Aug. 8, 1950 H. P. MIXER 2,518,358

CRAWL CARRY MECHANISM

Original Filed Nov. 12, 1941 4 Sheets-Sheet 1

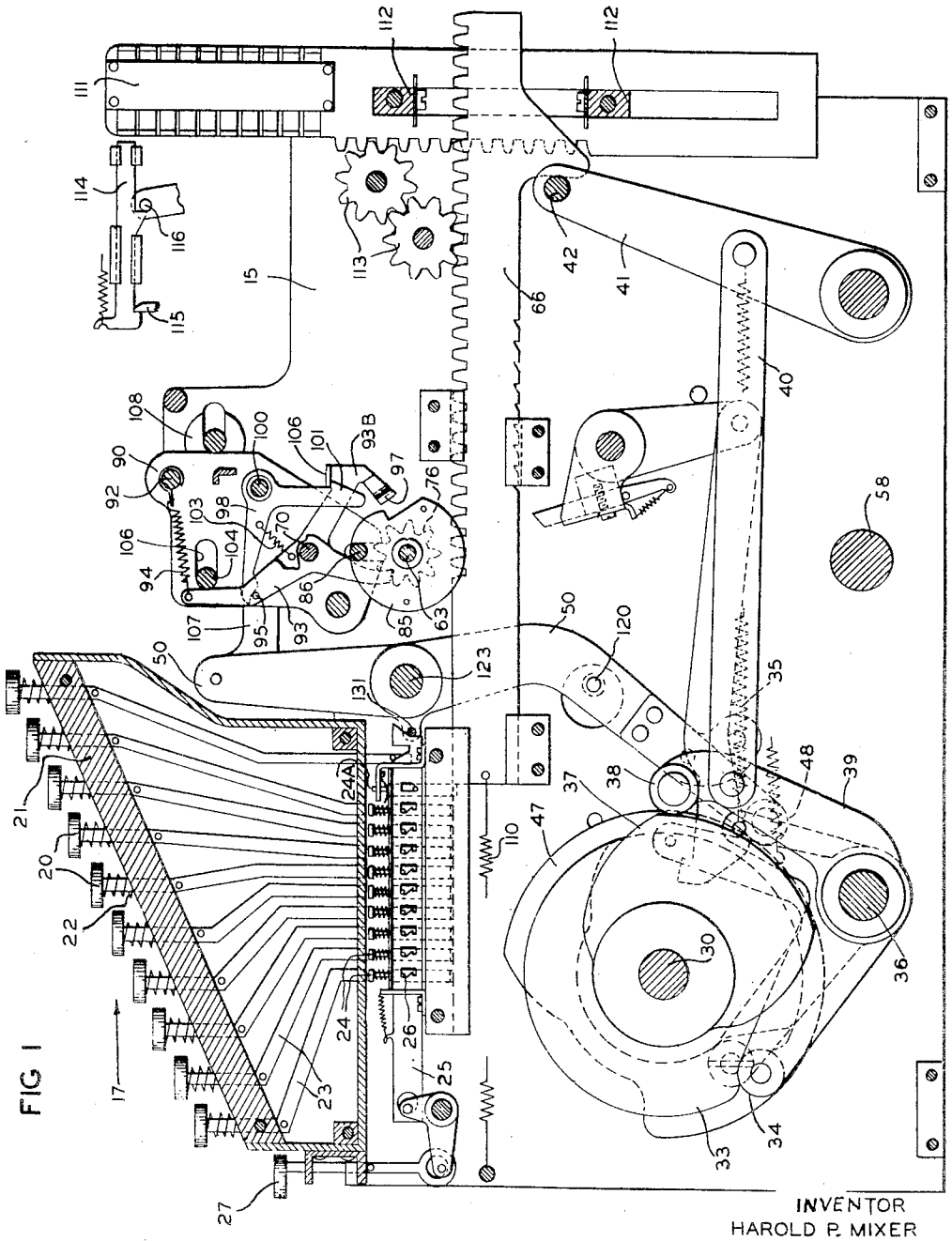

FIG 1

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Aug. 8, 1950 H. P. MIXER 2,518,358

CRAWL CARRY MECHANISM

Original Filed Nov. 12, 1941 4 Sheets-Sheet 2

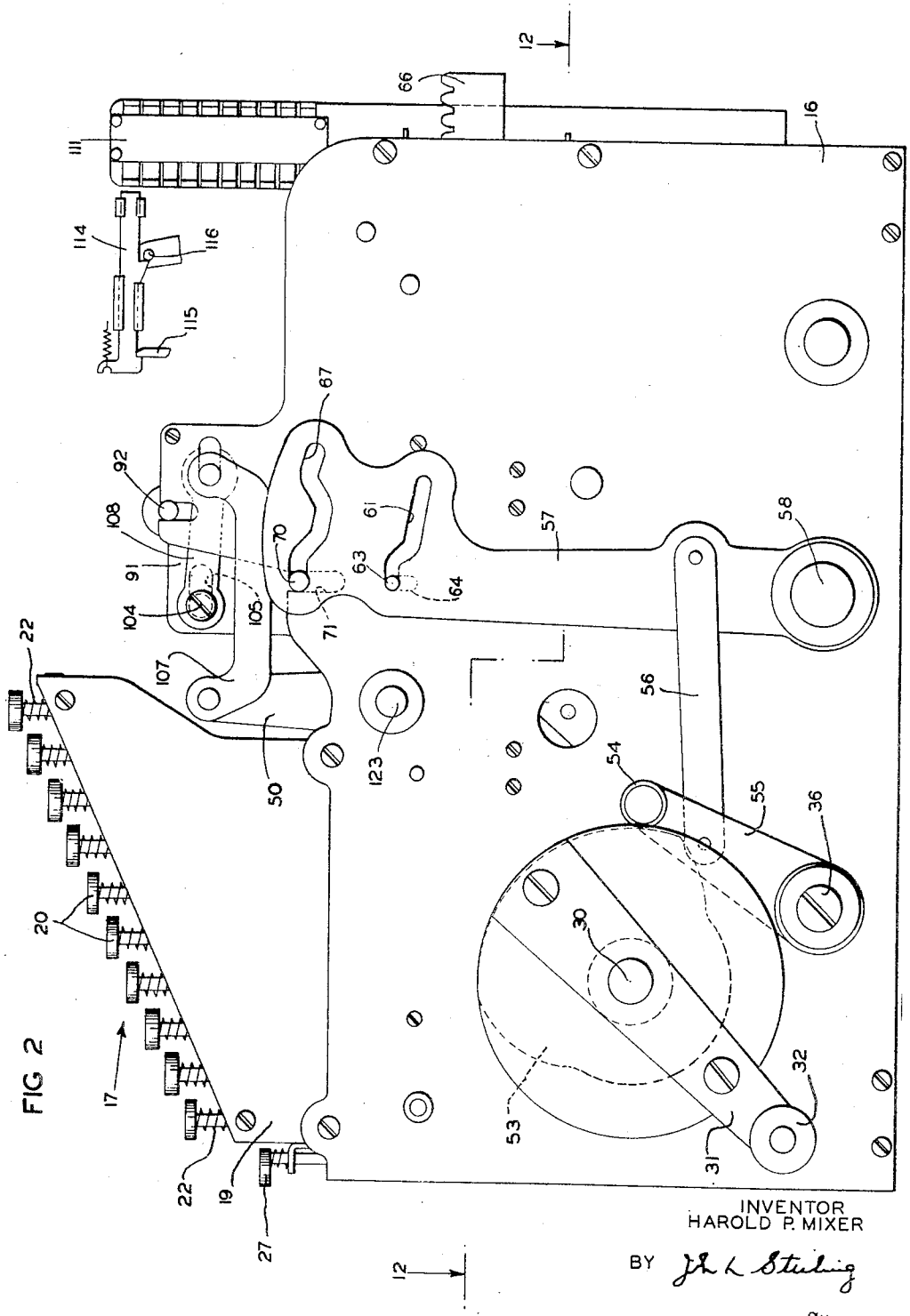

FIG 2

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Aug. 8, 1950 H. P. MIXER 2,518,358

CRAWL CARRY MECHANISM

Original Filed Nov. 12, 1941 4 Sheets-Sheet 3

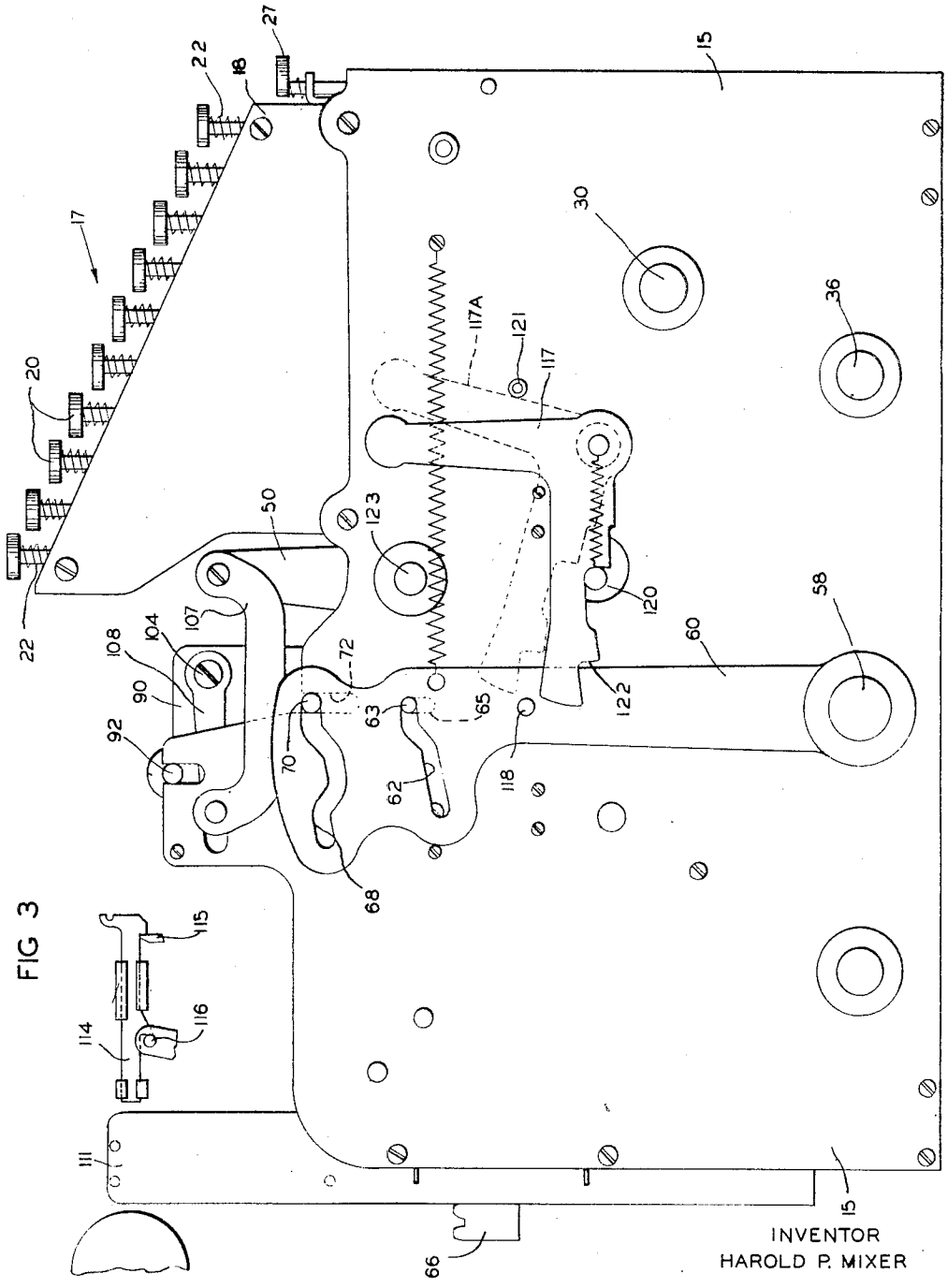

FIG 3

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Aug. 8, 1950 H. P. MIXER 2,518,358

CRAWL CARRY MECHANISM

Original Filed Nov. 12, 1941 4 Sheets-Sheet 4

FIG. 12

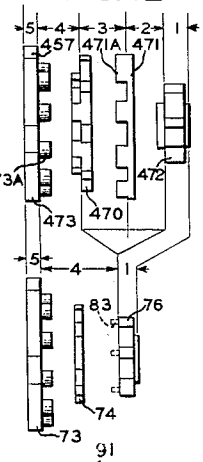


FIG. 11

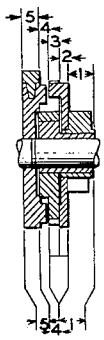


FIG. 4

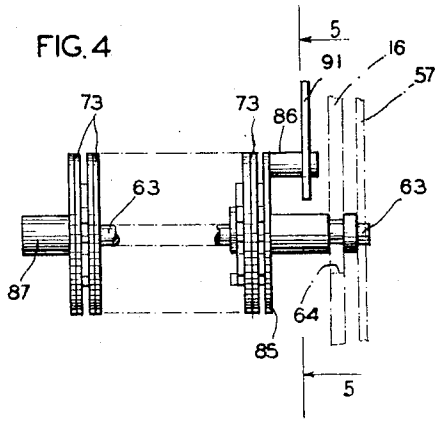


FIG. 5

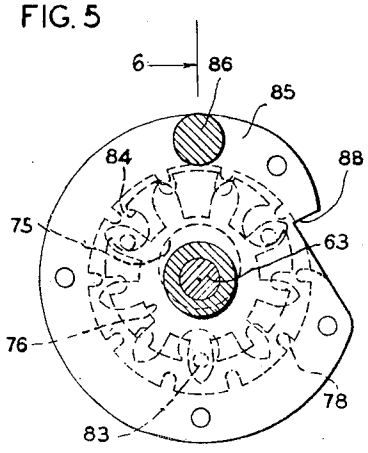


FIG. 6

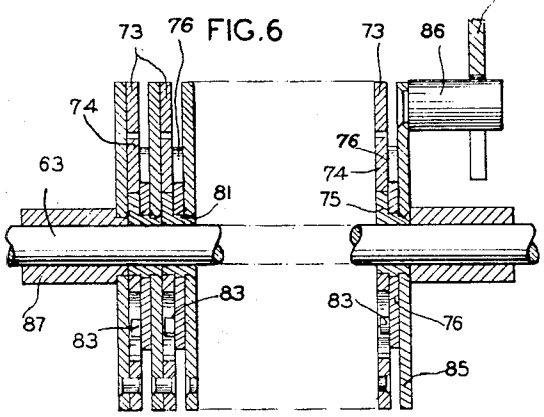


FIG. 7

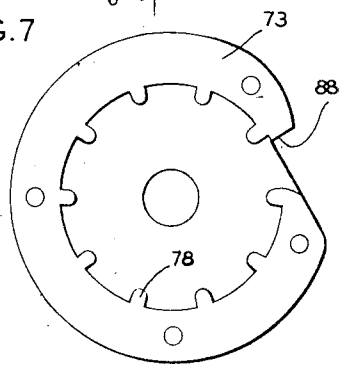


FIG. 8

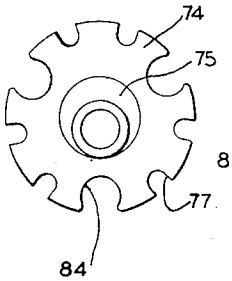


FIG. 9

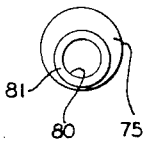
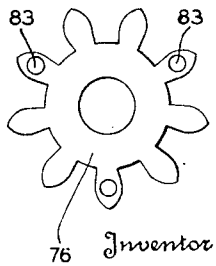


FIG 10



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Patented Aug. 8, 1950 2,518,358

UNITED STATES PATENT OFFICE

2,518,358

CRAWL CARRY MECHANISM

Harold P. Mixer, Rockville Centre, N. Y., assignor to Remington Rand Inc., New York, N. Y., a corporation of Delaware

Continuation of application Serial No. 493,987, July 9, 1943, which is a division of application Serial No. 418,796, November 12, 1941. This application July 15, 1948, Serial No. 38,832

7 Claims. (Cl. 235—136)

1

This is a continuation of my prior application for Computing Machines filed July 9, 1943, S. N. 493,987, now abandoned, which prior application was itself a division of my prior application for Letters Patent for Computing Machines, filed November 12, 1941, Serial No. 418,796, now Patent 2,360,615, dated October 17, 1944.

The invention relates to computing machines and more particularly to accumulators of the crawl carry type having in each denominational order a driving gear actuated by the usual actuating rack, and a resultant wheel actuated through differential gearing, partly by the driving gear of the same order and partly by the resultant wheel of next lower order.

The invention has for its principal object to improve accumulators of the said type, and especially to reduce the width of the accumulator. Where crawl carry accumulators as heretofore constructed have been embodied in machines provided with type carriers to print the items and totals, the lateral spacing of the accumulator wheels has necessarily been materially greater than that of the type carriers, which is a disadvantage in itself, and especially where it is desired to print other matter side by side with that which records the operations of the accumulator. Some modern accounting and statistical machines print a line of matter, either numerical or alphabetical of which that associated with one accumulator is but a portion. Sometimes several accumulators are disposed side by side and their records are printed side by side; and crawl carry accumulators have hitherto been found unsuitable by reason of their width. It is, therefore, an object of the invention to provide a crawl carry accumulator in which the lateral pitch or spacing from order to order is the same as that of the type carriers. The drawings were made from a machine in which such spacing is five thirty-seconds inch, which is a spacing commonly used in several marketed accounting and statistical machines.

The invention also results in a simpler accumulator than those of the same type as heretofore manufactured, and one cheaper to manufacture.

To the above and other ends, the invention consists of certain combinations and arrangements of parts and certain features of construction, all of which will be fully described herein and particularly pointed out in the claims.

An instance of the invention is illustrated in the accompanying drawings, in which

Fig. 1 is a general longitudinal sectional view of an illustrative computing machine having the invention embodied therein;

Figs. 2 and 3 are respectively a right hand and a left hand side elevation of said machine;

Figs. 4 to 10, inclusive, show in detail an instance of an accumulator according to the invention, Fig. 4 being on half the scale of the other figures;

2

Fig. 4 is a partial front elevation;

Fig. 5 is a right hand end elevation of the accumulator, partly in section on the line 5—5 of Fig. 4;

Fig. 6 is a partial longitudinal section on the line 6—6 of Fig. 5;

Fig. 7 is a right hand face view of a resultant, or accumulator wheel;

Fig. 8 is a face view of a floating pinion journaled eccentrically on a sleeve;

Fig. 9 is an end view of said sleeve;

Fig. 10 is a left hand face view of a driving gear;

Fig. 11 is a cross sectional view of one demonination of a prior crawl carry accumulator with certain diagrammatic lines added; and

Fig. 12 is an exploded view of the parts shown in Fig. 11 with certain diagrammatic lines added.

The drawings illustrate an adding and subtracting machine having the invention embodied therein, and which is fully described in the parent application, now Patent 2,360,615, October 17, 1944. It will be briefly described herein.

The machine frame comprises right and left hand frame plates 15, 16 on which is mounted a keyboard 17. The accumulator wheels are mounted on a shaft 63 and are driven by actuator rack bars 66, which, through idlers 113, also actuate type bars 111, which slide on guides 112 and whose types are struck by hammers 114 having a restoring bar 116 and latches 115, as conventionally shown in Fig. 1. The keys 20 have restoring springs 22, have converging stems 23 which slide in a plate 21 and are adapted to depress stops 24 for the racks 66, which latter are drawn forward by springs 110. The stops 24 when depressed are held by latch bars 25 cooperating with pins 26 on the stops in such fashion that when a stop is in its lower position it holds the latch bar forward of its normal position. A zero stop 24A is pressed down by a spring into normal position where it prevents movement of the rack 66. Said stop has a pin cooperating with a cam edge on the latch bar 25 so that, when said bar is drawn forward by the depression of a stop 24, the zero stop 24A is cammed upward out of the way of the rack. The last key in each row is adapted to move the bar 25 forward to release any depressed key in that row. A general release key 27 when depressed, operates all of the said bars to release all depressed keys.

The accumulator

The accumulator works on the same general principle as prior crawl carry accumulators, such, for example, as that described in patent to Gardner, No. 1,828,180, patented October 20, 1931, which patent is a division of Patent No. 1,867,002,

Referring to Figs. 4–10, it comprises a shaft 63 on which are journaled a series of sleeves 81. The left hand end of each sleeve is shaped into an eccentric 75 and on its right hand end is rigidly secured a resultant wheel 73. A driving gear 76 is journaled on each sleeve 81 between the eccentric 75 and the resultant wheel 73. The resultant wheel 73 consists of a disc having an annulus of internal gear teeth 78. As shown, the teeth are internal projections from a ring or partial ring, of sheet metal riveted to the sheet metal disc. Said teeth mesh with driving notches 77 in a floating gear 74 journaled on the eccentric 75 of the next sleeve 81 to the right. Said floating gear is itself driven by studs 83 projecting leftward from the driving gear 76 into circular openings 84 in the floating gear. The studs 83 and openings 84 are so proportioned with reference to each other and to the eccentricity of the eccentric 75 that, as gears 76 and 74 rotate together each of said studs moves around in theoretical contact with the periphery of its associate opening 84, and the floating gear turns always through the same angular distance as the gear 76. In this construction in all positions of the wheels, at least one stud 83 will prevent relative rotation of wheels 76 and 74 in one direction and at least one stud 83 will prevent such rotation in the opposite direction. The gear 76 has nine teeth, the driving notches 77 in the gear 74 have the spacing of nine teeth and the internal gear 73 has ten teeth, so that each tooth-space of rotation of gear 76 rotates gear 73 one tooth-space, and a complete rotation of gear 76 rotates the resultant wheel 73 nine tenths of a turn, to add or subtract nine; and also, a complete rotation of a resultant wheel 73, together with its sleeve 81 and eccentric 75, will cause a rotation of the resultant wheel 73 of next higher order one tenth of a turn in the same direction, to add or subtract one, all as in prior accumulators of this general type. Also, as heretofore, when, by the registration of numbers in the accumulator, the several driving gears 76 have imparted partial rotations to their respective resultant wheels, the resultant wheels of higher order will have had imparted to them rotations equal to fractional tooth spaces, each resultant wheel having imparted to the next higher one a rotation equal to one tenth of its own displacement from zero.

The sleeve 81 at the right hand end of the series (Fig. 6) has secured on it, instead of a resultant wheel, a disc 85, from which a stud 86 projects into an opening in a certain frame piece 91 to hold said plate and sleeve against rotation. Also, the left hand resultant wheel 73 is secured to a sleeve or hub 87 journaled on the shaft 63. It will be convenient to describe the accumulator as being made in a succession of strata or thicknesses. For purposes of the present application a stratum or thickness may be defined as the thickness of one of the several parts which of necessity must be added together to make up the over all width of a denominational order. For sake of uniformity of nomenclature in the claims only stratum will be used. Thus, (Fig. 6) the first stratum at the left contains the disc and the second stratum the internal gear of the accumulator wheel of highest order; and so on. The prior manufactured accumulators of the described type have been constructed so that each denominational unit occupied five stratum which, in the present construction have been reduced to three; and these may, and in the illustrated instance do, consist of three thicknesses of sheet metal.

In certain prior accumulators, for example, that shown in the patent to Gardner, 1,828,180, the driving wheel 472 (Figs. 4 and 6 of the patent, and Figs. 11 and 12 herein) corresponding to the wheel 76, was made in three strata, viz., one occupied by a nine-toothed numeral or driving pinion 472, the next by a disc 471 of considerably larger diameter and the third by teeth or studs 471*a* projecting from said disc. The floating gear 470 was also in two strata, one occupied by gear teeth meshing with those of the driving wheel disc 471 and the other by a gear meshing with internal gear teeth 473*a* on the resultant wheel 473. This floating gear was also of a diameter considerably greater than that of the driving gear. Thus the over all width of a denominational order of a Gardner accumulator is of necessity the width (Fig. 11) of the driving pinion 472, plus the thickness of the disc 471, plus the length of the teeth 471*a*, plus the length of the teeth 473*a*, plus the thickness of the web 473, it being noted that the teeth 471*a* and 473*a* are disposed end to end. The manner in which applicant has modified this construction so as to reduce the lateral spacing of the accumulator is diagrammatically illustrated in Fig. 12. In the present construction, the disc 471 has been eliminated, thus eliminating one stratum or thickness, and Gardner's teeth 473*a* have been moved farther from the shaft, being replaced by the teeth 78, and Gardner's teeth 471*a*, which stood end to end of his teeth 473*a*, are replaced by the studs 83 which are situated circumferentially inside of the teeth 78, thus eliminating another thickness. Said floating gear is also made in only one plane, and is, in fact, nothing but a flat disc of sheet metal suitably cut out. Thus two of the former strata have been eliminated, and the remaining three reduced to ordinary sheet metal. The resultant wheel is in two strata as heretofore, and is of considerably larger diameter than the other wheels. Beginning at the left in Fig. 6, the first stratum is occupied by the disc of a resultant wheel. The internal gear of said wheel, the floating gear, the eccentric, and the studs 83, are all in the second stratum and overlap one another so that a plane through the stratum as defined in geometry (a surface such that it has continuous extension in two dimensions and no more, having length and breadth but not thickness and such that a straight line joining any two points in said surface lies wholly within it) would pass through said internal gear, the floating gear, the eccentric and the studs. The third is occupied by the driving gear 76, and the fourth by the resultant wheel disc of next lower order. The comparatively small driving gear is thus between the two much larger resultant wheels, so that the actuator rack 66 is guided by said resultant wheels, even when the accumulator is lifted out of mesh, as shown in Fig. 1. This helps to make it practicable to make said driving gear of sheet metal thin enough to bring the accumulator spacing down to the desired small size.

In order to effect the thinning down above described, certain changes have been made in the design of the wheels themselves. In the Gardner accumulator, the disc 471 secured to or constituting part of the numeral or driving gear, had nine crown teeth 471*a* of convex outline projecting leftward from its peripheral part, into interdental concaved notches between nine teeth in the right hand half of the floating gear 470. Said nine crown teeth have been replaced by the three

cylindrical studs 83, which, in order to get them far enough from the axis of the wheel, are made to project one from every third tooth of the gear. These studs play in the three openings 84 in the floating gear, as hereinbefore described. These openings are made as far as may be from the center of the gear. In the illustrated instance, and preferably, they intersect the periphery of the gear 74, and constitute driven notches, interspersed with the driving notches 77 by which the floating gear rotates the resultant wheel. The omission of this part of the circumference of the hole 84 is permissible because the stud 83, when in that part of the hole, is at or so near to dead center, as to be ineffective as a driving element. The omission of every third driving notch 77 is also permissible, because the radii of curvature of the gear 74 and internal gear 73, 78 differ so little that each tooth 78 remains in engagement with a notch 77 for considerably more than a tooth space of rotation. Functionally, the floating gear is really two integral gears, viz., one that is driven by the driving wheel and another that meshes with and drives the resultant wheel. In the present construction, in effect, this gear 74 has two sets of teeth interspersed in the same stratum, two notches 77 meshing with internal gear 73, followed by a larger and differently shaped notch 84 meshing with the teeth 83 of the driving gear; then two notches 77 and one notch 84, and so on, around the wheel.

The operating mechanism of the machine may be of any suitable character, as far as the present invention is concerned. That illustrated in the drawing will be briefly described. An operating cam shaft 30 is journaled in the side frames 15 and 16. It carries a hand crank 31, 32 by which it may be given a complete rotation, clockwise in Fig. 2 for addition and counter-clockwise for subtraction and total taking. Its normal or rest position is defined by a detent roller 34 (Fig. 1) on a bell-crank having a spring 35 which yieldingly holds said roller in a notch in the periphery of an otherwise circular disc 33, mounted on the shaft 30. Said bell-crank is one of several follower levers pivoted on a cross rod 36.

The actuating racks 66 are restored to their normal rear position by a bail comprising a bar 42, and two arms 41 fast on a rock shaft. One of said arms is operated by a link 40, pivoted to a lever 39 having a follower roller 38 bearing on a cam disc 37 on shaft 30. Said cam has concentric high and low dwells connected by two inclines as shown.

In order to provide for moving the accumulator into and out of mesh with its actuators, its shaft 63 passes through vertical guide slots 64 and 65 in the side frames 16 and 15 (Figs. 2 and 3) and on through cam slots 61 and 62 in two upright arms 57 and 60 fast, respectively, on the right and the left hand ends of a transverse rock shaft 58, which is journaled in the side frame, so that the two arms rock in unison. Each of the cam slots 61 and 62 has a high dwell at its forward end connected forward of the mid-length of the slot, by an incline with a low dwell which constitutes the rear half of the slot. Rocking the arms 57 and 60 about half of their full excursion, suffices to depress the accumulator into mesh. The rocking member 57, 58, 60, is operated by a cam disc 53 (Fig. 2) acting on a follower roller 54 on a lever 55 which is connected with the arm 57 by a link 56.

Certain control mechanism for the accumulator (Fig. 1) is mounted in an auxiliary frame

comprising side plates 90 and 91 connected together by cross rods. This frame is situated above the accumulator and just inside the side frames 15 and 16. It is guided for up and down movement by the ends of two of its cross rods 92 and 70 which are embraced by vertical slots in the plates 15 and 16, the lower of said slots being marked 71 and 72. Within the auxiliary frame there are pivoted on said rod 70, detents 93, normally pressed by a bar 104 into positive locking engagement with the several driving gears 76. These detents are also parts of the zeroizing mechanism which will be described presently. The up and down movements of the auxiliary frame and mechanism are imparted thereto by the ends of the rod 70 extending, as shown in Figs. 2 and 3, into cam slots 67 and 68 in the rocking arms 57 and 60. The forward half of each of said slots corresponds with that of the slots 61 and 62 so that, in the first half of the forward rocking of the arms, the accumulator and the auxiliary mechanism descend together, the detents 93 remaining in engagement with the wheels. The rear halves of the slots 67 and 68, however, have each a rise, so that the detents are immediately drawn upward, leaving the accumulator gears in mesh with the racks and free to be rotated by them. When the arms 57 and 60 swing back to normal, the detents first move down into engagement, and they and the wheels then rise together to their normal positions.

The total taking control mechanism comprises parts mounted in the auxiliary frame 90, 91. Each detent above the lowest has a branch 93B terminating in a lug 97, adapted to be held up by the circular periphery of the resultant wheel 73 of next lower order, which, however, has a notch 69 into which the lug descends as the wheel comes to zero, where said lug arrests it. As it so descends, a pin 95 on its cams loose a latch 98, pivoted at 100 and having a spring 103. The hook end 101 of said latch then releases its hold on a lug 106 of the next higher order, permitting that wheel to begin its return rotation. The detents 93 are drawn to releasing position by springs 94. In order to initiate this operation, the bar 104 is first moved rearward in its slots 106. This bar is controlled by links 109, links 107 and arms 50, fast on a rock shaft 123. The left hand arm 50 is extended downward and carries a follower roller 48 riding on a cam 47 on shaft 30, the high part of which cam normally holds the bar 104 in its forward position. At the proper time, the follower descends onto the low part of the cam and permits the movements above outlined. Said movements are prevented on adding and subtracting cycles by a total key 117, a shoulder of which normally engages a stud 120 projecting from a lever 50 through a hole in the frame plate 15. When it is desired to take a total, this key is rocked clockwise in Fig. 3, releasing the levers 50 and bar 104. Said key also has a shoulder 122 which, when the key is operated, stands in the path of a stud 118 on the cam arm 60, and limits the rocking of said arm and the arm 57 to a half stroke. In this way, the accumulator and the rod 70 are moved downward into engagement, but the rod 70 is not thereafter elevated but remains in its low position with the detents 93 in engagement with the wheels. Said detents are then held in engagement by the latches 98 and are released one at a time as above described. When in a total taking operation, the levers 50 are rocked, a bail

bar 131, mounted on arms of said levers, cams all of the locking bars 25 frontward to release any depressed stops 24.

The cams on the shaft 30, except those that act on total taking, are all of similar design in this respect, namely, that each has a low part and a high part connected by two inclines, so that, when the shaft is turned for addition, the follower descends one of said inclines and rides up on the other, and, when it is turned in the opposite direction for subtraction or total taking, the follower descends the latter incline and ascends the former. Thus, the cam operated parts executed the same movements in both instances but at different times. The principal difference is that in addition the racks are first set against the stops 24, the accumulator then descends into mesh, and the racks are then restored, whereas in subtraction the wheels are first brought into mesh, the racks then advance to their stops 24, and the accumulator is moved out of mesh before the racks are restored.

Various change may be made in the details of construction and arrangement without departing from the invention.

What I claim as new, and desire to secure by Letters Patent, is:

1. In an accumulator comprising a succession of denominational orders, the combination in each order of a resultant wheel fast on a sleeve provided with concentric and eccentric portions and comprising a flat disc in one stratum and an annulus of internal gear teeth in a middle stratum; an eccentrically journaled floating gear in said middle stratum and having notches meshing with said internal gear teeth and three other notches; a driving spur gear in a third stratum and having three driving studs projecting from teeth of said spur gear into said other notches in said floating gear; said driving gear being journaled concentrically and said floating gear eccentrically on the sleeve of the resultant wheel of next lower order.

2. In mechanism of the class described disposed in a succession of denominational orders, the combination in each order of a nine-toothed driving spur gear in the right hand one of three contiguous strata and having three studs projecting from teeth thereof into the middle stratum, a resultant wheel consisting of a disc in the left hand strata and an annulus of internal gear teeth in the middle stratum, and an eccentrically journalled floating gear in said middle stratum and having peripheral notches meshing with said internal gear teeth and interspersed with three notches of circular outline into which said studs project; and a sleeve provided with concentric and eccentric portions fast with the resultant gear of lower order and on which the driving gear and floating gear of next higher order are journaled.

3. In each order of an accumulator of the class described, the combination of a driving gear having pins projecting therefrom, a resultant wheel comprising a web and an annulus of internal gear teeth, said internal gear teeth laterally overlapping said pins, and a floating gear situated between said web and said driving gear and meshing with said internal teeth and having openings to receive said pins.

4. In a crawl carry accumulator having in each order a resultant wheel having an annulus of internal gear teeth, a floating gear within the width of and meshing with said annulus and having

openings, and a drive pinion having studs projecting into said openings, said annulus, said floating gear and its said openings and said studs all lying in one stratum which may be defined as having a width substantially equal to any one of the three mentioned elements.

5. A denominational gear train of a creep carry accumulator occupying three strata, the driving gear occupying the whole right hand stratum, the web of the resultant gear occupying the whole left hand stratum, and the middle stratum being occupied by an internally toothed flange of the resultant wheel, a disc-like floating gear contained within said internal teeth and meshing therewith, an eccentric bearing for said floating gear, and studs projecting into openings in said floating gear from said driving gear, said studs being positioned nearer to the centers of said gears than said internal teeth, and said middle stratum being such that it may be defined as having a width substantially equal to any one of the three mentioned elements.

6. In a machine of the class described, a gear train including two groups of gears arranged along a shaft, each said group comprising a driving gear, a floating gear actuated by said driving gear and a resultant wheel actuated by said floating gear and having a hub with an eccentric thereon, said gears being arranged along said shaft in a succession of contiguous strata, three strata per group, the driving gear occupying the whole right hand stratum of said three and having teeth projecting into the middle stratum, the resultant wheel having its web occupying the whole left hand stratum and having an annulus of internal gear teeth occupying the whole width of said middle stratum, and the floating gear consisting of a disc having in its periphery notches 77 engaged by said internal teeth and interspersed with said notches 77 other notches 84 engaged by said teeth on the driving gear, and the driving gear of the left hand group being journalled on the hub of the resultant wheel of the right hand group, and the floating gear of the left hand group being journalled on the eccentric of said hub.

7. In each order of an accumulator of the class described, the combination of a driving gear having pins projecting therefrom, a resultant wheel fast on a sleeve and comprising a web and an annulus of internal gear teeth laterally overlapping said pins, and an eccentrically journaled floating gear situated between said web and said driving gear and meshing with said internal teeth and having openings to receive said pins, said driving gear being journaled concentrically and said floating gear eccentrically on the sleeve of the resultant wheel of lower order.

HAROLD P. MIXER.

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