Dec. 18, 1962 E. BARKAS ETAL 3,069,084

REGISTERING MECHANISM

Filed Jan. 26, 1960

3 Sheets-Sheet 1

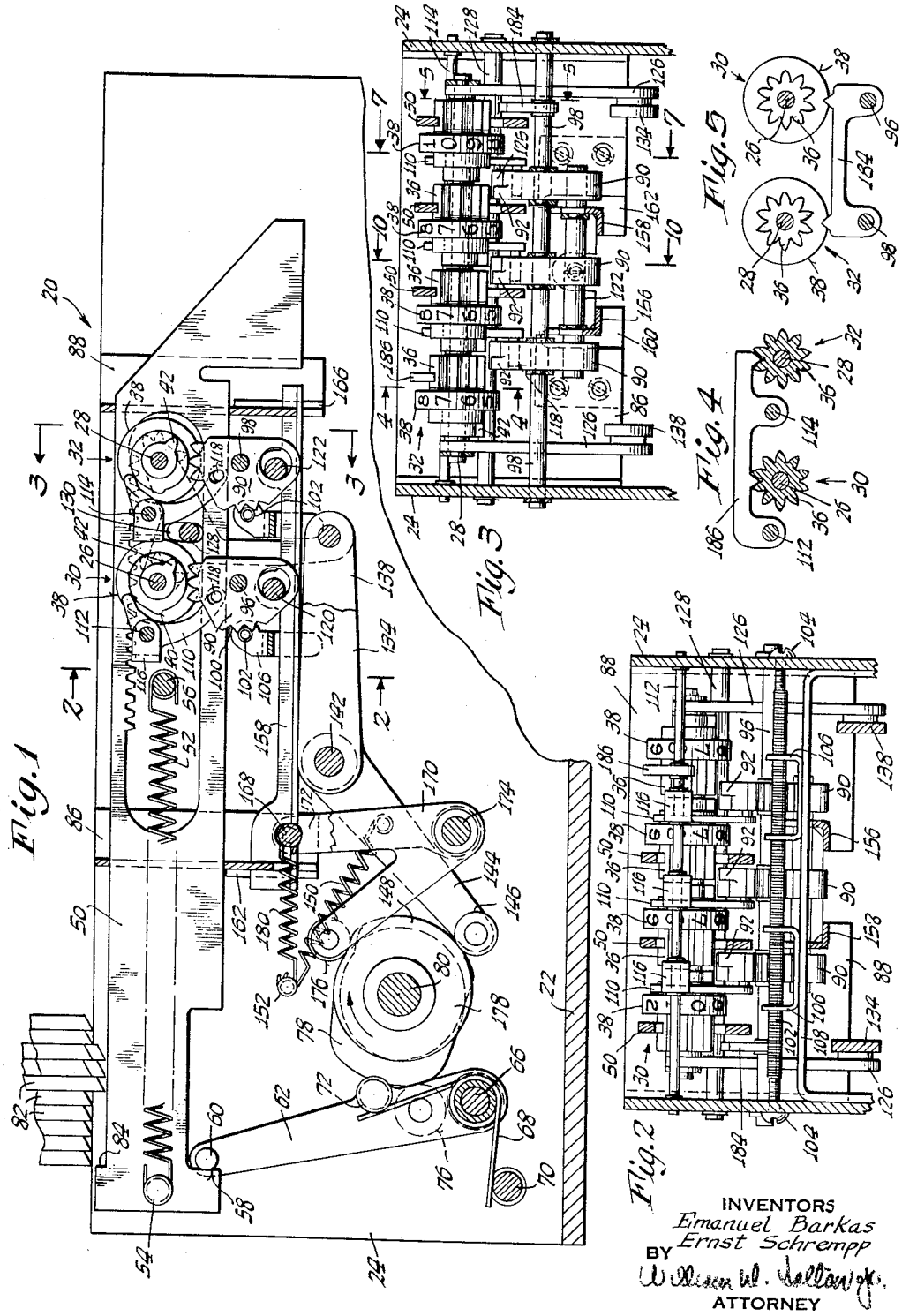

Fig. 1

Fig. 3

Fig. 5

Fig. 4

Fig. 2

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Fig. 6

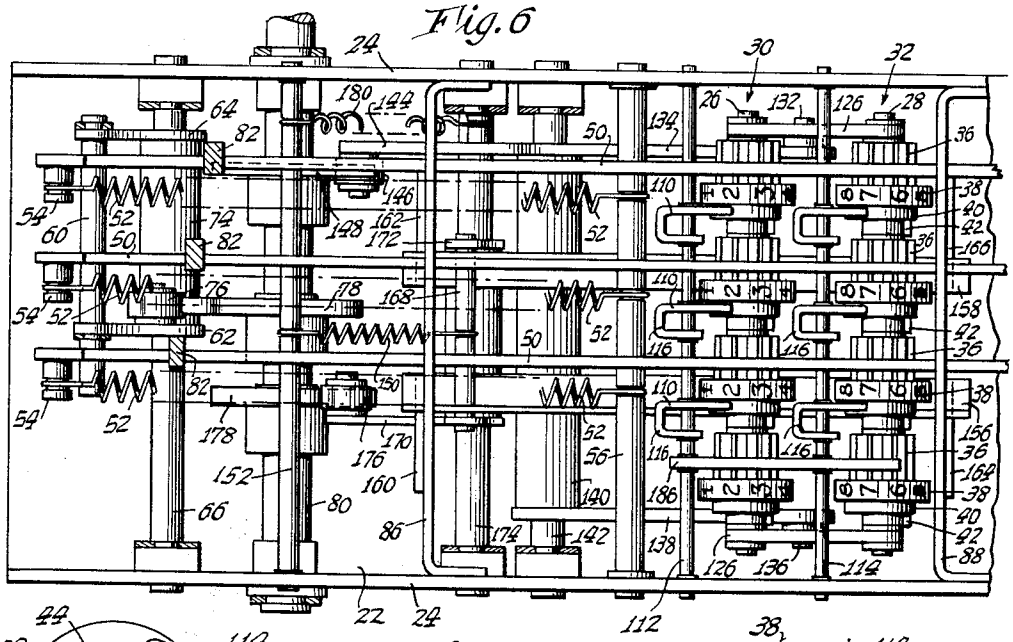


Fig. 7

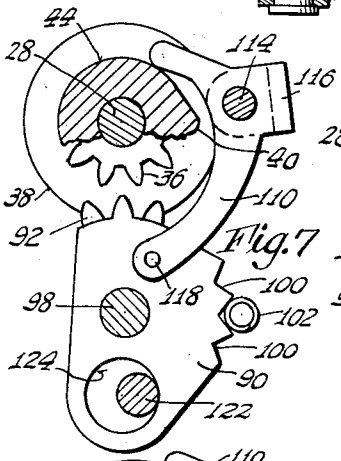


Fig. 8

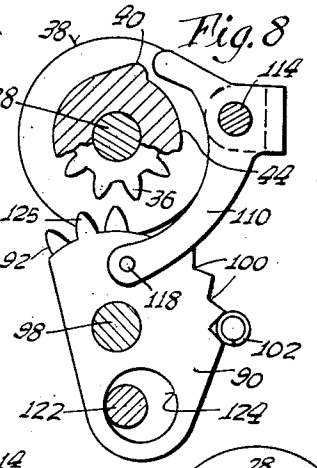


Fig. 10

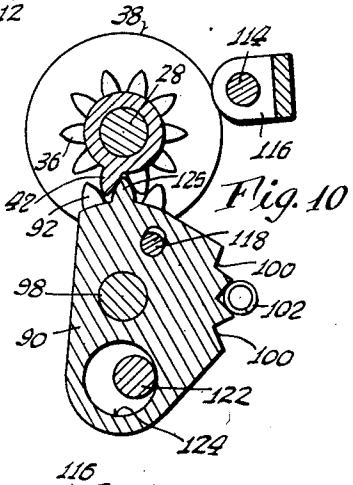


Fig. 9

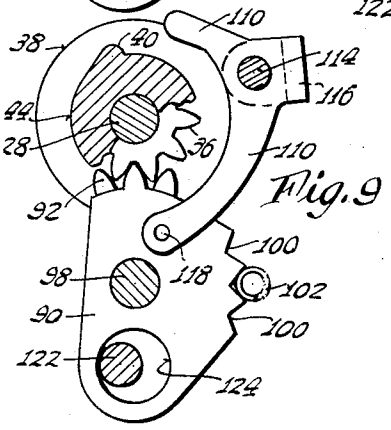
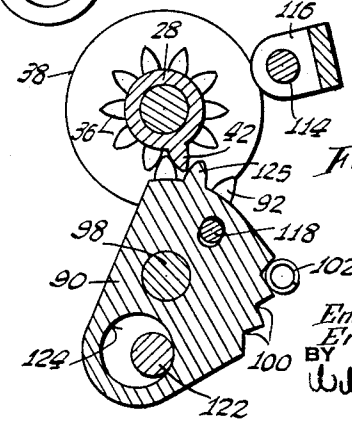


Fig. 11



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REGISTERING MECHANISM

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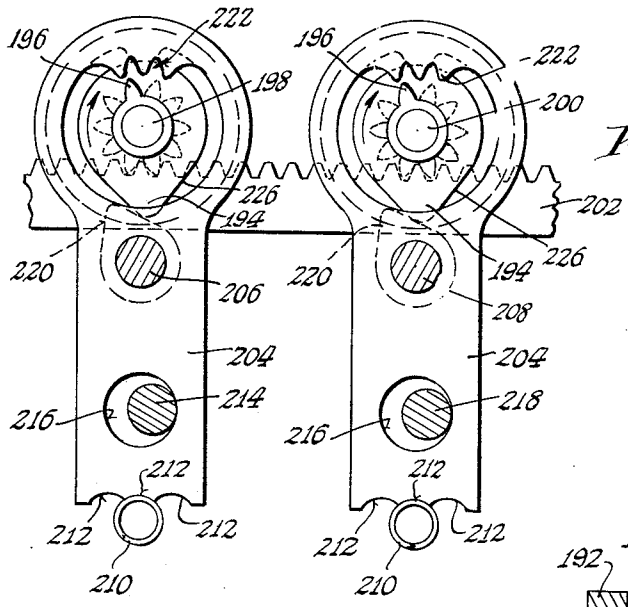


Fig. 13

Fig. 14

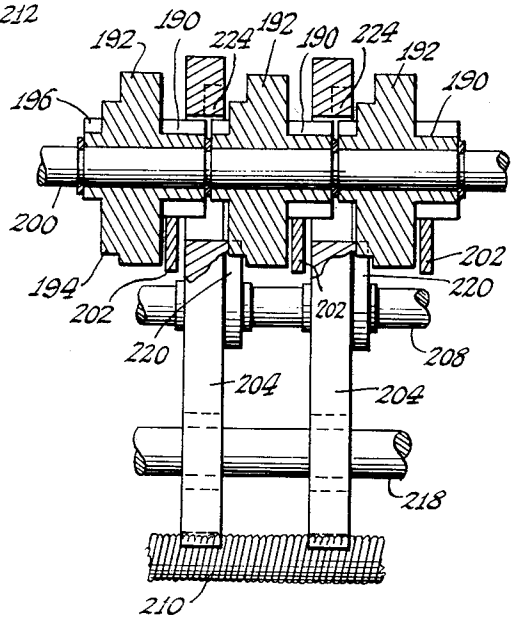
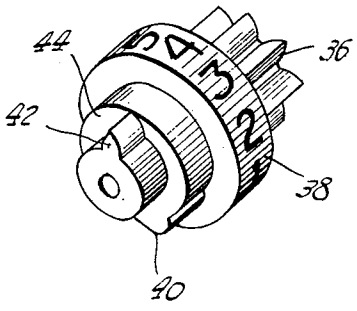


Fig. 12



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3,069,084

REGISTERING MECHANISM

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8 Claims. (Cl. 235—137)

This invention relates to registering mechanism for accounting machines, and more particularly, to such registering mechanism of the so-called simultaneous transfer type whereby all transfers that occur during an operating cycle of the registering mechanism do so simultaneously with each other and after digitation of the register has been completed.

According to both of the disclosed embodiments of the invention, two registers are provided; one of the registers being an ascending register and the other a descending register. Each of the registers includes a plurality of integral register wheel units in successive denominational orders. Each integral register wheel unit comprises a numeral wheel, a pinion, a primary transfer element and a secondary transfer element. When any register wheel unit, except the one of highest denominational order, is rotated through transfer position (i.e., from nine to zero in the case of the ascending register and from zero to nine in the case of the descending register) during digitation of the register, the primary transfer element of that register wheel unit positively sets a transfer actuator associated with the register wheel unit of next higher denominational order from a normal position to a retracted or conditioned position. Subsequently and after digitation of the registers is complete, all of the transfer actuators so conditioned are positively driven from their retracted position back to their normal position by a common driving member in each register to positively drive the respective register wheel units associated with the conditioned transfer actuators one digit, thereby effecting the primary transfers. If any register wheel unit is rotated through transfer position by a primary transfer thereto, the secondary transfer element of that register wheel unit positively drives the transfer actuator of next higher denominational order from said normal position to an advanced position to positively drive the register wheel unit of said next higher order one digit, thereby effecting a secondary transfer. Likewise, if any register wheel unit is rotated through transfer position by a secondary transfer thereto, the secondary transfer element of that register wheel unit positively drives the transfer actuator of next higher denominational order to positively drive the register wheel unit associated therewith one digit, thereby effecting another secondary transfer.

The term "primary transfer" as used herein denotes a transfer to a register wheel unit due to rotation of the register wheel unit of next lower denominational order through its transfer position by digitation of the register. The term "secondary transfer" is used herein to denote a transfer to a register wheel unit due to rotation of the register wheel unit of next lower denominational order through its transfer position by a transfer to the latter. Each transfer to a register wheel unit will, of course, be additive in the case of the ascending register and subtractive in the case of the descending register.

When any statement is made herein to the effect that a first part positively drives or positively moves a second part, this is intended to mean, as this phraseology is commonly used in the art, that the first part and second part (as well as any motion-translating parts intermediate the first and second parts) are rigid members as opposed to resilient members such as springs, and that

movement of the first part is translated into movement of the second part as opposed to movement of the first part effecting the release or activation of spring means which drives the second part.

Not only are the transfer actuators moved positively from the normal position to the retracted position by the primary transfer elements, from the retracted position to the normal position by a common driving member, and from the normal position to the advanced position by the secondary transfer elements as noted above, but the transfer actuators are also moved positively from the advanced position back to the normal position either by a common driving member or by a portion of a respective register wheel unit as will later be described. The advantages of one part always being positively moved by another part are well known to those skilled in the art of registering mechanisms. These advantages include greater reliability of operation because springs are inherently more liable to fail to perform their intended functions than are rigid parts.

All of the register wheel untis of each register are mounted for rotation about a common shaft. The pinions of certain of the register wheel units mesh with digitation actuators when said common shafts are in a digitation location, and the digitation actuators are driven settable amounts to drive the respective register wheel units corresponding numbers of digits. The common shafts are then moved to a transfer location at which the pinions of certain of the register wheel units mesh with the transfer actuators. When any one of the transfer actuators is driven while meshed with the pinion of the associated register wheel unit, a transfer is effected to that register wheel unit. The clearance between said pinions and their respective transfer actuators, when said pinions are fully meshed with their respective digitation actuators, is less than the distance said common shafts (as well as the pinions) move from the digitation location to the transfer location before the pinions become unmeshed with their respective digitation actuators, whereby said pinions are always in mesh with at least one of their respective actuators. In this manner, inadvertent rotation of the register wheel units is avoided during movement of the latter between the digitation and transfer locations.

During digitation of the register, the only substantial amount of resistance to rotation met by each register wheel unit is the comparatively slight amount that occurs when the primary transfer element of that register wheel unit drives the transfer actuator of the next higher denominational order from its normal position to its retracted position. It is possible during the transfer portion of the operating cycle, however, that one of the register wheel units will encounter comparatively greater resistance to its movement in that its secondary transfer element may drive the transfer actuator of next higher denominational order in turn to drive the register wheel unit of next higher denominational order whose secondary transfer element may in turn drive the transfer actuator of next higher denominational order, etc. This will be the situation when a plurality of secondary transfers occur to register wheel units of succeeding denominational orders during a single operating cycle. According to another features of the invention, digitation of the register wheel units is accomplished rapidly as compared with transfers to the register wheel units with the result that the peak forces which can build up against the parts during digitation and transferring will tend to be equalized thereby reducing the magnitude of the maximum stresses that build up in the respective parts.

According to still another feature of the invention, a simple single detent member, common to all of the transfer actuators of each register, is utilized to retain the

transfer actuators in any one of the three positions from and to which they are moved.

Accordingly, an object of this invention is to provide a new and improved registering mechanism of the simultaneous transfer type.

A further object of this invention is to provide such a registering mechanism including a transfer actuator in each denominational order except the lowest one, whereby all movements of the transfer actuators are positively effected either by a transfer element or by a driving member.

Another object of the invention is the provision of such a registering mechanism having in each denominational order an integral register wheel unit comprising a numeral wheel, a pinion, a primary transfer element and a secondary transfer element.

A further object of the invention is the provision of such a registering mechanism including a pinion in each of a plurality of denominational orders; which pinions, in moving out of mesh with digitation actuators into mesh with transfer actuators and then back into mesh with said digitation actuators, are always in mesh with at least one of the actuators.

Another object is to provide such a registering mechanism whereby all of the transfer actuators are retained by a single common detent member in the positions to which they are moved.

A further object of the invention is the provision of such a registering mechanism which is simple and inexpensive, and which requires a comparatively small number of parts.

Another object of the invention is the provision of a registering mechanism whereby digitation and transferring are effected at mutually different times in each operating cycle of the register and whereby the peak forces which can develop on the parts throughout each operating cycle are so balanced as to reduce the magnitude of the maximum stresses that will develop in the parts.

Further objects and advantages will become apparent as the description proceeds.

Several embodiments of the invention are shown in the accompanying drawings wherein:

FIG. 1 is a side elevational sectional view, partly broken away, of a registering mechanism according to a first embodiment of the invention, certain of the parts being omitted from this view and from subsequent views for clarity of illustration;

FIG. 2 is a front sectional view taken along line 2—2 in FIG. 1;

FIG. 3 is a rear sectional view taken along line 3—3 in FIG. 1;

FIGS. 4 and 5 are fragmentary side sectional views taken along lines 4—4 and 5—5, respectively, in FIG. 3;

FIG. 6 is a top plan view of the registering mechanism shown in FIG. 1;

FIG. 7 is an enlarged side sectional view taken along line 7—7 in FIG. 3 and showing the parts at a point in the digitation portion of an operating cycle shortly before a primary transfer element coacts with a transfer setting lever to positively move a transfer actuator from its normal position to a retracted or conditioned position;

FIG. 8 is a view similar to FIG. 7 but with the respective parts being shown at a point in the digitation portion of an operating cycle just after the transfer actuator has been moved to said retracted position;

FIG. 9 is also a view similar to FIG. 7 but with the respective parts being shown at a point in the transfer portion of an operating cycle just after the transfer actuator has been positively moved by a driving member from said retracted position to said normal position to positively effect a primary transfer;

FIG. 10 is an enlarged side sectional view taken along line 10—10 in FIG. 3 and showing the parts at a point in the transfer portion of an operating cycle just before a transfer actuator is positively moved by a secondary transfer element from said normal position to an advanced position to effect a secondary transfer;

FIG. 11 is a view similar to FIG. 10 but with the respective parts being shown at a point in the transfer portion of an operating cycle just after the transfer actuator has been moved to said advanced position;

FIG. 12 is a perspective view of an integeral register wheel unit according to said first embodiment of the invention.

FIG. 13 is a fragmentary side elevational view of a portion of the registering mechanism according to a second embodiment of the invention; and

FIG. 14 is a fragmentary rear view, partly in section, of the structure shown in FIG. 13.

The particular embodiments of the invention as described hereinafter are useful as registering mechanisms for value impression metering machines such as postage meters, tax stamp meters, etc. In this regard, these embodiments include two registers, one being an ascending resigster and the other a descending register. The ascending register will ordinarily not be reset and will indicate the total value of all of the impressions metered whereas the descending register will ordinarily be reset periodically by values corresponding to the amount of payments made by the user and will indicate the value of impressions which have not yet been metered but for which payment has been made. It will be recognized, however, that the invention is fully applicable to accounting machines other than metering machines and to registering mechanisms that have only one register or more than two registers.

Referring to FIGS. 1–11, a registering mechanism according to a first embodiment of the invention is generally indicated by the reference numeral 20 and includes a base 22 and a pair of upstanding side plates 24, 24. Top and side cover plates have been omitted from the drawing for the purposes of clarity of illustration. A shaft 26 supports a descending register generally indicated by the reference numeral 30, and a shaft 28 supports an ascending register generally indicated by the reference numeral 32. Each of registers 30 and 32 comprises a plurality of register wheel units in successive denominational orders. Each register wheel unit comprises an integral, one-piece member and includes a pinion 36, a numeral wheel 38, a primary transfer element 40 and a secondary transfer element 42. Primary transfer element 40 takes the form of a transfer cam and secondary transfer element 42 takes the form of a transfer tooth. Primary transfer cam 40 is reinforced by a hub portion 44 having a constant radius of curvature about its periphery.

Each register wheel unit of both of registers 30 and 32 is rotatable about its respective shaft 26 and 28, respectively, independently of rotation of the remaining register wheel units. The register wheel units of both of registers 30 and 32 rotate in the same direction (clockwise as viewed in FIG. 1 and anti-clockwise as viewed in FIGS. 7–11); the only difference between the register wheel units of the two registers being that the numerals on the numeral wheels 38 of the register wheel units of the descending register 26 increase from zero through nine in the direction of rotation thereof and the numerals on the numeral wheels 38 of the register wheel units of the ascending register 28 decrease from nine through zero in the direction of rotation thereof. As the description proceeds, it will become apparent that each of the registers 30 and 32 operates without dependence upon the other and that either register could be eliminated without affecting operation of the other.

Digitation of the registers 30 and 32 is accomplished by means of three digitation actuators, each in the form of a rack 50. One of the racks 50 meshes with the pinion 36 of the register wheel unit in each of the three lowest denominational orders of both registers. Each rack 50

is driven forwardly from the retracted position of FIG. 1 to the right under the bias of a tension spring 52. In this regard, each rack 50 has a laterally extending stud 54 to which one end of spring 52 is attached, and the other end of this spring is attached to a cross member 56 supported at its opposite ends by side plates 24, 24. With the parts in their positions as shown in FIG. 1, a shoulder 58 of all of the racks 50 engages a bar 60, the latter being supported at its opposite ends by a pair of levers 62 and 64, respectively. Levers 62 and 64 are biased in the clockwise direction (as viewed in FIG. 1) about the axis of a shaft 66 by means of a torsion spring 68, one end of the latter engaging a cross piece 70 carried by side plates 24, 24 and the other end engaging a laterally extending stud 72 carried by lever 62. Shaft 66 is supported by side plates 24, 24, and a spacer hub 74 is disposed on shaft 66 between levers 62 and 64. Lever 62 rotatably carries a cam-follower roller 76 which, under the influence of torsion spring 68, remains engaged with and follows a cam 78, the latter being fixed for rotation with a cam shaft 80. Shaft 80 is bearinged by side plates 24, 24 and is driven (by well known means, not shown) one revolution in the clockwise direction (as viewed in FIG. 1) for each operating cycle of the registering mechanism. Before each operating cycle, one of ten stops 82 for each rack 50 will be depressed in a well known manner (by means of setting levers, keys or the like) into the path of a shoulder 84 provided by each rack, thereby to limit the forward stroke of the respective rack to a number of teeth from zero through nine. In FIGS. 1 and 6, the respective ones of the stops 82 are depressed to permit the racks 50 of the three lowest denominational orders (units, tens and hundreds orders) to move forwardly seven, six and five teeth respectively, when levers 62, 64 and cross bar 60 swing to the right as cam 78 rotates in the clockwise direction. When each rack 50 comes into engagement with the respective depressed one of stops 82, forward movement of that rack ceases and lost-motion of bar 60 relative to that rack ensues until the bar 60 reaches the end of its forward swing. Each rack 50 is slidable in and guided by a separate slot in each one of two U-shaped supporting plates 86 and 88, respectively. U-shaped plates 86 and 88 are attached to and supported by side plates 24, 24. Each one of the racks 50 rotatably drives the pinion 36 meshed therewith the same number of teeth the respective rack is moved forwardly, and each tooth of rotation increases the value indicated by the respective numeral wheel 38 of ascending register 32 by one digit and decreases the value indicated by the respective numeral wheel 38 of descending register 30 by one digit. In this manner, digitation of registers 30 and 32 is accomplished. As cam shaft 80 continues to rotate after bar 60 has completed its full forward swing, cam follower roller 76 rides on a dwell portion of cam 78 and then is returned by cam 78 to its fully retracted position, thereby to return all three of racks 50 to their fully retracted positions. During this return movement of the racks 50, the pinions 36 of all of the register wheel units of both of registers 30 and 32 will be de-meshed from the racks as will later be described, so that no reverse rotation of any of the register wheel units will occur.

After the above-noted forward movement of the racks 50 and before the return thereof, both of registers 30 and 32 are moved downwardly from their digitation location at which the racks 50 are in mesh with the respective pinions 36 to their transfer location at which a separate transfer actuator 90 is in mesh with each of the pinions 36 of all of the register wheel units except the one of lowest denominational order in each of the registers 30 and 32. Each of the transfer actuators 90 has a three tooth sector 92 which meshes with the pinion 36 of the same denominational order when the register wheel units are in the downward transfer location. The transfer actuators 90 of descending register 30 are mounted for pivotal movement about a shaft 96 and the transfer actuators 90 of ascending register 32 are mounted for pivotal movement about a shaft 98. Shafts 96 and 98 are carried by side plates 24, 24. Each transfer actuator 90 has three V-shaped grooves 100 at one side thereof. A detent member 102 is common to all of the transfer actuators of each of registers 30 and 32. Each detent member 102 takes the form of a resilient coil spring connected at each end to a screw 104 threadedly received by one of side plates 24. Disposed laterally of each transfer actuator 90 of each of the registers is one of the legs of a pair of upright U-shaped brackets 106. Each of these legs provides an aperture through which the respective one of coil springs 102 extends. The pair of brackets 106 for each of the registers is fixed on an inverted U-shaped bracket 108, each of the latter being fixed at its ends to side plates 24, 24. It will be apparent that by cooperating with the V-shaped grooves 100 of the respective transfer actuators 90, the common detent member 102 of each of registers 30 and 32 yieldably retains the respective transfer actuators in any one of three pivotal positions to which the latter are moved about the respective one of shafts 96 and 98.

When, during digitation of registers 30 and 32, any one of the numeral wheels 38 in the three lowest denominational orders is rotated through transfer position (i.e., from nine to zero in the case of ascending register 32 and from zero to nine in the case of descending register 30), the primary transfer cam 40 of that register wheel unit engages one end of an associated transfer setting lever 110 and positively pivots that transfer setting lever 110 in the anti-clockwise direction as viewed in FIG. 1 and in the clockwise direction as viewed in each of FIGS. 7, 8 and 9. This pivotal movement of the setting levers 110 for descending register 30 is about a common shaft 114. Each of shafts 112 and 114 extends through an aperture in each of the respective transfer setting levers 110 as well as through an aperture in an L-shaped extension 116 of each of the respective transfer setting levers. Shafts 112 and 114 are supported at their ends by side plates 24, 24. Each transfer setting lever 110 carries a laterally extending pin 118 received within an aperture provided by the transfer actuator 90 of the next higher denominational order. As a result, the above-mentioned pivotal movement of any one of the transfer setting levers 110 positively sets the transfer actuator 90 of next higher denominational order from a normal position (as shown in each of FIGS. 1 and 7) to a retracted or conditioned position (as shown in FIG. 8). This movement of the respective transfer actuator from the normal position to the retracted position occurs during digitation of the registers and therefore while the three tooth sectors 92 of the transfer actuators are out of mesh with the pinions 36 of the respective register wheel units. In this manner, when any one of the respective register wheel units except the one of highest denominational order moves through transfer position during digitation of the registers, the transfer actuator 90 of the next higher denominational order will be conditioned to later effect a primary transfer to its register wheel unit.

The aperture provided by each transfer actuator 90 and which receives the pin 118 of a respective transfer setting lever 110, is slightly elongated to accommodate the respectively different arcuate paths followed by the pin 118 and the aperture.

After digitation of the registers is complete and after the registers move downwardly from the digitation location to the transfer location, a driving member 120 common to all of the transfer actuators of descending register 30 and a driving member 122 common to all of the transfer actuators of ascending register 32 are driven forwardly (to the right as viewed in FIG. 1) and then rearwardly (to the left as viewed in FIG. 1). Driving members 120 and 122 extend through over-size aper-

tures 124 in their respective transfer actuators 90. The left and right-hand sides of each of apertures 124 provide a pair of spaced stops between which a respective one of drive members 120, 122 is disposed. When all of the transfer actuators 90 are in the normal position, all of the apertures 124 of each register are aligned with each other and, consequently, each side of all of the apertures of each register are aligned with each other.

When any one of the transfer actuators has been moved to its retracted or conditioned position during digitation of the registers, the left-hand side of that aperture 124 (as viewed in FIGS. 7–9) will be moved as shown in FIG. 8 into engagement or close proximity with the respective one of driving members 120, 122. The subsequent forward movement (to the left as viewed in FIGS. 7–9) of driving members 120, 122 will therefore positively drive all of the transfer actuators in the retracted position back to the normal position shown in FIG. 9. Since the three tooth sectors 92 of the transfer actuators are then in mesh with their associated pinions of the register wheel units, each of the conditioned transfer actuators will positively drive its respective register wheel unit one digit thereby effecting a primary transfer. When any one of the transfer actuators is not set to the retracted position during the digitation portion of the operating cycle, the respective one of common driving members 120 and 122 will not drive that transfer actuator.

Each of the transfer actuators 90 of both of registers 30 and 32, has a single tooth 125 in the form of a lateral extension of the middle tooth of the three tooth sector 92 of that transfer actuator. Each single tooth 125, when the registers 30 and 32 are in their transfer location, lies in the path of movement of the secondary transfer tooth 42 of the register wheel unit of the next lower denominational order. Consequently, when a register wheel unit is rotated through transfer position by a primary transfer thereto, the secondary transfer tooth 42 of that register wheel unit will move from the position shown in FIG. 10 to that shown in FIG. 11 and, in so doing, will engage the single tooth extension 125 of the transfer actuator 90 of the next higher denominational order and drive that transfer actuator from its normal position to its advanced position. Since the three tooth sector 92 of each transfer actuator is in mesh with the pinion of the register wheel unit in that denominational order while the registers are in the transfer location, each transfer actuator, when so moved from its normal position to its advanced position, positively drives the register wheel unit in that denominational order one digit to effect a secondary transfer thereto. In the same manner that a secondary transfer occurs to a register wheel unit when the respective register wheel unit of the next lower denominational order is moved through transfer position by a primary transfer thereto, a secondary transfer likewise occurs to any register wheel unit when the respective register wheel unit of the next lower denominational order is moved through transfer position by a secondary transfer thereto. Accordingly, when a succession register wheel units stand at the digit nine in the case of the ascending register or at zero in the case of the descending register, and a primary transfer occurs to the register wheel unit of the lowest denominational order in said succession, a secondary transfer occurs to all of the remaining register wheel units in said succession and to the register wheel unit of the denominational order next higher than the one of highest denominational order in said succession. Furthermore, all of the transfers that occur in any one operating cycle of each of the registers, whether these transfers be only primary ones or both primary and secondary ones, do so simultaneously with each other.

With reference to FIGS. 10 and 11, it will be noted that when a transfer actuator 90 is driven from the normal position to the advanced position by the secondary transfer tooth 42 of the register wheel unit of the next lower denominational order to effect a secondary transfer, the common driving member (122 in the case of descending register 30, and 124 in the case of ascending register 32) will simultaneously move with or slightly ahead of the right hand side of the aperture 124 provided by that transfer actuator. It follows that the respective common driving member will lie against or in close proximity to the right hand side of this aperture when the secondary transfer is complete and the transfer actuator is in the advanced position. Subsequently, the registers 30 and 32 are moved from the transfer location to the digitation location, and then the common driving members are moved rearwardly (from the right to the left as viewed in FIGS. 10 and 11). When the registers 30 and 32 move from the transfer location to the digitation location, the hub portion 44 of each register wheel unit whose transfer setting lever 110 is connected to a transfer actuator 90 in the advanced poistion, will move against that transfer setting lever to positively move the latter and the transfer actuator 90 connected thereto from the advanced position to the normal position. This would not be the case for any transfer actuator 90 which was not connected to a transfer setting lever (as would ordinarily be the situation with the respective transfer actuator for each so-called overflow register wheel unit in excess of one, if such were provided, because there can be no primary transfers to any overflow register wheel units in excess of one). Nor would this be the case if the radius of the periphery of the hub portion 44 of the register wheel units were to be sufficiently decreased from that as shown in FIGS. 1–9. If, in either of these latter situations, or if for any other reason any transfer actuator 90 in the advanced position were not returned to the normal position with movement of the registers from the transfer location to the digitation location, the respective one of the common driving members 120 and 122, in moving rearwardly, would act against the right hand side of the respective aperture 124 thereof (as viewed in FIG. 11) to positively drive the transfer actuator from the advanced position back to the normal position.

It will be understood that since each of the registers 30 and 32 as shown in the drawing has only four numeral wheels, a secondary transfer can possibly occur only to the numeral wheels of the highest and second highest denominational orders. Obviously, the registers 30 and 32 could have more than four numeral wheels, in which case the number of numeral wheels to which a secondary transfer could possibly occur would be correspondingly increased.

It will be clear from the above that during each operating cycle of both registers, each one of the transfer actuators 90 will be moved in one of the following ways: from the normal to the retracted position and back to the normal position whereby a primary transfer is effected, from the normal to the advanced position and back to the normal position whereby a secondary transfer is effected, or will not be moved at all whereby no transfer is effected. Referring to FIG. 7, when any one of the transfer actuators does not move at all (i.e., remains in the normal position) during an operating cycle, the respective one of driving members 120, 122 merely moves to the left from the right hand side of aperture 124 up to the opposite or left hand side of aperture 124 (without driving that transfer actuator), and then moves rightwardly up to the right hand side of the aperture 124 (again, without driving that transfer actuator). It necessarily follows: that any transfer actuator which was set to the retracted position is positively driven back to the normal position by the driving member when the latter moves forwardly (to the left, as viewed in FIGS. 7–11) whereby a primary transfer is effected; that any transfer actuator which moves from the normal position to the advanced position, in effecting a secondary transfer,

moves with the driving member when the latter moves forwardly; and that any transfer actuator so moved to the advanced position will be positively driven back to the normal position by the driving member when the latter moves rearwardly unless that transfer actuator was previously positively returned to the normal position by the hub member 44 of the register wheel unit of the next lower denominational order during movement of the registers back to the digitation location. It also necessarily follows that after the driving members 120, 122 have so moved forwardly and before the rearward movement thereof, all of the transfer actuators not in the advanced position will be in the normal position; and, as noted above, when any transfer actuator is in the normal position, the rearward movement of the driving member is from the left hand side of the aperture 124 up to the right hand side thereof without driving that transfer actuator. In no case, therefore, does the respective common driving member interfer with the intended movement of any of the transfer actuators, and this feature is coupled with the one that each of the transfer actuators is always positively driven from and to all three of its positions by a transfer setting lever 110, by a common driving member or by a secondary transfer tooth 42.

The structure by means of which registers 30 and 32 are moved between their digitation location and transfer location will now be described. Shafts 26 and 28, which respectively mount the register wheel units of the descending register 30 and the ascending register 32, are carried at their opposite ends by a pair of carriers 126, 126. Carriers 126, 126 are guided for substantially vertical movement between the digitation and transfer locations by a bar 128 which extends through an elongated slot 130 in each of the carriers and which is carried at its ends by side plates 24, 24. Adjacent its lower end, each of carriers 126 provides an aperture, one of which receives a pivot pin 132 carried by the end of a link 134 and the other end of which receives a pivot pin 136 carried by the end of a link 138. Links 134 and 138, along with a spacer-hub 140, are fixed on a shaft 142 bearinged by side plates 24, 24. Link 134 includes an integral extension 144 which rotatably supports a cam follower roller 146, the latter being resiliently biased against a cam 148 by means of a spring 150 connected at its opposite ends to extension 144 and a cross bar 152. Cross bar 152 is supported at its ends by side plates 24, 24. Cam 148 is fixed on one-revolution cam shaft 80. By virtue of the contour of cam 148, carriers 126, 126 and registers 30 and 32 will be moved between the digitation and transfer locations in timed relation with racks 50, drive members 120, 122, and the remaining operating parts of registering mechanism 20.

The structure by means of which common driving members 120 and 122 are moved horizontally back and forth will now be described. Referring to FIGS. 1, 2, 3 and 6, both of common driving members 120 and 122 extend through and are retained in a respective aperture in each one of two slides 156 and 158, respectively. Slides 156 and 158 are L-shaped in cross-section. A pair of bracket plates 160 and 162 are bolted to U-shaped member 86, and contoured edges of these bracket plates and the U-shaped member 88 define two L-shaped guide slots within each of which rides one of the slides 156 and 158. In similar fashion, another pair of bracket plates 164 and 166 are bolted to U-shaped member 88 cooperatively to define two L-shaped guide slots within each of which rides one of the slides. Adjacent its rearward end, each of the slides 156 and 158 provides a slot opening downwardly and within which is received a bar 168. Bar 168 is carried at one end by one leg of a bell crank lever 170 and at its other end by a lever 172. Levers 170 and 172 are mounted for rotation, with a spacer hub therebetween, about a shaft 174, the latter being supported at its ends by side plates 24, 24. The distal end of the other leg of bell crank lever 170 rotatably mounts a cam follower roller 176. Cam follower roller 176 is resiliently biased against a cam 178 by means of a tension spring 180 having one end connected to cross bar 152 and the other end connected to bar 168. Cam 178 is fixed on one-revolution cam shaft 80 and is so contoured as to effect back and forth movement of common driving members 120 and 122 in timed relation with the movements of the other operating parts of the registering mechanism 20.

The operating sequence of the registering mechanism 20 is as follows. With the parts in the respective positions as shown in FIG. 1 and with one of the stops 82 depressed in the path of each of the racks 50 as also shown in FIG. 1, levers 62, 64 swing to the right under the control of cam 78 whereupon each rack 50 moves to the right until its shoulder 84 engages the respective stop 82. During this rightward movement of the racks, the register wheel unit in each of the three lowest denominational orders of both registers 30 and 32 is driven the same number of digits as the number of teeth the associated rack is driven, whereby digitation of both registers is accomplished. The primary transfer cam 40 of each register wheel unit, when it is driven through transfer position during digitation, acts through the respective transfer setting lever 110 to positively set the transfer actuator 90 of the next higher denominational order to retracted position. Levers 134 and 138 then swing downwardly about shafts 142 under the control of cam 148 to move register carriers 126, 126 and registers 30 and 32 downwardly from the digitation location to the transfer location whereby the pinions of the register wheel units are de-meshed from racks 50 and are meshed with the transfer actuators 90. Then, levers 170, 172 swing to the right about shaft 174 to move slides 156, 158 and driving members 120, 122 forwardly whereby all of the transfers, primary and secondary, occur simultaneously. Thereupon, levers 62, 64 swing leftwardly under the control of cam 78 to return all of the racks 50 to the position of FIG. 1. Levers 134, 138 then move register carriers 126, 126 and registers 30, 32 back to the digitation location under the control of cam 148. Subsequently, levers 170, 172, under the control of cam 178, swing to the left to return slides 156, 158 and driving members 120, 122 to their starting position, whereupon the operating cycle is completed and all of the parts are back to their positions as shown in FIG. 1.

When the pinions 36 of both of the registers 30 and 32 are fully meshed with their respective racks 50, the clearance between these pinions and their respective transfer actuators 90 is less than the distance the pinions (and the remaining parts of both registers) move in going from the digitation location to the transfer location. As a result, the pinions 36, when shifted from the digitation location to the transfer location, move into mesh with the transfer actuators before becoming de-meshed from the racks 50. Likewise, the pinions 36, when shifted from the transfer location to the digitation location, mesh with the racks 50 before de-meshing from the transfer actuators. In this manner, the pinions 36 are always in mesh with at least one of the racks 50 or the transfer actuators 90 whereby inadvertent rotation of the register wheel units is avoided during movement of registers 30 and 32 between their digitation and transfer locations. It is noted that there is no transfer actuator in the lowest denominational order of either of the registers (because there can never be a transfer to the numeral wheel of the lowest denominational order) nor is there a rack 50 in the highest denominational order (because the numeral wheel of the highest denominational order is a so-called overflow numeral wheel). To prevent inadvertent rotation of the register wheel unit of the lowest denominational order in both of the registers when the pinions 36 are de-meshed from racks 50, each of shafts 96 and 98 fixedly carries a retaining member 184 which terminates in a tooth at sub-

stantially the same level as the teeth of the sectors 92 of the transfer actuators. The fixed teeth of members 184, 184 mesh with and thereby retain the pinions 36 in the units order of both registers against inadvertent rotation while de-meshed from the respective one of racks 58. In similar fashion, shafts 112 and 114 fixedly support a retaining member 186 having two teeth, one of the latter meshing with and retaining the pinion in the highest (thousands) denominational order of each of the registers against inadvertent rotation while these pinions are de-meshed from the respective transfer actuators.

As previously noted herein, a greater resistance to rotation of any one of the register wheel units can occur during the transfer portion of the operating cycle than can occur during the digitation portion. This is the case because the only parts that can be driven by any one register wheel unit during digitation are the associated one of the transfer setting levers 110 and the respective transfer actuator 90 of the next higher denominational order whereas, during the transfer portion of the operating cycle, the secondary transfer element 42 of one of the register wheel units may drive the transfer actuator of the next higher denominational order in turn to drive the register wheel unit of said next higher denominational order whose secondary transfer element 42 may drive the transfer actuator of still the next higher denominational order, etc. (the latter being the situation when a plurality of secondary transfers in successive denominational orders occur in one of the operating cycles of the registering mechanism). In order to reduce the peak forces that can develop on the operating parts, the cam 78 is so contoured as to cause the digitation actuators to drive the pinions 36 of the register wheel units at a comparatively greater speed than the pinions are driven by the transfer actuators as determined by the contour of the cam 178. The result is that the peak forces which build up against the parts during digitation and those which build up during transferring tend to be equalized and, consequently, the magnitude of the maximum stresses that can build up in the parts is reduced. One direct advantage of this result is that the register wheel units and the transfer actuators can be made less expensively since they operate under and must withstand reduced forces.

Referring to FIGS. 13 and 14, a second embodiment of the invention is shown which obviates the use of the transfer setting levers of the previously described embodiment in that each of the transfer actuators is positively moved to the retracted position during digitation of the register directly by the primary transfer element of the register wheel unit of the next lower denominational order. Each of the register wheel units of the embodiment of FIGS. 13 and 14 is a single integral member comprising a pinion 190, a numeral wheel 192, a primary transfer element 194 and a secondary transfer element 196. Each primary transfer element 194 takes the form of a primary transfer cam, and each secondary transfer element 196 takes the form of a secondary transfer tooth. The register wheel units of this embodiment, as well as those of the embodiment of FIGS. 1–12, can be molded of suitable material as unitary integral members. Two register wheel units are shown in FIG. 13, one in an ascending register and one in a descending register, just as with the embodiment of FIGS. 1–12. The register wheel units of the descending register are mounted for rotation in the clockwise direction (as viewed in FIG. 13) about a shaft 198 and the register wheel units of the ascending register are mounted for rotation in the same direction about a shaft 200.

Digitation of the two registers is accomplished by means of three digitation actuators, each in the form of a rack 202. One of the racks 202 meshes with the pinion 190 of the register wheel unit in each of the three lowest denominational orders of both registers. Each rack is driven forwardly (to the left as viewed in FIG. 13) a settable number of teeth to drive the pinions of the register wheel units in the respective denominational order of both registers a corresponding number of digits from zero through nine. A transfer actuator 204 is disposed in each denominational order except the lowest one of both registers. The transfer actuators 204 of the descending register are mounted for pivotal movement about a shaft 206 and the transfer actuators 204 of the ascending register are mounted for pivotal movement about a shaft 208. A detent member 210 is common to all of the transfer actuators 204 in each of the registers. Each of the common detent members comprises a coil spring which cooperates with three concave grooves 212 provided by each transfer actuator of the respective register, yieldably to retain the transfer actuators in any one of three pivotal positions. A common driving member 214 extends through an oversize aperture 216 in all of the transfer actuators 204 of the descending register and a common driving member 218 is similarly arranged with respect to the transfer actuators 204 of the ascending register. When, during digitation of the registers, any register wheel unit is driven through the transfer position, the primary transfer cam 194 of that register wheel unit will engage and move against a cam follower member 220 fixedly carried by the respective transfer actuator of the next higher denominational order directly to positively drive that transfer actuator in the anti-clockwise direction from the normal position as shown in FIG. 13 to the retracted position. In this manner each of the transfer actuators is conditioned to later effect a primary transfer.

After digitation of the registers is complete, the ascending and descending registers are moved upwardly from their digitation location to their transfer location. The pinions of all of the register wheel units except the ones in the lowest denominational order of both registers, in moving to the transfer location, move into mesh with a three tooth sector 222 fixedly carried by the transfer actuator 204 in the same denominational order before becoming de-meshed from their respective racks 202. This is the case in that the clearance between the pinions 190 and the three tooth sectors 222, when the registers are in their digitation location, is less than the distance the registers move in going from the digitation location to the transfer location.

After the registers have moved to their transfer location, common driving members 214 and 218 are moved forwardly (to the left as viewed in FIG. 13) positively to drive each of the transfer actuators 204 which was set to the retracted position during digitation of the registers. Each transfer actuator 204, when so positively driven, in turn positively drives the associated pinion 190 to effect a primary transfer. When any register wheel unit is moved through the transfer position by a transfer thereto, the secondary transfer tooth 196 thereof moves against an extended tooth 224 carried by the transfer actuator of the next higher denominational order, positively to drive the latter to the advanced position to effect a secondary transfer to the respective register wheel unit in said next higher denominational order. While the registers are in the transfer location, racks 202 are returned (to the right as viewed in FIG. 13). The registers are then returned (downwardly as viewed in FIG. 13) to their digitation location, and thereafter, common driving members 214, 218 are moved rearwardly (to the right as viewed in FIG. 13). Whether any transfer actuator 204 in the advanced position (after having effected a secondary transfer) is moved back to the normal position during movement of the registers back to the digitation position or during the subsequent rearward movement of the common driving members 214 and 218 is determined, as with the embodiment of FIGS. 1–12, by the magnitude of the radial dimension of the reinforcing portion 226 of the respective register wheel unit adjacent the cam follower 220.

It will be apparent that the operating means for effecting the above-described movements of the parts of the embodiment of FIGS. 13 and 14 can or will be similar to

the operating means for the embodiment of FIGS. 1–12; the latter being modified only to effect the respectively different directions of movement of certain of the parts.

Since many changes could be made in the embodiments of the invention particularly described and shown herein without departing from the scope of the invention, it is intended that these embodiments be considered as exemplary and that the invention not be limited except as warranted by the following claims.

What is claimed is:

1. A simultaneous-transfer registering mechanism having a plurality of numeral wheels in successive denominational orders; a transfer actuator for each of said numeral wheels except the one of the lowest denominational orders; means mounting said transfer actuators for movement between a normal position, an advanced position and a retracted position; means operatively arranged to positively set each of said transfer actuators from said normal position to said retracted position when the respective numeral wheel of the next lower denominational order moves through transfer position while the transfer actuators are non-drivingly associated with their numeral wheels; a secondary transfer element carried by each of said numeral wheels to which a transfer is capable of being effected, for movement through transfer position to positively drive the transfer actuator of the next higher denominational order from said normal position to said advanced position while the transfer actuators are drivingly associated with their numeral wheels, thereby to effect a secondary transfer; and means for positively moving all of said transfer actuators in said retracted position to said normal position while the transfer actuators are drivingly associated with their numeral wheels to effect the primary transfers simultaneously with any of said secondary transfers, and for subsequently positively returning each of said transfer actuators in said advanced position to said normal position while the transfer actuators are non-drivingly associated with their numeral wheels; each of said transfer actuators providing an aperture; and said last-named means including a bar extending through all of said apertures and operatively connected to be driven forwardly for positively moving all of the transfer actuators in said retracted position to said normal position while the transfer actuators are drivingly engaged with their numeral wheels and to be driven rearwardly for positively moving any of the transfer actuators in said advanced position to said normal position while the transfer actuators are disengaged from their numeral wheels.

2. A simultaneous-transfer registering mechanism including a plurality of numeral wheels in successive denominational orders; a transfer actuator for each of said numeral wheels except the one of the lowest denominational order; means operatively arranged for selectively effecting movement of each of said transfer actuators in one direction from a normal position to a retracted position when the respective numeral wheel of the next lower denominational order moves through transfer position during digitation of the register while the transfer actuators are non-drivingly associated with their numeral wheels; means operatively arranged for selectively effecting movement of each of said transfer actuators in the opposite direction from said normal position to an advanced position when the respective numeral wheel of the next lower denominational order moves through transfer position while the transfer actuators are drivingly associated with their respective numeral wheels; each of said transfer actuators carrying two spaced stops; each of the stops of each of said transfer actuators being aligned with one of the stops of all of the remaining transfer actuators when the transfer actuators are in a normal position; a driving member common to all of said transfer actuators and disposed between the two stops of all of said transfer actuators; and means operatively connected for moving said common driving member from one of said stops to the other one of said stops of each transfer actuator in said normal position when the transfer actuators are drivingly associated with their numeral wheels and then for moving said common driving member from said other stop to said one stop of each transfer actuator in said normal position when the transfer actuators are non-drivingly associated with their numeral wheels; whereby each transfer actuator in said retracted position is positively driven in said opposite direction by the common driving member to said normal position to effect a primary transfer, each transfer actuator moved from said normal position to said advanced position in effecting a secondary transfer moves with said common driving member in said opposite direction, and each transfer actuator in said advanced position is moved in said opposite direction back to said normal position.

3. A simultaneous-transfer registering mechanism including a first numeral wheel of one denominational order, a second numeral wheel of the denominational order next higher than that of said first numeral wheel, and a third numeral wheel of the denominational order next higher than that of said second numeral wheel; said first numeral wheel carrying a first primary transfer element and said second numeral wheel carrying a second primary transfer element; a first transfer actuator positively conditionable, by movement of said first primary transfer element through transfer position, to effect, when driven, a primary transfer to said second numeral wheel; a second transfer actuator positively conditionable, by movement of said second primary transfer element through transfer position, to effect, when driven, a primary transfer to said third numeral wheel; means operatively arranged for positively and simultaneously driving the transfer actuators so conditioned; and a secondary transfer element carried by said second numeral wheel for movement through transfer position to positively drive said second transfer actuator for effecting a secondary transfer to said third numeral wheel simultaneously with a primary transfer to said second numeral wheel.

4. The simultaneous-transfer registering mechanism as set forth to claim 3 wherein each of said transfer actuators provides an aperture, and wherein said last-named means comprises a single bar extending through all of said apertures and operatively connected to be driven forwardly to effect all of said transfers and to be moved rearwardly to reset said second transfer actuator after the latter has effected a secondary transfer to said third numeral wheel.

5. A simultaneous-transfer registering mechanism including a first numeral wheel of one denominational order, a second numeral wheel of the denominational order next higher than that of said first numeral wheel, and a third numeral wheel of the denominational order next higher than that of said second numeral wheel; said first numeral wheel carrying a first primary transfer element and said second numeral wheel carrying a second primary transfer element; a first transfer actuator conditionable, by movement of said first primary transfer element through transfer position, to effect, when driven, a primary transfer to said second numeral wheel; a second transfer actuator conditionable, by movement of said second primary transfer element through transfer position, to effect, when driven, a primary transfer to said third numeral wheel; means for subsequently driving said transfer actuators when so conditioned; and a secondary transfer element carried by said second numeral wheel for movement through transfer position to drive said second transfer actuator for effecting a secondary transfer to said third numeral wheel simultaneously with a primary transfer to said second numeral wheel.

6. A simultaneous-transfer registering mechanism having a plurality of successive denominational orders; an integral register wheel unit in each of said denominational orders; each of said register wheel units comprising a numeral wheel, a pinion, a primary transfer element and a secondary transfer element; a toothed digita-

tion actuator for driving each of said pinions a settable number of digits; a toothed transfer actuator in each of said denominational orders except the lowest denominational order; means operable during each operating cycle of the registering mechanism, for moving said pinions in one direction out of mesh with their respective digitation actuators and into mesh with their respective transfer actuators and then back in the opposite direction into mesh with their respective digitation actuators and out of mesh with their respective transfer actuators; the clearance between said pinions and their respective transfer actuators, when said pinions are fully meshed with their respective digitation actuators, being less than the distance said pinions move in said one direction before becoming unmeshed with their respective digitation actuators, whereby said pinions are always in mesh with at least one of their respective actuators; each of said primary transfer elements, when its register wheel unit is driven through transfer position while said pinions are fully meshed with their respective digitation actuators, being operatively arranged to positively drive the transfer actuator of the next higher denominational order from a normal position to a retracted position; each of said secondary transfer elements, when moved through transfer position while the transfer actuators are fully meshed with their respective pinions, being operatively arranged to positively drive the transfer actuator of the next higher denominational order from said normal position to an advanced position to effect a secondary transfer to the register wheel unit of said last-mentioned denominational order; and means operatively arranged to positively drive all of the transfer actuators in said retracted position to said normal position while the transfer actuators are fully meshed with their respective pinions thereby to effect a primary transfer to each register wheel unit having a pinion in mesh with a transfer actuator so driven; said last-named means being operatively arranged to positively drive all of the transfer actuators in said advanced position to said normal position while the transfer actuators are de-meshed from their respective pinions.

7. A simultaneous-transfer registering mechanism having a plurality of numeral wheels in successive denominational orders; a transfer actuator for each of said numeral wheels except the one of the lowest denominational order; means mounting said transfer actuators for movement between a normal position, an advanced position and a retracted position; means operatively arranged to set each of said transfer actuators from said normal position to said retracted position during digitation of the numeral wheels while the transfer actuators are non-drivingly associated with their numeral wheels; said last-named means including a primary transfer element positively movable by each of said numeral wheels and a motion-translating means associated with each of said primary transfer elements; each of said motion translating means including a portion lying in the path of its associated primary transfer element and a portion movable against the transfer actuator of the next higher denominational order for positive movement of the last-named transfer actuator from said normal position to said retracted position by said associated primary transfer element when the respective numeral wheel of the next lower denominational order moves through transfer position; a secondary transfer element movable by each of said numeral wheels to which a transfer is capable of being effected, for movement through transfer position to drive the transfer actuator of the next higher denominational order from said normal position to said advanced position while the transfer actuators are drivingly associated with their numeral wheels, thereby to effect a secondary transfer; and means for moving all of said transfer actuators in said retracted position to said normal position while the transfer actuators are drivingly associated with their numeral wheels to effect the primary transfers.

8. The simultaneous-transfer registering mechanism as set forth in claim 7 wherein said last-named means includes a drive mechanism for driving said transfer actuators to drive said numeral wheels at a speed slower than that at which digitation of said numeral wheels takes place.

References Cited in the file of this patent

UNITED STATES PATENTS

765,520	Felt	June 14, 1904
785,097	Hamilton	Mar. 21, 1905
1,693,766	Schubode	Dec. 4, 1928
2,101,818	Overbury	Dec. 7, 1937
2,694,524	Reynolds	Nov. 16, 1954
2,826,366	Capellaro	Mar. 11, 1958