depresses the units lever a single degree of movements as in said prior patents, but upon connections independent of said lever,—in the present instance upon connections through which a sun gear is oscillated, said sun gear belonging to planetary gearing that intervenes between the units lever and the units registering wheel.

In the aforesaid Pasinski patent means are disclosed for preventing any overthrow of a higher order registering wheel by reason of its receiving a carrying impulse when a key of its own order is being held down, at which time the overthrow-preventing-pawl normally effective upon said wheel is withdrawn. Another object of the present invention is to prevent the possibility of overthrow of the registering wheel under any and all circumstances whether the wheel is receiving a carrying or a primary impulse, while at the same time I provide for disabling the overthrow-preventing devices when zeroizing. Thus I provide for checking any tendency of a wheel to advance or forge ahead of its actuator under a primary impulse as well as to check any tendency of a higher order wheel to overrotate under a carrying impulse when a key of its own order is out of normal whether fully or only partially depressed, while at the same time I provide for movement of such wheel independently of its actuator in the performance of a zeroizing operation. In the machine here illustrated, as in the machine of said prior patents, there is a one-way driving connection between each lever and its registering wheel, comprising a ratchet wheel oscillated by the associated lever and a pawl carried by a gear wheel which connects with the numeral wheel. In carrying out my invention in the form here shown I provide means for intercepting such movement of the pawl as must accompany advance of the numeral wheel, and consequent turning of the pawl-carrying wheel, ahead of the ratchet wheel or independently thereof, whether such ratchet wheel is in motion or dormant, and I provide for disabling the intercepting means in a zeroizing operation.

In the drawings which accompany and form part of this specification and illustrate a preferred form of embodiment of my invention, Figure 1 represents the machine in right side elevation with the inclosing casing in section and the right side supporting frame piece for the most part removed, and one of the interior or division frame pieces broken away; Fig. 2 is a vertical cross section taken substantially on the line 2—2 of Fig. 1 looking toward the front of the machine; Fig. 3 is a fragmentary front elevation of certain of the parts appearing in Fig. 4 under a different condition; Fig. 4 is a vertical cross section taken substantially on the

line 3—3 of Fig. 1 looking toward the rear of the machine; Fig. 5 is a section taken substantially on the line 5—5 of Fig. 8; Fig. 6 is a broken top plan view of the front part of the machine partly in section; Fig. 7 shows certain of the parts of Fig. 8 illustrating the overthrow preventing action; Fig. 8 is an enlarged sectional elevation of the front portion of the machine; Fig. 9 shows the driving pawl in perspective; Fig. 10 is a fragmentary sectional elevation showing certain parts of Figs. 7 and 8 under different conditions than illustrated in either of said figures; Figs. 11 and 12 are broken sectional elevations illustrating the zeroizing actions.

In view of the disclosures of the before mentioned prior patents it will be unnecessary to enter into a detailed description of the complete machine, though in addition to the departures of the nature outlined above in stating the objects of the present invention, it should be noted that the keys D do not operate upon levers having segment gears as in the construction of said prior patents, but that the wheel driving segments F′ are separately mounted upon a frame cross rod b at the front part of the machine and operatively connected by bars or links 19 and bell cranks 21 with the levers F respectively (Figs. 1 and 8). This has to do with a different arrangement from that shown in the first mentioned patents for positively arresting the levers in their varying degrees of depression by the keys. The levers are pivoted at their rear ends and are upheld by spring F^2 and extend along the respective rows of key stems after the manner of the levers F of the aforesaid patents, but unlike the latter they simply terminate at their forward ends in plain extremities (Fig. 8). At an intermediate point each lever has a depending portion F^3 slotted as as at f to embrace a roller stud 21^a upon one arm of the bell crank 21, which is here shown as in the form of a triangular frame. The rear arm or branch of the bell crank is pivotally connected to the rear end of the link or bar 19 whose forward end is pivotally connected to the segment F′. Obviously depression of the lever F rocks the bell crank, throws the bar 19 forward and rocks the segment. The bar is formed with a series of lugs 19^a which supply vertical shoulders to abut against the rear sides of lugs d^2 upon the key stems which obviously has the effect of positively arresting the bar and the segment.

In the present instance I dispense with frame cross rods such as shown in said prior patents for guiding and limiting the movement of the keys, and instead I set the key stems crosswise and slot the division frame plates C vertically to receive extended portions of the lugs d^2 which lie in the same plane as the main portions of the key stems (Fig. 2). In the case of the "9" key the lug d^3 which acts upon the lever is made short so as not to obstruct the bell crank 21, and another lug d^4 (Fig. 4) is formed upon the key stem at a higher point for engagement with the slot of the division plate. In the present construction the bar 19 has no lug to encounter any portion of the stem of the "9" key, movement of the lever this greatest degree being positively arrested by the stud 21^b (which connects the bell crank and the stop bar) striking against the front end of a guiding slot c in the adjacent division plate.

Preferably springs 22 are applied to the bell cranks 21 to serve in conjunction with the springs F^2 for restoring the levers and driving the registering mechanism. Studs 19^b which connect the bars 19 and segments F′ strike against the rear ends of guiding slots c' in adjacent division plates, to limit the return movements of parts.

The segments F′ mesh with gear wheels or pinions H to which are secured internal ratchets H′, and gear wheels I′ are driven by said ratchet wheels through the medium of pawls presently to be identified, said gear wheels meshing with other gear wheels L which carry planet gear wheels or pinions M′ in mesh with internal gears N upon the numeral wheels N′ and with sun gears as in the constructions of said prior patents.

Next referring in detail to the overthrow preventing devices of my present invention, the pawls I^2 which are carried by the gears I′ have a special formation distinguishing them from the similarly lettered pawls of my aforesaid prior patent, for the purpose of coöperation with overthrow preventing means. Thus each pawl has an extension or tail i on the side of the pawl pivot opposite that where the acting end of the pawl projects for coöperation with the ratchet wheel, and this pawl-tail projects past the ratchet wheel for coöperation with the interior shouldered edge of a plate or ring 10. In order to provide for this relation of pawl and ratchet, gear wheel I′ is not mounted closely adjacent the open side of the ratchet wheel, as in the prior constructions, but is formed with a spacing hub so that the body of the pawl may lie outside the ratchet wheel as clearly shown in Fig. 5, that portion of the pawl which engages with the ratchet being in the form of a laterally turned extremity i^2. The ring or plate 10 encircles the space between said gear wheel and the ratchet and has a continuous series of stop shoulders 10^a to provide for encounter with the tail of the pawl wherever the latter may happen to be as a result of the turning of the gear wheel I′. It is of course essential that the ratchet shall not be interfered with during the key depression when

the ratchet wheel should run freely over the pawl. Consequently said shoulders 10^a are cut at such an angle and so spaced apart and the intervening shoulders 10^b so cut, as to allow of unobstructed vibration of the pawl resultant from the passing of the ratchet wheel over its acting end i^2. Thus as the inclined back of a ratchet tooth slides over the pawl-end i^2 the extremity of the pawl-tail i will swing over one of the shoulders 10^a, (as will be obvious from Fig. 8 and as specially illustrated in Fig. 10), and back again when the ratchet tooth has passed. However, if the connected registering wheel tends to over-rotate, which involves turning of the gear wheel I′ independently of the ratchet wheel, the accompanying movement of the pawl will cause its tail end to strike against one of the shoulders 10^a, as illustrated in Fig. 7, whereby the movement of the wheel is arrested. This obviously will occur whether the ratchet wheel happens to be dormant at the time or whether it is being rotated to drive the gear wheel I′ and numeral wheel. In either case the riding of the end i^2 of the pawl over the inclined back of the ratchet tooth will tilt the pawl on its pivot and the combined tilting and rotarial movement of the pawl will cause its tail end to strike against one of the shoulders 10^a before the end i^2 can escape past the ratchet tooth. Of course the pawl might be at varying positions relative to a shoulder 10^a when this combined tilting and rotarial motion occurs, but the extent of the end edge of the tail of the pawl is such and the length of the shoulders 10^a is such that whatever may be the position of the pawl at the time, some part of the end edge of its tail will strike against some part of one of the shoulders 10^a and block the overthrow. In the case of such action when the ratchet is in motion, the latter will immediately overtake the pawl and the pawl will disengage from the shoulder 10^a so that the rotation of the gear wheel I′ by the ratchet may continue.

Referring next to the matter of canceling or zeroizing, the reference letter W designates the hand lever used for such purpose the same as in my aforesaid prior patent, and the numeral S designates the familiar rock shaft which said handle operates and which in turn operates the hooks R through the same sort of connections as illustrated in my said patent. The operation of advancing all of the wheels to the "9" position is precisely the same as there described. In that former construction the rock shaft S carries a short arm S^3 at its right hand end for operating a special units locking pawl J^2 with the effect of pulling down the units lever F one step. In my present construction this is done away with and the right hand rock shaft arm S′ unlocks the units wheel just as the other similar rock shaft arms unlock the higher order wheels, the units locking pawl J being separate from the arm J′ and connected therewith by a spring the same as in other orders. The one-step movement of the units wheel to advance it from "9" to "0" is accomplished in the present instance by imparting a one-fifth turn to the sun gear M^2 of the units planetary system. In the prior construction the sun gear of the units planetary system was fixed. In the present instance though the sun gear M^2 in question is normally fixed and in all registering operations simply supplies a fixed circular rack for the planet pinion M′ to traverse, it is loosely journaled about the frame cross rod a^6 and in a zeroizing operation serves to advance the units wheel from "9" to "0" much as sun gears of higher order planetary systems serve in the prior construction to transmit carrying impulses.

As a matter of convenience and economy in manufacture I employ the same assemblage of sun gear and disk in the units order as in the higher orders though the projections p^5 have no function to perform, there being no escapement action in connection with the units sun gear in the form of embodiment of my invention here shown. Thus instead of applying escapement devices for the purpose of effecting the advance of the units wheel from "9" to "0" in a zeroizing operation, I find it much simpler and equally effective to oscillate the sun gear. This merely requires a link 12 having the character of a pitman connecting the disk P′ and the rock shaft arm S′. It is of course pivotally connected to the disk and arm and with such leverage as to impart a one-fifth rotation to the disk and sun gear in a full rocking of the arm. When the arm rocks downwardly (Figs. 11 and 12) the link 12, being connected to the disk P′ on the rear side of the axis thereof, rotates the sun gear in a clockwise direction as the parts are viewed from the right. This tends to turn the numeral wheel backward through rotation of the planet pinion on its own axis, and the back action of the coiled spring P promotes this effect, such spring being connected at one end, as in the prior constructions, to disk O^4 and wound by gearing which connects that disk with the numeral wheel. However, any such backward turning will be compensated for by the accompanying change in relationship between the hook R and the stud or pin o^6 on the disk or web of the internal gear O^2 through which and the intermediate pinions O′ and O and the pinion N^3 on the numeral wheel, the latter is turned to the "9" position by said hook as shown in Fig. 12. For instance if the units wheel already stood at "9", backward rotation to the "8" position by the clockwise turning of the sun gear would move the stud o^6 next forward of the hook correspond-

ingly and the hook would act upon it to turn the wheel again to the "9" position. Fig. 11 represents such condition and shows the arm S′ as in course of lowering and as having just started to lower the hook after rocking the same to position for acting upon the stud o^6 next below it, the upper stud having advanced beyond the hook by reason of the backward turning of the wheel. On the return stroke of the rock shaft arm S′ the sun gear is rotated in a counterclockwise direction and through the medium of the planet pinion will advance the units wheel from "9" to "0", just as sun gears of higher orders advance their wheels in a carrying operation for they are likewise turned counterclockwise a fifth of a rotation when released by the escapement devices which the next lower wheels trip. Of course with the passing of the units wheel from "9" to "0" all the other wheels are advanced to zero by their respective carrying mechanisms.

It is not of course essential to operability of this new form of zeroizing mechanism that there should be any backward turning of the units registering wheel, for if there is sufficient resistance to such turning or interference therewith, (as may be the case with the units wheel already standing at zero (Fig. 1) when the hook R would move immediately over the stud o^6 and into close proximity thereto), the planet pinion M′ may roll upon the numeral wheel internal gear N, as a fixed rack, since turning of the gear wheel L for necessary accompanying revolution of said planet pinion is permitted by reason of the early unlocking of the gear wheel I′.

In short, in either aspect of the matter, the initial oscillation of the sun gear is negligible and it is the return oscillation which counts, such return oscillation necessarily advancing the numeral wheel through rotation of the planet pinion upon its own axis because the gear wheel L is at all times locked against reverse turning, by reason of the fact that the customary pawl K is constantly engaged with the toothed wheel I^3 on the hub of the gear wheel I′ to prevent reverse rotation thereof.

Since the turning of wheels to the "9" position by the zeroizing devices involves rotation of the gear wheels L and therefore forward rotation of the gear wheels I′ independently of the ratchets H′, it becomes necessary, in order to adapt the before described overthrow preventing devices to this zeroizing operation, that the co-action between the pawls I^2 and these overthrow preventing devices be suspended. To this end the several plates or rings 10 (there being of course one for each wheel) are mounted to slide laterally upon the frame cross rods a^4 and a^5 which guide and support them, and means are provided for shifting them out of line with the tails of the pawls, as an incident to the zeroizing operation. The plates or rings have hubs 10^c (Fig. 6) by which they are additionally supported and through the mounting of which upon a slide rod 14 they may be collectively shifted. Thus said rod is formed with grooves 10^d which receive clips 15 for confining the hubs laterally upon the rod. The latter slides through the division frame plates C and has rounded end portions to protrude beyond the right and left hand plates. Normally the rod and the rings are positioned to the left with the shouldered interior edges of the rings in line with the tails of the pawls. Under these conditions the rounded left hand extremity of the slide rod protrudes from the left hand frame plate C, as shown in Fig. 6. A cam blade 16 is adapted in upward movement to act against this end of the rod and thrust it over to the right as illustrated in Fig. 3. Said cam blade is formed at the upper end of a plate 17 and the latter is pivotally connected at its lower end to a rearwardly extending arm S^5 secured to the left end of the rock shaft S. The plate is suitably guided through engagement of its vertical slot 17^a with a stud o^6 projecting from the frame plate C. During the first part of the initial rocking of the shaft S when the hooks R are being tilted to position for engaging the studs o^6, the plate 7 is thrust upwardly and its cam blade 16 caused to operate upon the slide rod 14 whereby all of the rings 10 are shifted to the right out of line with the tails of the pawls I^2, the rings being large enough to slide freely over the ratchet wheels. Thus the overthrow action is suspended during the zeroizing operation. For the purpose of restoring the rings to operative position with the conclusion of the zeroizing operation, a cam blade 18 is mounted upon the upper end of the crank arm S^4 secured to the right hand end of the rock shaft S. Normally the inner portion of this blade holds the rod 14 to the left as shown in Fig. 6 but as the rock shaft starts its initial movement this blade 18 moves forward and its inclined portion passes along the end of the rod as the inclined portion of the other cam blade 16 operates upon the left-hand end of the rod. When the rock shaft returns and the arm S^4 swings rearward the cam blade 18 will operate to thrust the rod to the left. It will be seen that the rod is positively controlled by the two cam blades, the one retiring as the other advances, and it will be noted that the blade 16 maintains engagement with the rod when the latter has been thrust to the right (Fig. 3) so that the notched or shouldered rings are certainly kept out of effective position during the main portion of the zeroizing operation.

Any tendency to overthrow in the zeroizing operation is checked by the same sort of

means as shown and described in my aforesaid prior patent for this purpose.

I claim:

1. In a machine of the class described, the combination of registering wheels; individual actuators therefor having one-way driving connection therewith; means for collectively advancing all the wheels to positions short of zero independently of said actuators; additional means operating in conjunction with said last mentioned means to individually step the wheel of lowest order on to zero independently of its actuator; and transfer mechanism connecting the wheels in series.

2. In a machine of the class described, the combination of registering wheels; individual actuators therefor having one-way driving connection therewith; a manipulative operating member; means driven thereby for collectively advancing all the wheels to positions short of zero independently of said actuators; additional means driven by the same member to individually step the wheel of lowest order on to zero independently of its actuator; and transfer mechanism connecting the wheels in series.

3. In a machine of the class described, the combination of registering wheels; individual actuators therefor having one-way driving connection therewith; intervening planetary gearing; transfer mechanism connecting the wheels in series through the planetary gearing; means for collectively advancing all the wheels to positions short of zero independently of said actuators; and means operating in conjunction with the last mentioned means for actuating the planetary gearing of the wheel of lowest order to step the latter on to zero independently of its actuator.

4. In a machine of the class described, the combination of registering wheels; individual actuators therefor having one-way driving connection therewith; intervening planetary gearing; transfer mechanism connecting the wheels in series through the planetary gearing; means for collectively advancing all the wheels to positions short of zero independently of said actuators; and means operating in conjunction with the last mentioned means for turning the sun gear of the planetary gearing of the wheel of the lowest order to step the latter on to zero independently of its actuator.

5. In a machine of the class described, the combination of registering wheels; individual actuators therefor having one-way driving connection therewith; intervening planetary gearing; transfer mechanism connecting the wheels in series through the planetary gearing; means for collectively advancing all the wheels to positions short of zero independently of said actuators; and means operating in conjunction with the last mentioned means for oscillating sun gear of the planetary gearing of the wheel of lowest order to step the latter on to zero independently of its actuator.

6. In a machine of the class described, the combination of registering wheels; individual actuators therefor having one-way driving connection therewith; intervening planetary gearing; transfer mechanism connecting the wheels in series through the planetary gearing; means for collectively advancing all the wheels to positions short of zero independently of said actuators, said means embracing a reciprocating driver; and a link connecting the latter and the sun gear of the planetary gearing of the wheel of lowest order.

7. In a machine of the class described, the combination of registering wheels, individual actuators therefor having one-way driving connection therewith; intervening planetary gearing; transfer mechanism connecting the wheels in series through the planetary gearing; means for collectively advancing all the wheels to positions short of zero independently of said actuators; stud-carrying disks geared to the wheels respectively; hooks to act on studs of said disks for advancing the wheels to positions short of zero; a rocking structure to operate said hooks; and a link connecting said structure with the sun-gear of the planetary gearing of the lowest order, substantially as and for the purpose described.

8. In a machine of the class described the combination of ratchet and pawl driving and driven wheels, the latter serving for registering purposes; an encircling abutment device for the pawl to encounter when relative advance movement occurs between its wheel and the ratchet wheel; and means for disabling the abutment device and advancing the driven wheel independently of the driving wheel for zeroizing purposes.

9. In a machine of the class described, the combination of ratchet and pawl driving and driven wheels, the latter serving for registering purposes; an encircling interiorly shouldered ring for the pawl to encounter when relative advance movement occurs between its wheel and the ratchet wheel; and means for disabling said ring and advancing the driven wheel independently of the driving wheel for zeroizing purposes.

10. In a machine of the class described, the combination of driving and driven elements; the latter serving for registering purposes; an intervening ratchet and pawl connection; an encircling shouldered stop member for the pawl to encounter under relative movement between it and the ratchet; and means for displacing the said stop member and advancing the driven member independently of the driving member for zeroizing purposes.

11. In a machine of the class described, the combination of a registering wheel; a reciprocating actuator; a ratchet in gear with the latter; a pawl and pawl carrier in gear with the wheel; a shiftable internally shouldered ring for the pawl to encounter when its carrier advances independently of the ratchet; means independent of the actuator for advancing the registering wheel; and means operating in conjunction with said last-named means for shifting the shouldered ring.

12. In a machine of the class described, the combination of a registering wheel; a reciprocating actuator; a ratchet in gear with the latter; a pawl and pawl carrier in gear with the wheel; a shiftable internally shouldered ring for the pawl to encounter when its carrier advances independently of the ratchet; means independent of the actuator for advancing the registering wheel; and a cam operated by said last-named means for laterally shifting the shouldered ring.

13. In a machine of the class described, the combination of a registering wheel; a reciprocating actuator; a ratchet in gear with the latter; a pawl and pawl carrier in gear with the wheel; a shiftable internally shouldered ring for the pawl to encounter when its carrier advances independently of the ratchet; means independent of the actuator for advancing the registering wheel; and cams operated by said last-named means for laterally shifting the shouldered ring out of and into effective position.

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