W. J. PASINSKI.

ADDING MACHINE.

APPLICATION FILED JULY 5, 1911.

1,023,168.

Patented Apr. 16, 1912.

5 SHEETS—SHEET 1.

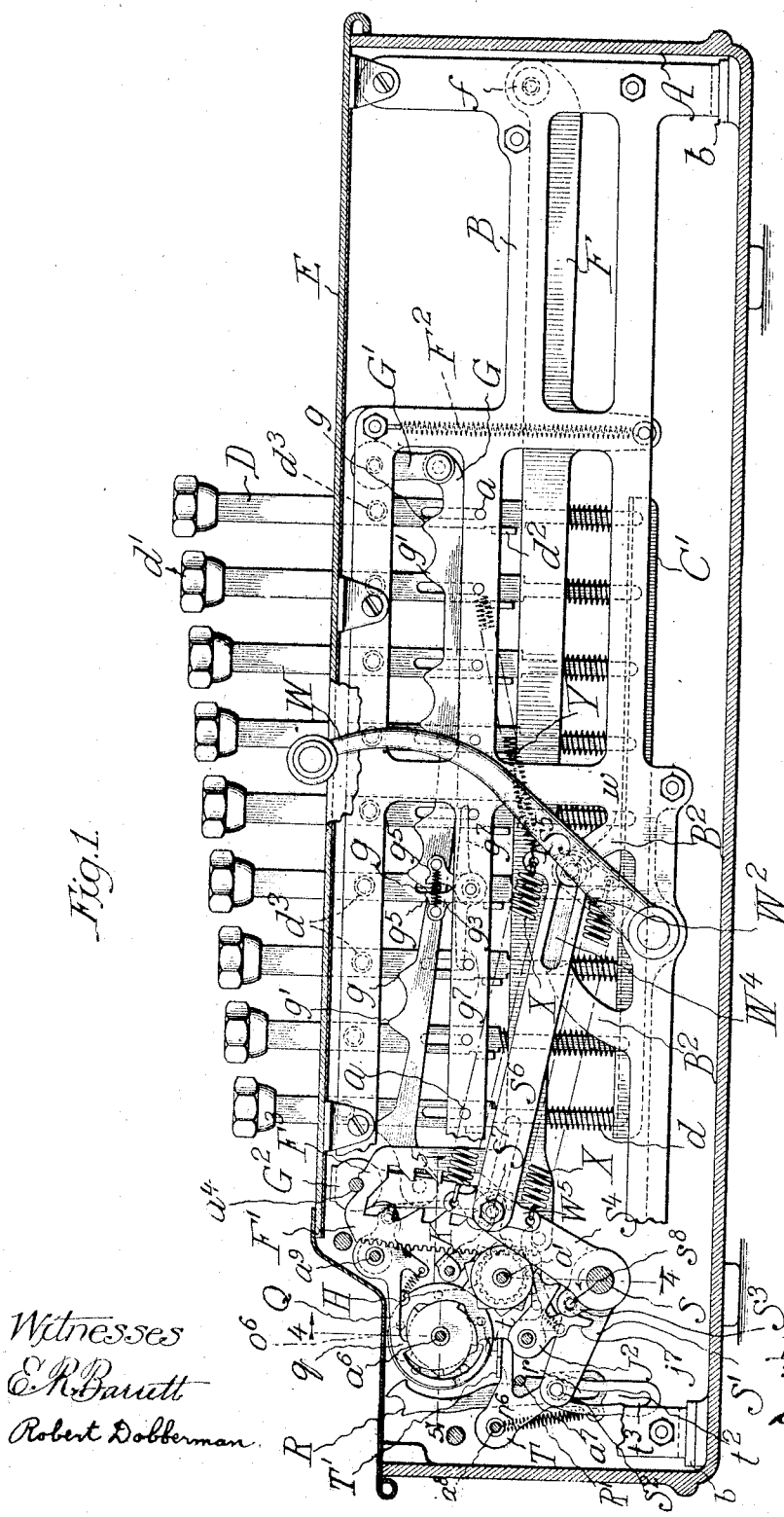

Fig. 1.

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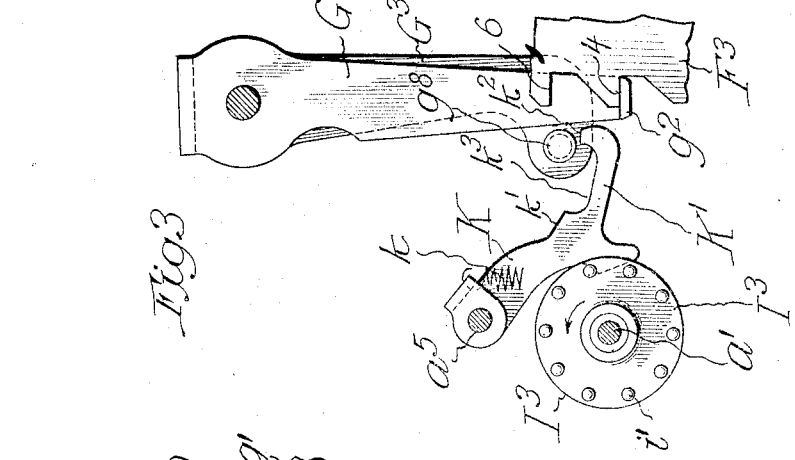

Fig. 3

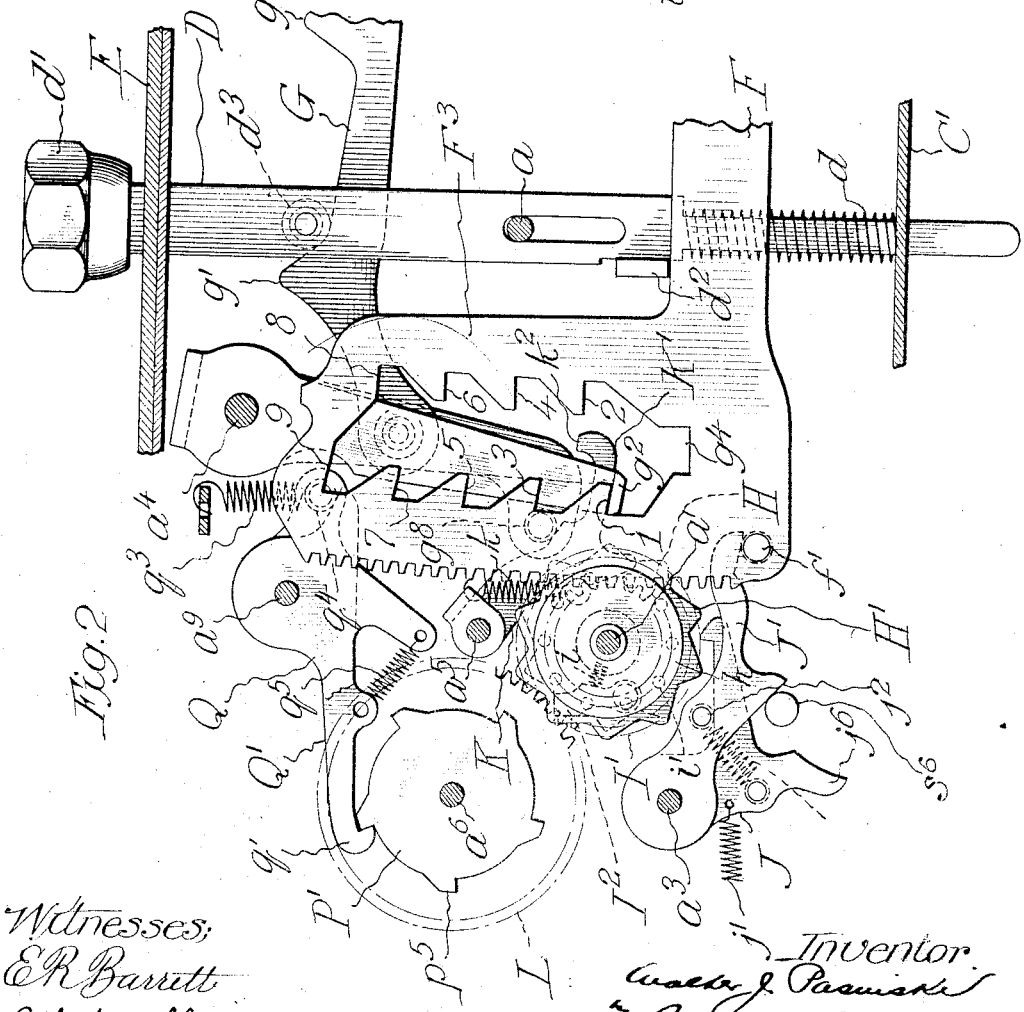

Fig. 2

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5 SHEETS—SHEET 3.

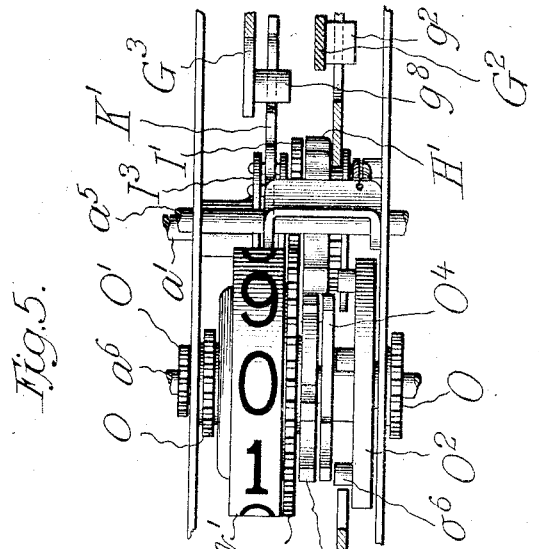

Fig. 5.

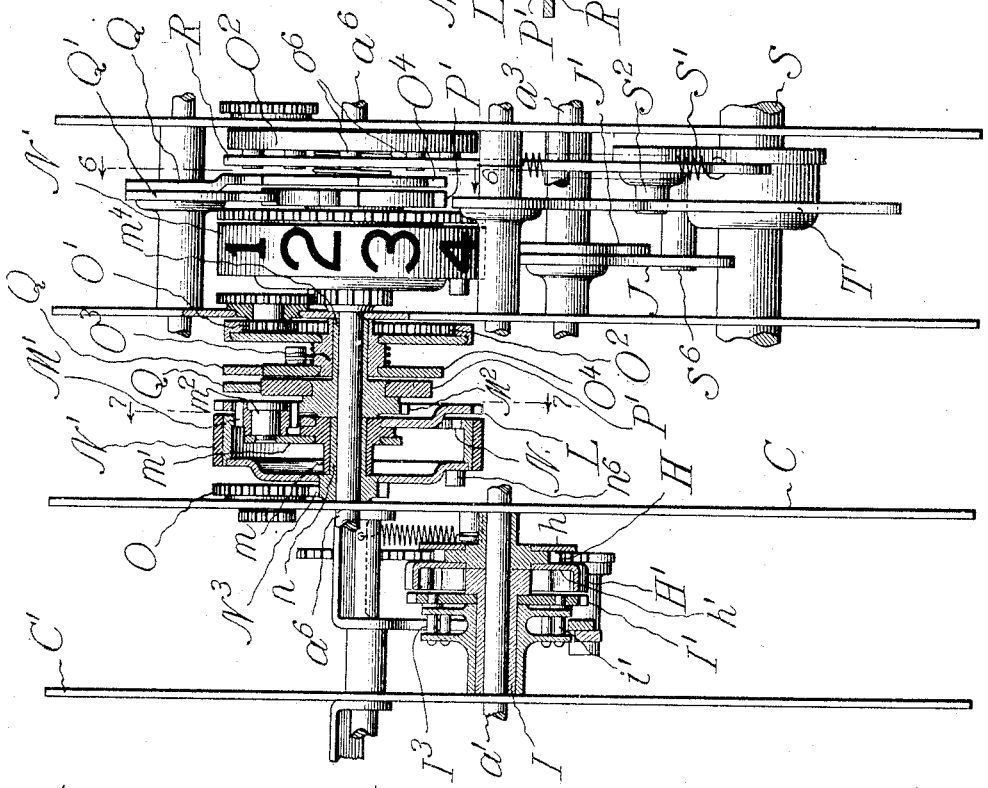

Fig. 4.

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5 SHEETS—SHEET 4.

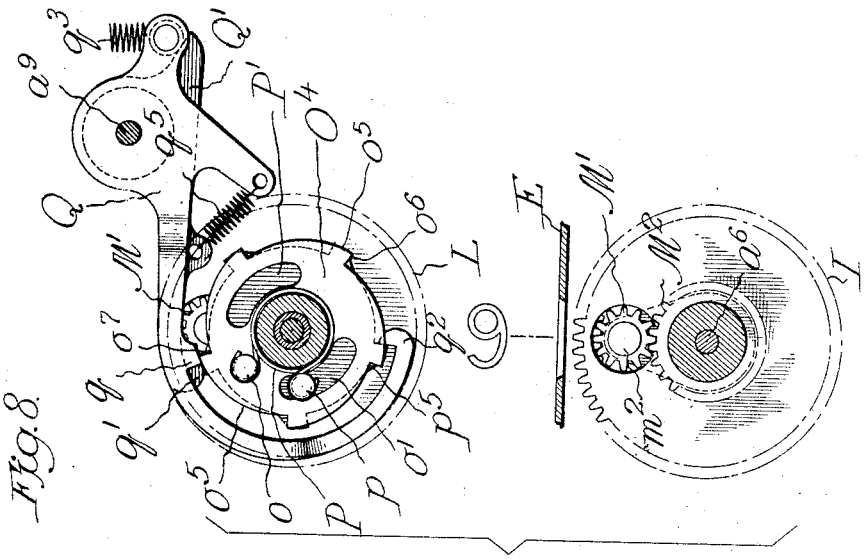

Fig. 8.

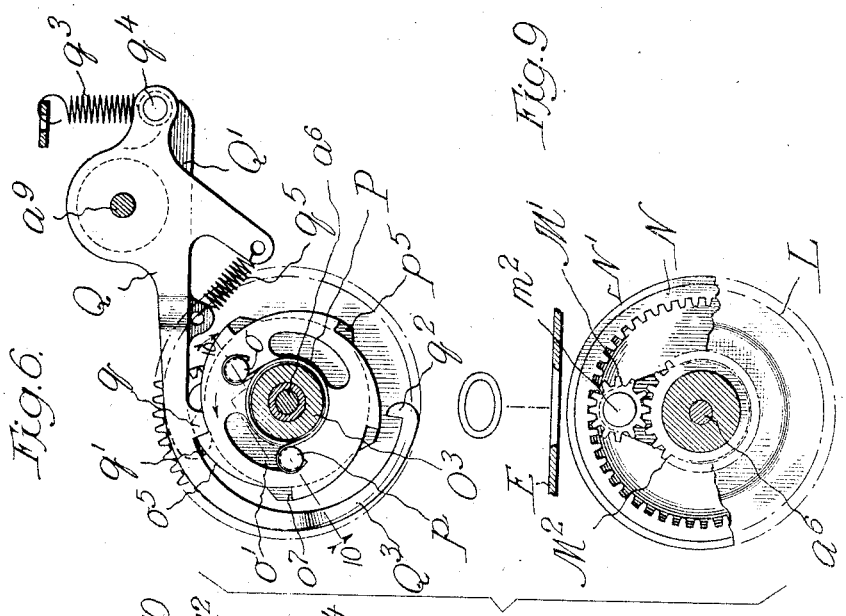

Fig. 6.

Fig. 9.

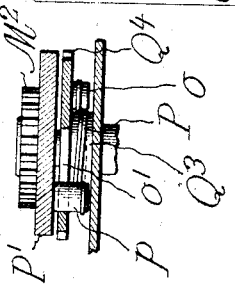

Fig. 10.

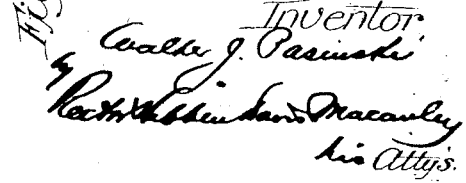

Fig. 7.

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ADDING MACHINE.

APPLICATION FILED JULY 5, 1911.

1,023,168. Patented Apr. 16, 1912.

5 SHEETS-SHEET 5.

Fig. 11.

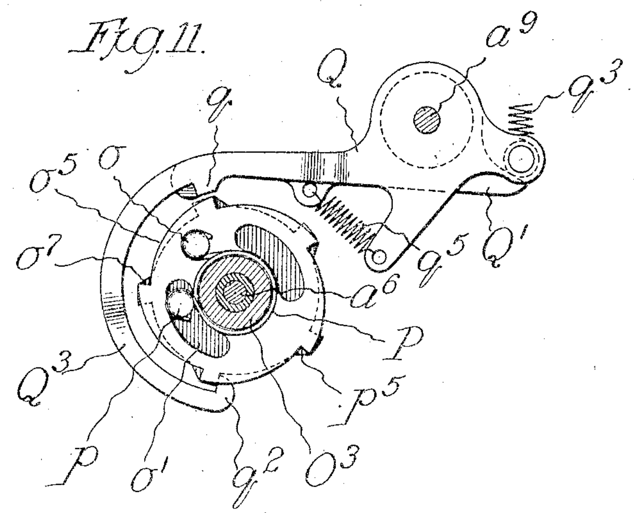
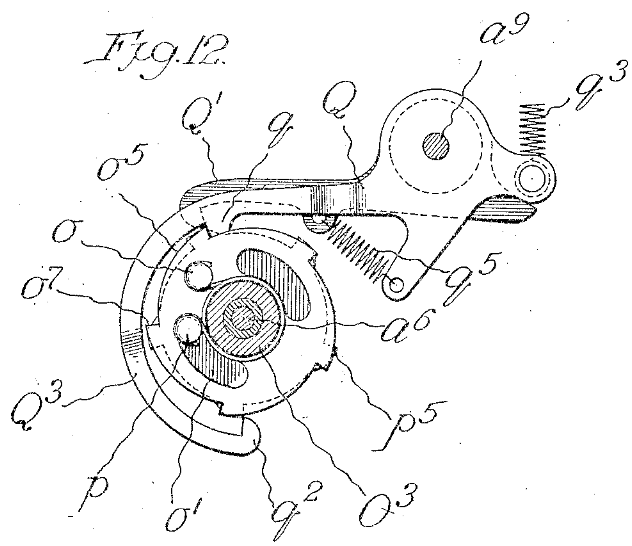


Fig. 12.



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UNITED STATES PATENT OFFICE.

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ADDING-MACHINE.

1,023,168. Specification of Letters Patent. Patented Apr. 16, 1912.

Application filed July 5, 1911. Serial No. 636,878.

To all whom it may concern:

Be it known that I, WALTER J. PASINSKI, 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 more particularly to the transfer or carrying mechanism of an adding machine and is primarily intended for that type of machine in which there are independent actuators for adding wheels of different orders or denominations, which actuators are individually operated by manipulative means such as series of depressible keys.

One object of the present invention is to prevent overthrow of a registering wheel to which carrying movement is being imparted, by reason of the actuator for that wheel being held in operated or abnormal position while the actuator of next lower denomination is operated to rotate its own registering wheel to such extent as to cause carrying movement of the higher order wheel. In the particular machine which will hereinafter be specifically described, each actuator is in the form of a lever having a rack sector in mesh with pinions and the latter are connected through ratchet and pawl mechanism with gears normally locked but adapted to be unlocked upon the actuators being moved from normal. It is this unlocking that makes possible overthrow of the higher order wheel if its actuator is held in abnormal position while the next lower order actuator is operated. By the present invention provision is made for again locking the higher order gear when its actuator has been fully operated. I should perhaps add at this point that though the actuator for the higher order wheel is adapted to turn that wheel through the medium of the gear, the carrying movement, in the particular machine hereinafter specifically described, takes place independently of any movement of said gear, which does not mesh with the registering wheel but is connected thereto through planetary gearing.

Another object of the present invention is to provide an improved form of escapement mechanism which will reduce to the minimum that movement of a higher order wheel which accompanies or is caused by the preliminary or initial shifting of an escapement detent, so that should such shifting occur prematurely, as it may, by reason of momentum, numerals displaced by the registering wheels will not be thrown noticeably out of alinement. I aim to accomplish this without having recourse to detent shifting cam projections confined in extent to an arc corresponding with that of the registering wheel between the "9" and "0" inscriptions thereon. By so doing I obviate hard action and excessive wear incidental to the necessarily abrupt character of cam projection when confined in extent to the arc above mentioned. In my improved escapement mechanism I furthermore seek to obviate any tendency of the detent to stick in its shifted position by reason of friction between it and the escapement disk when the carrying spring, which is superior to the detent spring, has been released by the preliminary or initial detent shift. In this connection I arrange for an edge to edge engagement at such an angle to the intersecting radius of the detent that this engagement of itself tends to return the detent member to normal.

In the drawings which accompany and form part of this specification Figure 1 represents, partly in section and partly in side elevation, a complete adding machine in which my improvements are incorporated, all the parts being at normal; Fig. 2 is a view somewhat similar to the left hand portion of Fig. 1 on a larger scale and taken on a section line further over or just to the right of a higher order train of mechanism than appears in Fig. 1, this view further differing from Fig. 1 in showing a changed relation of parts due to depression of the "1" key of the series; Fig. 3 similarly illustrates some of the parts appearing in Fig. 2, though here a different relative positioning is illustrated as due to depression of the "4" key of the series; Fig. 4 is a partial vertical cross-section and a partial front elevation of the forward part of the machine, the section being substantially on a line 4—4 of Fig. 1 and the view being curtailed laterally; Fig. 5 is a plan view and horizontal section taken substantially on the line 5—5 of Fig. 1 and limited to a train of mechanism associated with one order or denominational place; Fig. 6 is a vertical section taken on the line 6—6 of Fig. 4, and shows the escapement mechanism at normal; Fig. 7

illustrates the corresponding position of the associated lower order wheel which is represented as exhibiting its cipher, this view being somewhat diagrammatic and taken on a section line such as that designated 7—7 in Fig. 4 though the registering wheel represented would in fact be that to the right and not included in Fig. 4; Figs. 8 and 9 are views corresponding with Figs. 6 and 7, but with escapement members in different relative positions, the lower order wheel being represented as registering "9"; Fig. 10 is a sectional view taken on the line 10—10 of Fig. 6; and Figs. 11 and 12 are views on the same order as Figs. 6 and 8, illustrating different conditions to demonstrate the advantages of my improved form of escapement.

Before proceeding to point out the particulars of the present invention I shall first describe considerable mechanism which is not of my invention but represents the specific adding machine to which I have applied my improvements, to wit, the machine shown in application of Allen A. Horton, filed April 18, 1911, Serial No. 621,872.

The machine is inclosed in a suitable casing A, preferably a casting comprising base and sides; and the mechanism is supported by a suitable framework comprising side pieces B with feet resting upon and secured to bosses on the bottom of said casting, sound deadening pads b being preferably interposed. The framework also comprises intermediate uprights C to certain of which are secured angle plates C'. Key stems D slide through a top plate E and through said angle plates and are upheld by spiral springs d all as shown in Figs. 1 and 2. Also they are slotted to embrace guiding cross rods a held by the frame side pieces and uprights. The keys are arranged in parallel rows, nine in a row, as usual, and their surmounting finger pieces d' inscribed from "1" at the front to "9" at the back and if desired with complementary numerals for subtraction purposes. There is a long lever F for each row of keys, these levers being pivoted at the extreme rear of the machine on a frame cross-rod f and extending along the keys to a point forward of them where each lever has integral with it a segmental rack F'. Main springs F^2 connect depending arms of the levers with overhead portions of the framework and the levers are adapted to be forced down against the stress of these springs in varying degree by depression of the keys, and upon release of the keys the springs F^2 exert their power to drive gearing hereinafter described which is in mesh with the segments F'. Lugs d^2 struck out from the key-stems extend over the levers F to contact with the same at various distances from their pivots to differentially operate the levers. As there is a possibility that in rapid and hard operation, especially with the higher denomination keys in action, extreme vibration of parts might cause movement of the acting end of the lever beyond that measured by the key, special means are employed to guard against overthrow of the adding wheels by any such excessive motion of the levers. It is obvious that this can be accomplished by positively stopping the forward ends of the levers directly below the segmental racks, and in the present instance means are provided for doing this in a very simple and effective way. As the devices employed in this connection for each row of keys are the same, a description of one complete set will suffice.

Referring first to Fig. 1, a bar G is arranged below the key stems suspended by a pair of radius links G' and G^2 journaled on cross rods at the top of the machine frame, and this bar is formed along its upper edge with series of cam projections g and g', there being one such projection for each key, and the stems of the keys being equipped with roller studs d^3 to act upon them. Outer inclined edges of a pair of these projections g and g' extend on opposite angles for coöperation with the studs respectively on adjacent keys so that an off number key thrusts the bar G one way (forward), and an even number key thrusts the bar the opposite way (rearward). The forward radius link G^2 extends downward beyond the bar G and is bent laterally to form a foot g^2 to coöperate with stop shoulders on the lever F. The latter is formed at the forward end, immediately back of the gear segment F', with a widened open-center portion F^3 within which the foot g^2 projects. The inner confronting edges of this portion of the lever have ratchet formations providing two series of downwardly directed shoulders, the shoulders at one side being staggered with reference to the shoulders at the other side and there being a terminal shoulder at the upper end at each side and in similar relation. The foot g^2 normally seats in a square notch g^4 centrally located between inclined edges below the lowermost shoulders of the two series, and said foot has beveled edges to facilitate its so seating.

The above described structure comprising swinging bar G, and radius links G' and G^2, is normally centralized by scissors jaws g^6 pivoted on one of the cross-rods a and engaging opposite side of a stud g^6 which projects from the bar G (Fig. 1), said jaws being drawn together by a connecting spring g^7 and having angular extensions or arms g^7 engaging others of the cross-rods a. Normally the condition is as illustrated in Fig. 1, the foot g^2 being out of line with all of the stop shoulders, and the condition continues during the first part of the descent of a key, or until the roller stud d^3 of a key

strikes one of the cam projections g or g'. It will be noted that there are, all told, nine of the stop shoulders, one for each key, and of course the purpose is to throw the foot g^2 into the path of one or another of these stop shoulders according to which key is depressed. Naturally the lowermost shoulder designated by the numeral 1 is to come into play when the foremost or "1" key is depressed; the next higher shoulder, which is designated by the numeral 2, is to come into play when the next or "2" key is depressed, and so on. It will be remembered that the odd keys coöperate with corresponding inclines of the cam projections g, whereas the even keys coöperate with inclines of the cam projections g' which extend oppositely to said inclines of the projections g. In this connection it is to be noted that the series of four shoulders at the rear side of the opening in the sector lever serve for the even keys, whereas the series of five shoulders at the front side of said opening serve for the odd keys. The five shoulders of the forward series begin with that designated 1 and end with the terminal shoulder designated 9. Correspondingly, the four shoulders of the rear series begin with that designated 2 and end with the terminal shoulder designated 8. The bar G is not straight but inclines upward from about its middle toward the front. Furthermore, the key studs d^3 are not all in horizontal alinement and the cam projections vary to some extent in outline, the purpose being to properly time the action of the foot g^2 in its swinging forward or back to engage with one or another of the stop shoulders. Thus, the "1" key strikes its cam projection at an earlier point in its descent than the "2" key strikes its cam projection, since the foot g^2 should swing under the shoulder 1 one step earlier in descent of the sector F' than such foot should swing the other way for engagement with the shoulder 2. The desideratum is to swing the foot as soon as possible into line with the shoulder, so as to insure full engagement between the parts for effectively stopping the sector. Varying movements of the lever F caused by depression of different keys through contact at varying distances from the pivot of the lever, and the fact that the lugs d^2 are not normally the same distance from the lever, but vary somewhat in order to provide for the proper division of movement of the sector F' into nine equal increments of movement, are matters that require to be taken into consideration in establishing the relation between the several keys and the swinging bar G, so that the sector will descend the proper distance before the foot g^2 swings under one of the stop shoulders, while at the same time providing for such movement of the foot at the earliest practicable moment. The point is of course to make sure that the foot engages the shoulder corresponding with the key. It will be noted that this is very greatly promoted by having the nine stop shoulders in different series, those belonging to the odd keys making up one series and those belonging to the even keys making up another oppositely located series. This clearly provides for a much greater space between the adjacent shoulders of the same series than if all of the shoulders were in a single series, and therefore gives greater latitude for the early and full entry of the foot into the path of the stop shoulder. For example, in the case of depression of the "3" key, the foot can and does begin its forward swing as soon as the shoulder 1 has passed down well beyond it and without regard to the passage of the shoulder 2 because of course the foot is to swing away from the latter.

It has been before mentioned that the formation along the front and rear sides of the opening in the wide portion F^3 of the sector lever is in the nature of a ratchet. Thus, the projections which supply the stop shoulders have beveled upper edges. This serves the double purpose of providing for the early swing of the foot under any shoulder and also causing the foot to be forced out of line with the shoulder upon ascension of the sector. Of course the spring g^6 constantly tends to bring the foot to a central position out of line with all of the shoulders, but in rapid operation this might not alone be dependable. Without the spring the parts would restore to normal but there would be objectionable vibration of the foot and connected parts in rapid rise of the sector, and excessive noise-making contact between the foot and different inclined edges of the stop projections. As it is, the spring acts to centralize the foot and steady it so that its vibration is reduced to the minimum. Of course in so acting the spring restores the bar G to normal position, and engagement of the square notch g^4 with the foot at the conclusion of the rise of the sector, locks said bar in its proper position for being acted upon in exact time by the keys.

Passing now to the registering mechanism, a journal rod a' extends across the front part of the machine, being supported at its opposite end in the side frame pieces B and intermediately by the uprights C through which it extends; and upon this rod are mounted pinions H, one for each of the sectors F' and meshing therewith respectively, these pinions being rotatable independently of each other and adapted to be turned back and forth by the sectors, with which they are constantly engaged. The sectors are kept in alinement with the pinions by disks h and h' secured to opposite

sides of the pinions and overlapping the sectors, and the disks h' have peripheral flanges formed as ratchet wheels H' of the internal variety, see Figs. 2 and 4. There is loosely mounted upon the journal rod a' adjacent each of the pinions H a sleeve I which is enlarged into a hub-like portion within the internal ratchet, and upon said sleeve against a shoulder thereof is secured a gear wheel I' carrying a pawl I^2 pivotally mounted upon one side thereof within the said ratchet and pressed into engagement therewith by a spring i seating in a socket of the hub-like portion of the sleeve as shown in Fig. 2. Obviously this arrangement provides for turning of the pinion H by downward movement of the sector without turning the gear-wheel I', whereas when the sector returns, said gear-wheel will be turned with the pinion and ratchet. To prevent overthrow in the latter operation, there is mounted upon the sleeve I, a lantern wheel I^3, the same being here shown as equipped with studs or pins i', engaging holes in the gear-wheel I', Fig. 4, whereby to rotatively connect the lantern wheel, gear and sleeve. Stop pawls are loosely mounted upon another journal rod a^5, there being one such pawl for each lantern wheel I^3. Pawls designated J, comprising all except the one associated with the units section or bank of the machine, are connected by springs j with arms J' also loose on cross rod a^3, and which extend alongside the associated sectors F' respectively over studs f' projecting laterally from the lower portions of the sectors, as shown in Figs. 1 and 2; so that normally such pawls are forced upwardly into engagement with pins of the lantern wheels as shown in Fig. 1. Springs j' tend to withdraw these pawls from engagement with said wheels so that upon the lowering of any sector the associated pawl unlocks the gear-wheel I', the gravity of the pawl and arm J' also serving to bring this about, though preferably not relied upon. It will thus be seen that the gear wheels I' are normally locked by these pawls against turning in the direction in which the sectors turn them through the ratchet and pawl mechanism above described, and it will also be seen that the driving of these pawls into engagement with the lantern wheels by the sectors in arriving at their normal position will effectually prevent any over-rotation of the gears. Upward movement of the sectors is here shown as limited by their abutment against the journal rod a^4 on which the stop members G^2 are mounted, and of course by the time the sectors strike this rod they will have driven the pawls into effective position. It will be understood, of course, that the springs j are superior to the springs j', so that when the studs f' drive against the arms J' the pawls J will move as though integral with the arms (the spring-studs j^2 on the arms J' overlying the upper edges of the pawls J) except, of course, that the pawls would yield if their ends happened to encounter the passing pins of the lantern wheels. This, however, is not the real occasion for the yielding connection between the pawls and the arms, which has to do primarily with the resetting or turning to zero of the number wheels, presently to be described, which are actuated by the gears I'. In the case of the units set of devices, the stop pawl is not separate from its actuating arm, but a one-piece structure J^2 is employed as shown in Fig. 1, such one-piece structure having a tooth or projection to engage the lantern wheel and a rearward extension to engage the sector stud f'. In so far as concerns the locking of the gear-wheel, this pawl J^2 functions the same as the other pawls J, though as will be hereinafter described it has a special function to perform in connection with the resetting or turning to zero.

The gear wheels I' are in constant engagement with the members respectively of another set of gear wheels L which are secured respectively to hubs m (Fig. 4) journaled upon sleeves n which are in turn journaled upon a cross-rod a^6 extending from side to side of the machine. There are also secured to said hubs m, arms m' carrying studs m^2 on which are journaled pinions M'. These pinions protrude through orifices in the gears L and as planet gears they engage sun gears M^2 upon the rod a^6. All the sun gears except that with which the planet gear M' of the units order engages, are rotatable upon the rod a^6 for transfer or tens carrying purposes, it being of course obvious that there is no carrying to the units wheel. The planet gears M' are of double width, and besides meshing with the sun gears M^2, mesh with internal gears N which form part of the number wheels N', whose webs N^2 are fastened to the aforesaid sleeves n respectively. There are formed upon the latter outside these webs, pinions N^3 which mesh with gear wheels O on journals in bearings set in the division plates C, such journals carrying on the other sides of said plates, pinions O' in mesh with the internal gears O^2. These internal gears have their webs secured to hubs O^3 journaled upon sleeves m^4 integral with the hubs of the sun gears M^2. Springs P are coiled around the hubs O^3, there being one spring for each hub, and each spring being connected at one end to a stud o projecting from the side of a disk O^4 also secured to the hub O^3. The said disk is formed with a slot o' in the arc of a circle, see Figs. 6 and 8, and through such slot projects a stud p from the side of another disk P' which is secured to the hub of the sun gear M^2, it being understood that there is

one of these disks secured to each sun wheel except that belonging to the units section of the machine, which always remains fixed.

It will be obvious that the turning of any gear wheel L by a sector-actuated gear-wheel I′ will result in turning of the associated number wheel N′ through the medium of the planet gear M′ as the latter traverses the sun gear M^2, being at the same time engaged with the internal gear N. Naturally the ratio of movement is made such as to turn the number wheel distances according with the number of the key depressed. In so far as the units wheel is concerned this is the only turning thereof which need be considered, except that done in a zero-setting operation, but of course as to higher order wheels they must receive one step movements to register tens carried over from lower wheels. This is done by the springs P and timed by an escapement mechanism which will be later described.

Passing now to the matter of re-setting the number wheels to zero, this is done by turning all of the wheels forward to the (9) position and in the same operation pulling the units sector down one step so that when released it will turn the units wheel to zero and the other wheels will be turned to zero through the carrying action that ensues. To advance the wheels to the "9" position the internal gears O^2 are laid hold of, it being obvious that by turning them the number wheels will be rotated. Each of said internal gears carries projecting laterally from its web five equi-distant studs or pins o^6 and one or another of these is adapted to be acted upon by a hook R which normally stands forward out of the path of said studs, as shown in Fig. 1. It is so held by a cross-rod a^7 against the stress of a spring R′ connecting a lower portion of the hook with cross rod a^8.

A rock shaft S journaled in suitable bearings at the front part of the machine carries a series of arms S′ extending alongside the lower portions of the hooks R respectively, and equipped with studs S^2 engaging longitudinal slots r in the hooks. Normally the springs R′ tend to rock the hooks upon said studs, which are then in the upper ends of said slots, but such motion of the hooks is resisted by the cross rod a^7 which is then engaging seats or sockets in the rear edges of the hooks as illustrated in Fig. 1. When the arms S′ are swung downward by the rocking of the shaft S in the direction of the arrow the first effect is to turn the hooks R to a limited extent, the cross-rod a^7 supplying fulcra. Thereby the hooks are brought into position at their upper ends to engage pins or studs o^6. Continued downward swinging of the arms S′ brings their studs S^2 to the lower ends of the slots r, whereupon the hooks are drawn downward, stretching the springs R′, and will pick up the gears O^2, by engagement with their studs or pins o^6, at varying points according to what the number wheels are registering at the time. The relation between these parts is such that the full downward movement of the hooks, produced by downward swinging of the arm S′, will rotate the number wheels forward to the 9 position. The formation of the rear edges of the hook members above the seats or sockets which normally engage the cross rod a^7 is such as to accommodate the arc movement of the portions of the hooks engaged with the studs or pins o^6, the said edges having a reverse curvature in the arc of a circle. In order to prevent overthrow of the wheels in the zero setting operation, *i. e.*, movement beyond the "9." position, a pair of levers T of bell crank form are loosely mounted upon the cross rod a^8. The rearwardly extending arms of these levers carry a cross bar or plate T′ having upstanding lugs t, one for each wheel and adapted to be moved into the paths of pins or studs n^6 projecting from the webs N^2 of the latter and so located thereon that when said wheels exhibit 9's the studs have arrived at the rear sides of these lugs. In the present construction the lugs are not brought into such position until the hooks R have descended some distance, though said lugs are brought to effective position in ample time to prevent the possibility of overthrow. Suitable provision is made for so timing the action of these stop lugs, as follows: The depending arms of the bell-crank levers T are formed with longitudinal slots, the upper portions t^2 of which are normally concentric with the shaft S, but lower portions t^3 of which are eccentric thereto or of cam formation. The studs S^2 of adjacent arms S′ extend through these slots and traverse the concentric portions t^2 thereof during the greater portion of the downward swing of the arms S′, but as these arms complete their downward movement, the studs act upon the eccentric or cam portions t^3 of the slots and thereby rock the levers and project the lugs t into the paths of the number wheel studs n^6.

It is of course necessary that the wheels be unlocked before the hooks R start downward. To this end the locking pawls J have downward extensions j^6 with curved rear edges normally eccentric to the shaft S, and the arms S′ have studs or pins s^6 adapted, during the first part of the downward movement of said arms, to act upon the corners at the upper ends of said edges and disengage the pawls from the lantern wheels I^2, then holding said pawls displaced, during the further downward movement of the arms, by reason of the studs traversing the curved edges then concentric with the shaft S. As to all but the units pawl this

does not have any effect upon the sectors F′, as the springs *j* stretch, being inferior to the sector springs F^2. However, it will be remembered that the units locking pawl J^2 is integral with the rearwardly extending arm which engages the sector stud *f*. Hence when the pawl is rocked to disengage it from the lantern wheel the sector will be forced downward. The relation of parts is such that the downward movement of the sector thus produced is exactly equal to the movement produced by depression of the "1" key. Hence when the shaft S is released and restores to normal the units sector will turn its wheel one step forward or from "9" to zero, and a carrying action will ensue all the way across the series of wheels so that all come to zero position. As the arm S′ which acts to turn the units wheel carries the stud s^6 which unlocks the tens train of gears (owing to the lateral relationship of parts as shown in Fig. 4, the units gear O^2 being spaced considerably leftward of the units lantern wheel I^3 and the studs s^6 projecting leftward, as the machine is viewed from the front), a short additional arm S^3 is secured on the rock shaft S near its right hand end to operate the pawl J^2, the latter having a depending branch j' like those of the pawls J, and the said short arm having a stud s^8 to act thereon. Actuation of the rock shaft S is effected by a hand lever W arranged at the right hand side of the machine, as shown in Fig. 1, and screwed to rotative engagement with a short rock shaft which carries a crank arm W^2 operatively connected to a similar crank arm S^4 secured to the rock shaft S. The connection is preferably a yielding one in the interest of safeguarding the machine against violent usage and of protection in the event of a hitch in the operation. Thus a link member W^4, pivoted to the crank arm W^2, is longitudinally slotted at its other end to embrace a stud S^7 on the crank arm S^4, and springs X connect a cross head W^5, at the slotted end of the link W^4, with a cross head S^5 at the similarly slotted end of a link member S^6, which at its forward end is pivoted on the stud S^7 and at its rear end embraces the pivot stud *w* on the crank arm W^2. A spring Y attached to the cross head S^5 and to the frame work restores the rock shaft S after it has been rocked one way by the handle W.

Any suitable means may be employed for limiting the movement of the handle. In the present instance, the stud, *w*, is extended outward to abut the ends of arms B^2 which spring from the lower bar of the right side frame piece B.

All of the above detailed description relates to the particular machine to which I have applied my improvements. I shall now describe the improvements themselves, first taking up the escapement mechanism which controls the springs P, and as the construction is the same for each higher order wheel a description of one set of escapement devices will suffice.

The disk O^4 which has already been described has geared to the lower order wheel and progressively turned thereby, is divided into five equal peripheral sections since the ratio between the pinion M^3 on the lower order wheel and the internal gear O^3 is such that a complete rotation of the number wheel turns the internal gear and disk O^4 one-fifth of a rotation. These subdivisions of the periphery of said disk are in the form of gradual cams o^5 which terminate in radial shoulders o^6. The sun gear disk P′ correspondingly has five equally distant peripheral projections or teeth p^5, radial on one side to face oppositely to the cams o^5 and inclined on the other sides but not brought to a point, there being outer edges of appreciable extent concentric with the disk and flush with the outermost or highest portions of the cams o^5. For the purposes of the present invention an escapement pallet is employed comprising two independently movable members spring-held together, one of which members normally engages and restrains an escapement disk P′ and the other of which rides upon the periphery of the cam disk O^4 and is adapted to engage and momentarily restrain the escapement disk P′. The two members are mounted side by side upon a frame cross-rod a^9 so as to turn thereon in unison or independently of each other, and the first mentioned member is in the form of an arm Q′ having at its forward end an integral dog *q′* which normally engages with its straight edge the radial edge of one of the teeth or peripheral projections p^5 of the disk P′ as shown in Fig. 6, thereby restraining said disk while the spring P is tensioned. Said arm Q′ has a rearwardly extending portion underlying a stud q^4 set in an arm of the other pallet member Q. This member comprises an arm extending alongside the arm Q′ and formed with a foot *q* which is pressed against the periphery of the cam disk O^4 by a spring q^5 connecting the stud q^4 to a portion of the framework. The foot is formed to closely engage the periphery of the cam disk and to spring inward against the lowest or innermost portion of a section or subdivision thereof the moment that the highest or outermost point of the next or preceding cam o^5 passes the inner edge of the foot so that with the lower order wheel standing at zero the relation of parts would be such as illustrated in Fig. 6. This forwardly extending arm of the pallet member Q has a curved or hook-shaped extension Q^3 formed with a terminal dog q^3 offset into the plane of the disk P′ but nor-

mally standing free of the same as illustrated in Fig. 6. The extent and disposition of this curved extension Q^3 is such that as the pallet member Q is rocked by the action of a cam o^5 against its foot q, said dog q^2 will be moved into line with one of the projections or teeth p^5 of the disk P′ a very slight distance in advance thereof, such particular tooth or projection being the next but one in advance of the similar tooth or projection which the dog q' normally engages. It will be obvious that as the pallet member Q is so moved by the cam o^5 the member Q′ will accompany it by reason of the engagement of the stud q^4 with the rearwardly projecting arm of said member Q′. Hence the dog q' will be moved outwardly and as the disk O^4 partakes of movement corresponding with that of the associated number wheel from "9" to "0" said dog will disengage from the tooth and, the spring P having been meantime put under tension, the disk P′ will be turned slightly or until the other tooth thereof beforementioned engages the straight edge of the dog q^2 as illustrated in Fig. 8, the first-mentioned tooth passing under the dog q'. Then as the movement of the disk O^4 proceeds and its cam o^5 passes by the foot q the spring q^3 acts and disengages the dog q^2 from the tooth of the disk, whereupon the latter partakes of the balance of its carrying movement as measured by abutment of another of the teeth or projections against the dog q' which rides down off of the tooth ahead as the disk resumes its movement under actuation of the spring P. A spring q^5 connects the arm Q′ with a branch of the pallet member Q, said spring enforcing engagement between the dog q' and the periphery of the disk P′.

The advantage of the pallet composed of two independently movable members instead of one integral member is that gradual cams can be safely employed for the peripheral subdivisions of the disk O^4. The difficulty about employing such gradual cams with the one-piece pallet is that the parts attain momentum sufficient to disengage the holding dog from the escapement wheel prematurely, as for instance when the lower order wheel is passing from "7" to "8" or "8" to "9" and the movement of the higher order wheel that ensues must be sufficient to carry the tooth of the escapement wheel past the holding dog so that when further turning of the cam disk ensues and the high point of a cam thereon passes by the foot of the pallet, the latter may recover its normal position freeing the escapement disk for completion of its carrying movement. Inasmuch as the teeth of the escapement wheel or disk must have appreciable peripheral extent in the interest of wearing qualities, the initial movement of the disk in such cases is too great to preserve the alinement of numbers on the registering wheels. When there is not displacement of the pallet until the number wheel is moving from "9" to "0" the preliminary or initial movement of the disk is instantly followed by the final movement, and of course the extent of the initial movement in such case is immaterial. It is in case of premature displacement of the pallet by momentum when acted upon by a cam extending through a greater arc than that corresponding with the arc of the number wheel from "9" to "0," that the difficulty arises. Thus if the lower order wheel was only moving to the "9" position and the higher order wheel stood at "3" and there should be this premature displacement through momentum, the resultant movement of the higher order wheel would bring partially to view the numeral "4" thereon and the wheel would be left standing with part of the numeral "3" showing and part of the numeral "4," which would obviously be objectionable. Of course if the cam is confined to the "9" to "0" arc this cannot occur, but the gradual cam is much to be desired in the interests of wearing qualities and ease of action. The above described improvement providing a pallet made of two independently movable members, permits of the employment of the gradual cam because it is not essential that the preliminary or initial movement of the escapement disk shall be so great as to carry its tooth past the holding dog. With the holding dog on a separate member from the other or detaining dog the escapement action will not be interfered with by the holding dog remaining in engagement with the outer edge of the tooth after the preliminary movement of the disk has taken place. Fig. 11 illustrates the condition when momentum has caused displacement of the pallet members and a consequent slight initial movement of the escapement disk bringing the tooth thereof against the dog q^2 and leaving the dog q' resting upon the other edge of the tooth of the disk. The same condition is illustrated in Fig. 8 where the cam disk may be regarded as in motion through the "9" to "0" arc. This initial movement is so slight that the numbers on the registering wheels are not thrown perceptibly out of alinement. With subsequent or further turning of the lower order wheel the cam passes by the foot q and the fact of the dog q' being in engagement with the outer edge of the tooth of the escapement disk does not preclude recovery of the pallet member Q to its normal position, disengaging its dog q^2 from the escapement disk, for the reason that this member Q will then be rocked independently of the member Q′ as illustrated in Fig. 12. Of course there immediately ensues movement of the escapement disk so

that the spring q^5 restores the member Q′ to its normal relation with the member Q, moving the dog q' into the path of the next tooth of the escapement disk.

The advantage of the particular disposition of the dog q^2 hereinbefore pointed out is that an edge to edge engagement between the same and the tooth of the escapement disk is had, which extends at an acute angle to the intersecting radius of the pallet. It has been found that where such engagement is had in a line substantially at right angles to such radius the direct thrust toward the pivot of the pallet under stress of the carrying spring such as that designated P in the present instance, causes friction sometimes sufficient to make the pallet stick, its own spring being inferior to the carrying spring. It will be noted that the edge to edge engagement at an acute angle to the radius will have the opposite effect, *i. e.* the carrying spring P′ will assist in shifting the pallet back to normal, since the edge of the escapement disk tooth will thrust against the dog q in a direction to swing the pallet back to normal with a camming action.

Referring next to the other improvement hereinbefore mentioned, to-wit, provisions for preventing overthrow of the higher order wheel in a carrying operation with a key of the higher order held down, I here utilize the overthrow preventing system comprising the bar G and the links G′ and G². It will suffice to describe the arrangement for a single order or denominational place, as the construction is the same for each order.

Referring to Figs. 2 and 3, reference letter K designates a pawl which engages the lantern wheel I³ to prevent backward turning of the same and the gear I′, said pawl being hung upon a frame cross-rod a^5 and drawn downwardly by a spring k. For the purposes of my invention I modify the construction of such a pawl so that it may serve also to prevent forward turning of the gear. It will be understood that this gear must remain stationary when the carrying movement of the connected number wheel is had, except of course if the wheel is being individually advanced by its own actuator. Now since the depression of that actuator unlocks the gear as before described, if the actuator is held down by continued depression of one of the amount keys while the next lower actuator is repeatedly operated, or operated sufficiently to cause transferring or carrying to the higher wheel, it will be seen that an overthrow might occur with the gear I′ unlocked. Therefore the pawl K is formed with a rearward extension K′ and raised shoulders k' and k^2 at opposite ends of a depression k^3 in the upper side of said extension. The before-described stop member G² is formed as part of a yoke, the other member G² of which carries a stud g^8 normally standing over the depression k^3 as illustrated in dotted lines in Fig. 1. It will be recalled that as a key reaches the end of its movement the stop member G² is swung either forward or back to engage its foot g^2 with one of the stop shoulders of the actuator. This movement is taken advantage of here to block the pawl K and prevent an overthrow in carrying such as might occur in the manner above mentioned. If one of the odd keys is depressed the forward swinging of the yoke of which the stop member G² forms a part will carry the stud g^8 over the shoulder k' as illustrated in Fig. 2. If an even key is depressed the rearward swinging of the yoke will carry the stud g^8 over the shoulder k^2 as shown in Fig. 3. In either case the pawl K will be blocked so as to prevent forward turning of the lantern wheel I³. This obviously will prevent overthrow of the registering wheel. It will be understood, of course, that when the depressed key is released and begins to rise the spring g^3, Fig. 1, instantly restores the yoke to its normal position so that the stud g^8 moves over the depression k^3 and permits the operation of the gearing by the actuator for the purposes of registration in that order or denominational place, as described at the outset.

What I claim is:

1. The combination with adding wheels relatively arranged for progressive registrations thereon; of carrying mechanism comprising a cam disk rotatively connected with a lower denomination wheel, an escapement disk rotatively connected with a higher denomination wheel, a spring applied to the latter disk and tensioned by the lower denomination wheel, and a pallet composed of relatively movable members one of which engages the cam disk and the escapement disk and the other of which engages only the escapement disk.

2. The combination with adding wheels relatively arranged for progressive registrations thereon; of carrying mechanism comprising a cam disk rotatively connected with a lower denomination wheel, an escapement disk rotatively connected with a higher denomination wheel, a spring applied to the latter disk and tensioned by the lower denomination wheel, and a pallet composed of relatively movable members one of which engages the cam disk and the escapement disk and the other of which engages only the escapement disk; the two members being interengaged for movement as one by the cam disk.

3. The combination with adding wheels relatively arranged for progressive registrations thereon; of carrying mechanism comprising a cam disk rotatively connected with a lower denomination wheel, an escapement

disk rotatively connected with a higher denomination wheel, a spring applied to the latter disk and tensioned by the lower denomination wheel, and a pallet composed of relatively movable members one of which engages the cam disk and the escapement disk and the other of which engages only the escapement disk, the two members being interengaged for movement as one by the cam disks and a spring being applied to the first mentioned pallet member in opposition to the cam disk.

4. The combination with adding wheels relatively arranged for progressive registrations thereon; of carrying mechanism comprising a cam disk rotatively connected with a lower denomination wheel, an escapement disk rotatively connected with a higher denomination wheel, a spring applied to the latter disk and tensioned by the lower denomination wheel, and a pallet composed of relatively movable members one of which engages the cam disk and the escapement disk and the other of which engages only the escapement disk, the two members being interengaged for movement as one by the cam disks and a spring being applied to the first mentioned pallet member in opposition to the cam disk, and the other member being individually spring actuated in a like direction.

5. The combination with adding wheels relatively arranged for progressive registrations thereon; of carrying mechanism comprising a cam disk rotatively connected with a lower denomination wheel, an escapement disk rotatively connected with a higher denomination wheel, a spring applied to the latter disk and tensioned by the lower denomination wheel, and a pallet composed of relatively movable members one of which engages the cam disk and the escapement disk and the other of which engages only the escapement disk, the two members being interengaged for movement as one by the cam disks and a spring being applied to the first mentioned pallet member in opposition to the cam disk and the two members being spring-connected together.

6. The combination with adding wheels relatively arranged for progressive registrations thereon; of carrying mechanism comprising a cam disk rotatively connected with a lower denomination wheel, an escapement disk rotatively connected with a higher denomination wheel, a spring applied to the latter disk and tensioned by the lower denomination wheel, and a pallet engaging both disks, a shoulder of the pallet engaging a substantially radial shoulder of the escapement to normally restrain the latter and another shoulder of the pallet engaging another substantially radial shoulder of said disk to restrain the latter when released from the first shoulder, the second engagement being edge to edge at an acute angle to a radius of the pallet intersecting the second pallet-shoulder, substantially as and for the purposes described.

7. The combination of sector levers, pinions in mesh therewith respectively, gears having a one-way connection with said pinions respectively, planet gears revolubly connected to said gears respectively, sun gears, registering wheels engaged with the planet gears, escapement mechanism controlling the sun gear of a higher order registering train and controlled by the next lower order wheel, locking pawls normally engaging the first mentioned gears to prevent registering rotation thereof and adapted to be disengaged therefrom upon actuation of the sector levers, differential means for actuating said levers, and means for locking said gears by said differential means.

8. The combination of sector levers, pinions in mesh therewith respectively, gears having a one-way connection with said pinions respectively, planet gears revolubly connected to said gears respectively, sun gears, registering wheels engaged with the planet gears, escapement mechanism controlling the sun gear of a higher order registering train and controlled by the next lower order wheel, locking pawls normally engaging the first mentioned gears to prevent registering rotation thereof and adapted to be disengaged therefrom upon actuation of the sector levers, back-stop pawls engaging said gears, differential means for actuating said levers, and means for obstructing said back-stop pawls by said differential means.

9. The combination of sector levers, pinions in mesh therewith respectively, gears having a one-way connection with said pinions respectively, planet gears revolubly connected to said gears respectively, sun gears, registering wheels engaged with the planet gears, escapement mechanism controlling the sun gear of a higher order registering train and controlled by the next lower order wheel, locking pawls normally engaging the first mentioned gears to prevent registering rotation thereof and adapted to be disengaged therefrom upon actuation of the sector levers, back-stop pawls engaging said gears, a series of depressible keys for each lever to differentially vibrate the same, and a movable member common to said keys and adapted to be operated by any one of the same when fully depressed, said member having a part adapted to then engage the back stop pawl of the same order whereby to lock the gear against registering movement.

10. The combination of sector levers, pinions in mesh therewith respectively, gears having a one-way connection with said pinions respectively, planet gears revolubly

connected to said gears respectively, sun gears, registering wheels engaged with the planet gears, escapement mechanism controlling the sun gear of a higher order registering train and controlled by the next lower order wheel, locking pawls normally engaging the first mentioned gears to prevent registering rotation thereof and adapted to be disengaged therefrom upon actuation of the sector levers, back-stop pawls engaging said gears, a series of depressible keys for each lever to differentially vibrate the same, and a movable member common to said keys and adapted to be operated by any one of the same when fully depressed, alternating keys being reversely engaged with said member to move it oppositely and said member having a part to co-act with the back-stop pawl of the same order, said pawl having engaging portions separated by a depression substantially as and for the purposes described.

WALTER J. PASINSKI.

Witnesses:
F. C. RINSCHE,
ROB. T. BROCKMAN.