June 26, 1951 — H. SUTER — 2,558,631

DECIMAL-TRANSFER MECHANISM IN CALCULATING MACHINES

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FIG. 1

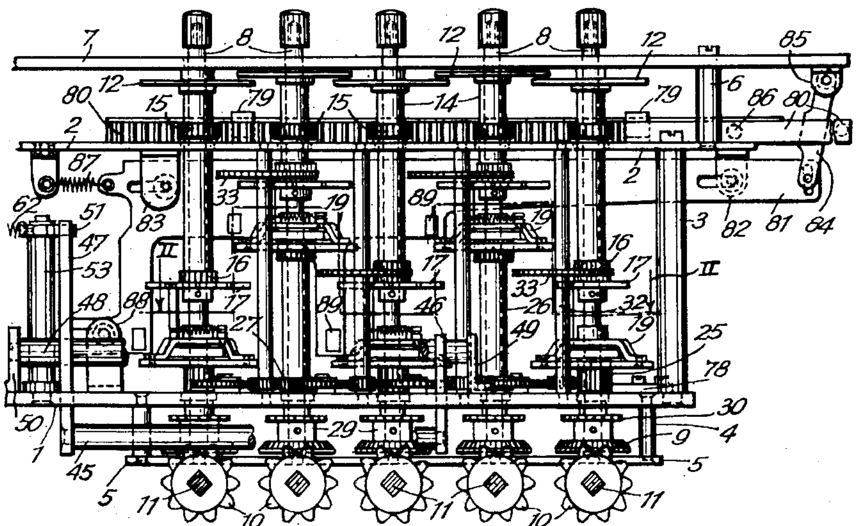


FIG. 2

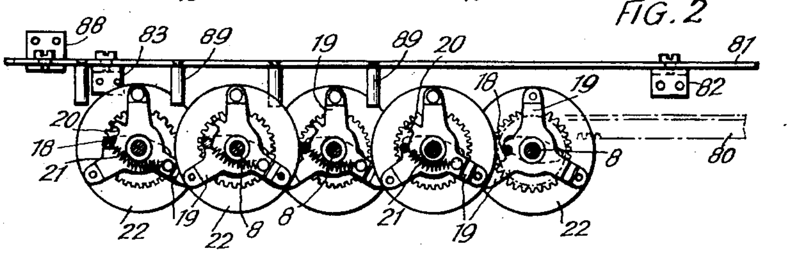
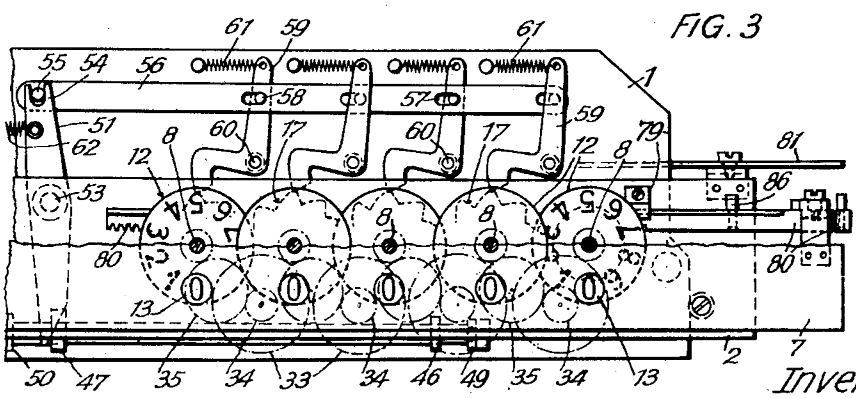


FIG. 3



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DECIMAL-TRANSFER MECHANISM IN CALCULATING MACHINES

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FIG. 11

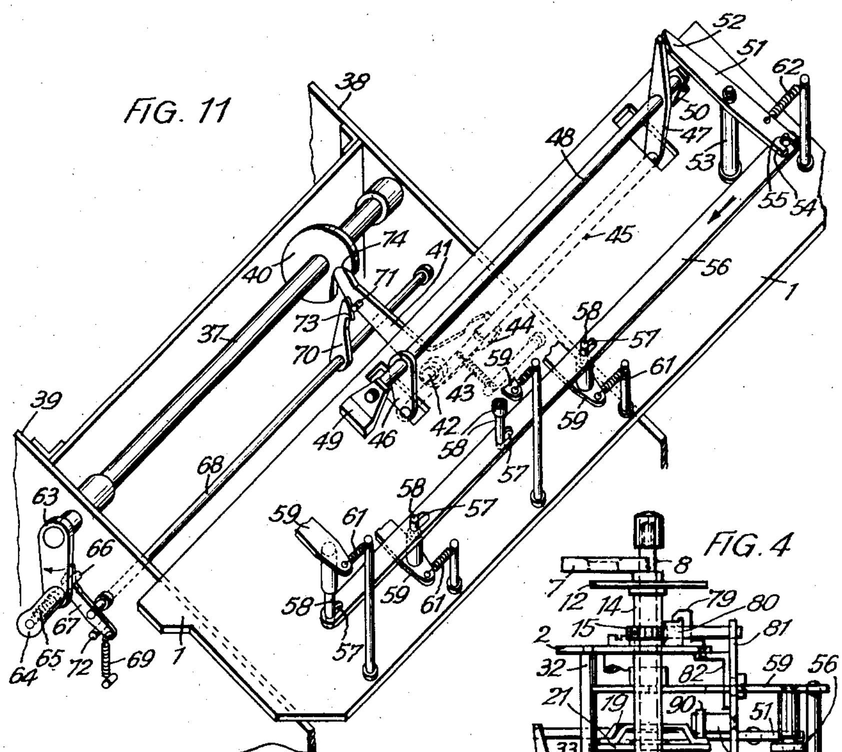


FIG. 4

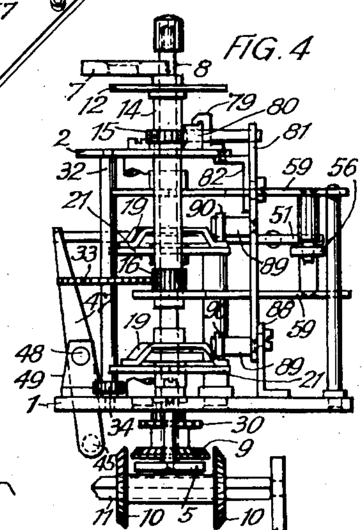


FIG. 6

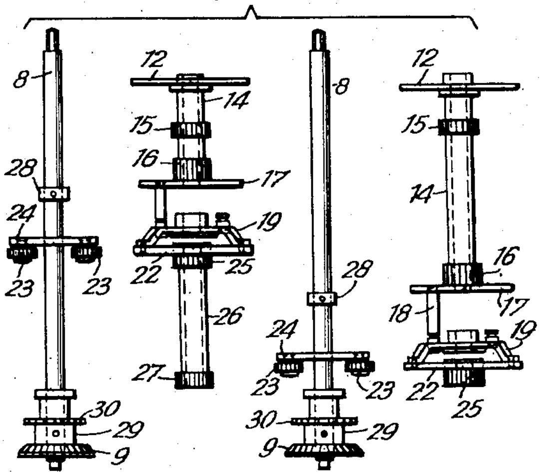
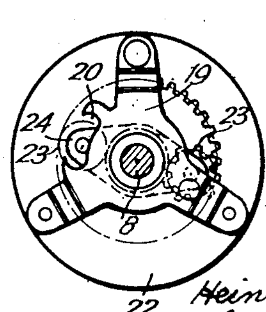


FIG. 5



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DECIMAL-TRANSFER MECHANISM IN CALCULATING MACHINES

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FIG. 7

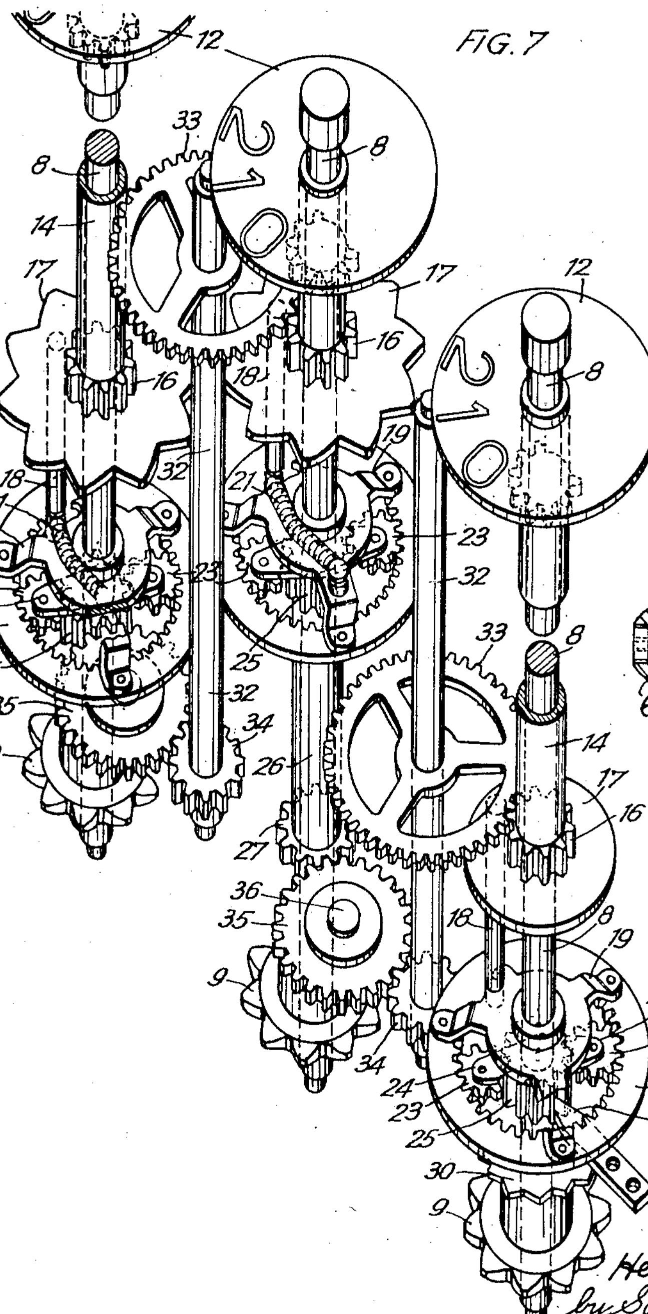
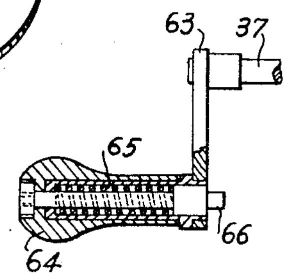


FIG. 12



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DECIMAL-TRANSFER MECHANISM IN CALCULATING MACHINES

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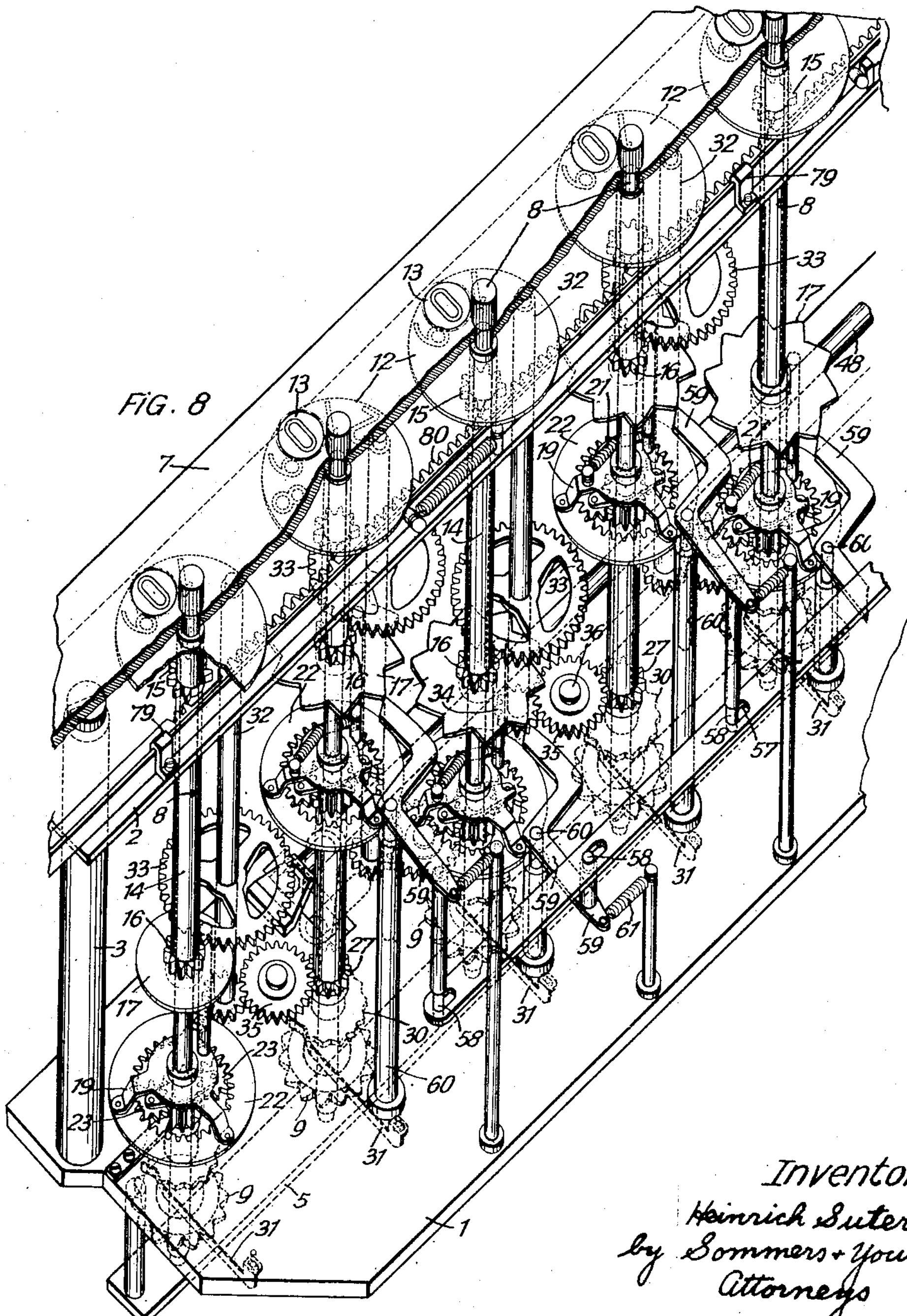
FIG. 8



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DECIMAL-TRANSFER MECHANISM IN CALCULATING MACHINES

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FIG. 11a

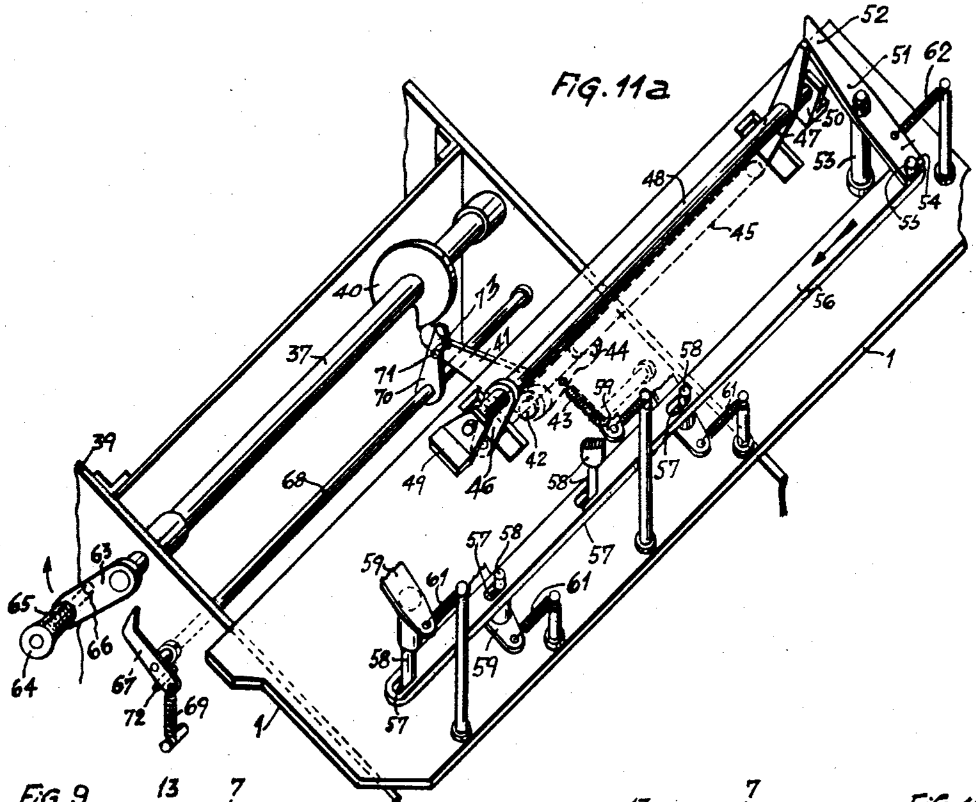


FIG. 9

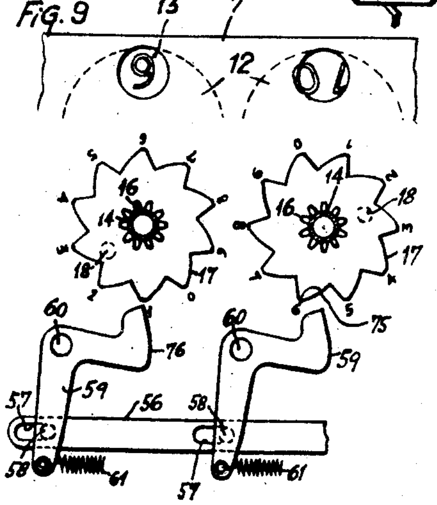
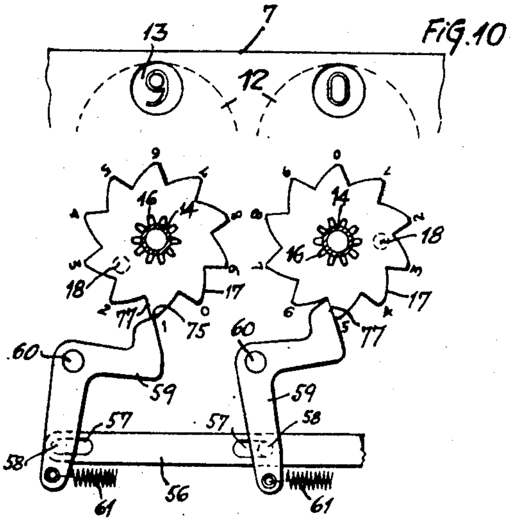


FIG. 10



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Patented June 26, 1951

2,558,631

UNITED STATES PATENT OFFICE

2,558,631

DECIMAL-TRANSFER MECHANISM IN CALCULATING MACHINES

Heinrich Suter, Zurich, Switzerland, assignor to H. W. Egli A. G., Zurich, Switzerland

Application July 15, 1947, Serial No. 761,002
In Switzerland January 17, 1945

Section 1, Public Law 690, August 8, 1946
Patent expires January 17, 1965

2 Claims. (Cl. 235—136)

My present invention relates to improvements in decimal-transfer mechanism in calculating machines, and the main object of my improvements is to afford a positively operating mechanism for high-speed operation.

In calculating machines of prior art, comprising stepped drums or racks, spaced parallel totalizer axles are provided in the accumulator carriage for the ordinal columns, and decimal transfer is taking place, by itself, after the numerical value has been set. In such prior machines, the operating speed is limited in view of the danger of overthrowing the mechanism in decimal transfer.

A calculating machine is known in the art, in which, for the purpose of making high-speed operation possible, planet gears are provided for decimal transfer, the dials being mounted on a continuous shaft, such construction, however, is not suited for machines of the type indicated above.

In accord with my present invention, spaced parallel totalizer axles associated with the ordinal columns, are mounted in the accumulator carriage, which axles are interconnected by gearing so that—when turning one of the said axles by one unit—the axle of the next higher denominational column is coercively turned for the requisite fraction of such unit, in order that—after a full revolution of the said first axle—the said second axle has been turned by a unit of its own from the first axle. Such inventive arrangement permits of opertaing the calculating machine at a high operative speed.

When, e. g. in the decimal system, the totalizer axle of the unit column has performed a full revolution, the axle of the tens column has been turned through an angle corresponding to a unit thereof, the axle of the hundreds columns through an angle corresponding to the tenth part of a unit thereof, and so on. When dials are associated with the totalizer axles, a correction device must be provided for turning or restoring the dials, which latter are given—due to the said axle-interconnecting gearing—an additional fractional rotation corresponding to the operating step, into the correct indicating position after finishing the calculation.

One form of invention is shown, by way of example, in the drawings which substantially are limited to the parts and portions requisite for explaining my invention, and in which

Fig. 1 shows an elevation,

Fig. 2 a partial horizontal section of Fig. 1,

Fig. 3 a top plan view of Fig. 1 and a section

through the totalizer axles, a top frame-plate having been broken off,

Fig. 4 a partial side view of Fig. 1,

Fig. 5 in larger scale, a portion of Fig. 2,

Fig. 6 an elevation of two adjacent totalizer axles and the accessories stripped therefrom,

Fig. 7 a perspective view of several totalizer axles with their accessories,

Fig. 8 a perspective view of the frame with the totalizer axles and further parts,

Fig. 9 a plan view of portions of the correction device,

Fig. 10 the same portions, but in a position different from Fig. 9, and

Fig. 11 a perspective view for explaining the correction device.

Fig. 11*a*, in contrast to Fig. 11 shows parts in position of operation after beginning of operation.

Fig. 12 is a view partly in section of an operating handle.

The accumulator carriage (only partly shown) of a calculating machine equipped with stepped drums is provided with a rigid frame comprising two longitudinal horizontal main plates **1** and **2** which are fastly interconnected by stay bolts **3**, a bottom plate **5** being mounted to the lower main plate **1** by stay bolts **4**, and a head plate **7** to the top main plate **2** by stay bolts **6**. Five parallel totalizer axles **8** are journaled in bottom plate **5** and head plate **7**, and are provided at their foot ends with a bevel gear **9** pinned thereto. Gear **9** cooperates with a pair of gears **10** (Fig. 4) which are pinned to a common hub. Thus a reversing spool gear of known type is afforded, operable by means disclosed in U. S. Patent to Suter et al. No. 2,089,770, August 10, 1937, including a control bar (not shown) to slide on the square shaft **11** so as to bring one or the other gear **10** to mesh with gear **9** of axle **8**, according to whether the latter is to be turned in the additive or subtractive sense. The square shafts **11** are rotated see U. S. Patent No. 2,089,770 by stepped drums (not shown). A dial **12** is mounted on each axle **8** and possesses circular disposed digits 0–9 which may be viewed through a window **13** provided in head plate **7**. Dial **12** is pinned to the top end of a sleeve **14** (Figs. 4, 6) mounted on the respective axle **8**. Two gears **15** and **16** are pinned to the ends of sleeve **14**, and a disc **17** to the bottom end thereof. Disc **17** is coupled to a spider **19** by means of a pin **18**, spider **19** having a recess **20** (Fig. 5) for engaging pin **18**. Recess **20** of spider **19** on axle **8**, being associated with the first or unit denominational column, corresponds, according to Fig. 2, to the diameter of coupling pin 18. The disc 17 appurtenant to the units denomination column has a circular periphery, whereas the other discs 17 have a notched periphery. Recess 20 of the spiders 19 associated with the remaining totalizer axles 8, is so dimensioned as to permit of a predetermined relative rotation between disc 17 and spider 19; the notched discs 17 represent corrections discs. A tension spring 21 biases coupling pin 18 into abutment against one end of elongated recess 20 in spiders 19. An internal gear 22 is pinned to each spider 19 and meshes with two planet wheels 23 which are pivoted, diametrically opposite each other, to a common mount 24 which is fastly secured to the respective totalizer axle 8. The two planet wheels 23, on the other hand, mesh with a sun wheel formed by a pinion 25 mounted on axle 8. The sleeves 14 of adjacent axles 8 are of different length so that two groups of sleeves 14 are formed, and therefore the correction discs 17 are distributed in two planes in the said frame, as are the internal gears 22 of the planet gears, in order to permit of placing the axles 8 as close as possible to each other. To such end, the adjacent dials 12 also are superposed in two planes. The pinions 25 of the first, third and fifth ordinal columns thus are situated in the said frame on a lower level than the pinions 25 of the second and forth ordinal columns. The pinions 25 of the second group are provided with a downwardly pointing hub 26 (Fig. 6) which at its foot end has a gear 27 pinned thereto. Gears 27 are situated at one and the same elevation with the pinions 25 of the first group. A set collar 28 mounted on each axle 8, permits of raising or lowering sleeve 14. Bevel gear 9 pinned to the foot end of axle 8 is provided with a ratchet wheel 30 secured to its hub 29. Wheel 30 is positively engaged by a leaf spring 31 (Fig. 8) secured to the underside of main plate 1, so as to hold axle 8 and, therefore, the corresponding dial 12 (by way of planet gear 25, 23, 22) in the correct indicating position.

An auxiliary axle 32 (Fig. 7) is associated with two adjacent totalizer axles 8 each, parallel thereto, and a gear 33 pinned thereon meshes with gear 16 of sleeve 14 of an adjacent axle 8. A pinion 34 is pinned to the foot end of auxiliary axle 32 (see also Fig. 4), which latter is journaled in the main plates 1 and 2, and meshes with a gear 35 which is pivoted on a stud 36 secured to main plate 1 and is operatively connected with the pinion 25 of the axle 8 belonging to the next higher ordinal column, be that by direct engagement with pinion 25 situated on the same level, or by way of gear 27 when the corresponding pinion 25 is situated on a higher level than the associated gear 33. Sleeves 14 of axles 8, and thus the dials 12, are rotatably interconnected; such a driving ratio being provided that, when dial 12 of one ordinal column is rotated by one division or unit respectively, dial 12 of the next higher column is turned by one tenth of its own division (unit), even when a number (given by the calculation) is set at the same time into such column by means of dial 12. Let us assume, number 385 has been transferred into the accumulator, dial 12 of the unit column then is in a position in which the digit 5 appears in full, i. e. in the correct indicating position, in the respective window 13 of head plate 7. Dial 12 of the tens column has been rotated, additionally to its rotation from 0–8, by one half of a division, since dial 12 of the unit column has been rotated by five units. The central portion of the dial 12 associated with the tens column, therefore, becomes visible between the digits 8 and 9 in the corresponding window 13 of head plate 7. Dial 12 in the hundreds column has been turned from 0 to 3 and additionally from the unit column, by $\frac{5}{100}$ of a division, and, from the tens column by $\frac{8}{10}$ of a division so that such dial 12 does not indicate (in the respective window 13 of head plate 7) the digit 3 as required by the number (385) essential for the calculation. In order to obtain the correct numerical indication, the dials 12 of the tens- and hundreds-columns have to be turned back by the amount of the additional rotation mentioned. To such end, the said correction discs 17 are used, as well as their associated parts and portions which will be described below.

Fig. 9 shows the correcting arrangements of two adjacent calculating stations. In this case, in the first calculating station (at the left) the indicating disk 12 is shown set to "6"; lever 59 and operating rod 56 are still in operating position. The automatically set indicating disk 12 in the second calculating station (at the right) is, due to partial movement, in an intermediate position (between two units). Since the indicating disk was set to "6" in the first calculating station, the correcting disk 17 of the second calculating station, the correcting disk 17 of the second calculating station has been positively moved to the extent of $\frac{6}{10}$ of one tooth division or figure division so that the two figures 0 and 1 of the indicating disk 12 will be partially visible in the sight windows.

Fig. 9, taken in conjunction with Fig. 10 shows the cooperation of the correcting lever 59 with the disk 17 and Fig. 10 shows the cooperation of these parts after the shaft 37 stops rotating.

According to Fig. 10 the operating rod 56 in response to the pull of spring 62 has assumed a position in which the correcting levers 59 are able to swing out so that they can be forced against the correcting disks 17 by their springs 61. Since the correcting disk 17 of the first calculating station, (along with the indicating disk 12) was turned to the extent of one tooth or one full tooth division, and hence is not to be corrected, the correcting lever 59 comes to rest with its tip on the flattened-off tip 75 of a tooth of the correcting disk 17. Since, in the second calculating station, the correcting disk is turned to the extent of $\frac{6}{10}$ of the tooth or figure division, the correcting lever 59 springs into the corresponding tooth gap of the correcting disk 17 which is set back as a result thereof and due to cooperation of the flank of the correcting lever 59 with the flank 77 of the corresponding tooth.

In the case of the correcting arrangement provided by the present invention, the correcting lever 59 therefore cooperates directly with the correcting disk 17 which is rigidly attached to the indicating disk 12. This permits of an exact and rapid operation because practically no lost motion is present and therefore no movement losses can occur.

The numeral 37 in Fig. 11 designates the main shaft of the calculating machine, which is journaled in two rigidly interconnected side shields 38 and 39 which pass, with a stepped portion, underneath main plate 1, and shields 38 and 39 are at right angles to the latter. A cam disc 40 is pinned to main shaft 37 and cooperates with a bell crank 41 which is pivoted on a pin 42 fastly secured to shield 38. Bell crank 41 is biased by a tension spring 43 which engages the second arm thereof. The latter receives a rod 45 in a fork 44 below main plate 1. Rod 45 is supported at its end in two levers 46 and 47 passing through openings in the bottom main plate 1. Levers 46 and 47 are fulcrumed on a bar 48 and thus and oscillating structure is formed. The latter is journaled in the bearing blocks 49 and 50 which are secured to main plate 1 and which receive the bar 48. The said structure cooperates, by means of a second arm of lever 47, with a two-arm auxiliary lever 51 which to such end is provided with a skew face 52 at one end. Auxiliary lever 51 is pivoted on a stud 53 secured to main plate 1, and is adapted, at its second arm, as fork 54 which receives a pin 55 of a flat control bar 56. The latter has longitudinal slots 57 wherein the pins 58 of the correction levers 59 are engaged. A correction lever 59 (Figs. 11, 8, 3) is associated with each ordinal column, with the exception of the unit column, and is of angular shape and cooperates with the correction disc 17 provided on the respective totalizer axle 8. Each of the four correction levers 59 shown, two of which are disposed below and two above control bar 56, is pivoted on a vertical pin 60 secured to main plate 1, and is biased by a spring 61 into abutment against the periphery of the respective correction disc 17. A spring 62 biases auxiliary lever 51 (Fig. 11).

A crank handle 63, 64 is pinned to one end of shaft 37 on which cam disc 40 is mounted. Handle 64, together with a pin 66 mounted coaxial therewith, is adapted axially displaceable, in a limited sense and against the action of a tension spring 65. Pin 66 co-acts with a two-arm trigger 67 which is pinned to a shaft 68 journaled in the shields 38, 39, and which is biased by a spring 69. Trigger 67 normally thus is held engaged, as shown in Fig. 11, by pin 66. A dog 70 is keyed to shaft 68, and co-acts with a pin 71 fixed to bell crank 41.

Fig. 11*a* shows the correcting lever 59 with the bolt 58 in the position which they assume with respect to the slot 57 of the operating rod 56 after the crank 63 starts to rotate; in Fig. 11 these parts are shown as a rest.

The correction gear described operates as follows:

According to the example assumed above, the number 385 has been transferred into the accumulator; the dials 12 of all ordinal columns, with the exception of the unit column, being not in their proper indicating position, as explained above, due to the additional rotation impressed thereon. The correction takes place by turning main shaft 37, for which purpose handle 64, against the action of spring 65, is axially displaced until pin 66 is disengaged from trigger 67. The crank handle 63 then is turned in direction of the arow shown in Fig. 11. Trigger 67, released from pin 66, is rocked by spring 69; such rocking being limited by a stop pin 72 fixed to shield 39. Dog 70, during such rocking of trigger 67, is swung into abutment against the stop pin 71, fixed to bell crank 41. During the said rotation of main shaft 37, bell crank 41 is so rocked by cam disc 40, as to engage pin 71—after temporarily pushing back dog 70—by hook 73, upon which bell crank 41 is held fast in the corresponding position; in which bell crank 41 is disengaged from recess 74 provided on disc 40. During such rocking the structure 45—48 is rocked by bell crank 41, so that lever 47 turns auxiliary lever 51 over its skew face 52, against the action of spring 62. Control bar 56 thus is displaced, in direction of the arrow shown in Fig. 11, so far as to disengage the correction levers 59 coupled thereto from the notches of correction discs 17, and to release the latter for rotation. At the end of a revolution of main shaft 37, bell crank 41 again may be brought to cooperate with cam disc 40 or into engagement with recess 74 thereof respectively. Bell crank 41, however, remains locked in its said position by dog 70, at the end of one rotation, when an addition or subtraction is involved, or at the end of a plurality of rotations at a given calculating station, when multiplications are involved until handle 64, Figure 12, is drawn rearward by spring 65, thus bringing pin 66 into the track of detent 67. Pin 66 then abuts against detent 67 and swings same backward, against the action of spring 69, whereupon dog 70 trips bell crank 41, due to a corresponding rocking of shaft 68. Bell crank 41 then again is engaged in recess 74 of cam disc 40 (being biased by spring 43), while, on the other hand, bell crank 41, swings back the oscillating structure 45—48. Spring 62 biasing auxiliary lever 51, causes control rod 56 to be withdrawn, and thus the state of conditions shown in Fig. 11, is re-established. Such restoration only will be brought about when the numerical value set into the calculating machine has been transferred into the accumulator, as otherwise bell crank 41, at each revolution of main shaft 37, would drop into recess 74 of cam disc 40 in the course of the calculating operation, either when multiplying or dividing. When the handle 64 and hence the pin 66, at the end of one or more rotations at a given calculating station, moves the shaft 68 and hence lever 70 through agency of lever 67 so far that the abutment 73 of the lever 70 releases the lever 41, the latter, under the influence of spring 43, drops into the recess 74 of the control disc 40.

When transferring the numerical value in question into the accumulator, dials 12 are set in the manner hereinbefore described, bell crank 41 of the correction gear being disengaged from cam disc 40. During the last revolution of main shaft 37, the correction gear again is brought into the state according to Fig. 11, the correction levers 59, biased by the springs 61, being rocked with their cranked end against the correction disc 17, due to the restoration of control bar 56. Dial 12 of the unit column is in its numerically correct indicating position, and (as shown in Fig. 10) a tip 75 of the toothed correction disc 17 is in the track of correction lever 59 which, therefore, is engaged by the said tip during the said rocking. The correction discs 17 of the remaining dials 12, which have been rotated for the purpose of transferring the tens—which rotation, in the numerical example given, constitutes an additional rotation for the dials 12 of the tens column, the hundreds column and the other higher columns—occupy a position wherein the appurtenant correction levers 59 cooperate (in the sense of Fig. 9) by their arcuate face 76 with the correspondingly adapted guide face 77 of a tooth of the associated correction discs 17. These levers 59 thereby are rocked by their springs 61 until they abut with their tip against the bottom of the respective interdental gap, while correspondingly turning the correction discs 17 rearwardly. The dials 12 associated with all the denominational columns, with the exception of the unit column, and which have been turned for decimal transfer purposes, now again are in their numerically correct indicating position or, respectively, in their zero position, provided that they have not been turned during the calculating operation by one unit at least. The totalizer axles 8 must remain unbiased by the said turning back of dials 12 or correction discs 17 respectively, in order to maintain the registered numerical value unchanged for an eventual extension of the calculating operation. To such end, the leaf springs 31 acting on the ratched wheels 30 are subjected to a higher stress than the springs 21 biasing the coupling pins 18 of the corrections discs 17. The coupling pins, by the springs 21, normally are held in abutment (in the sense of Fig. 2) against one end of recess 20 provided in spider 19. The said recesses 20 afford the lost motion required for the said turning back of dials 12. Since during the calculating operation, dial 12 of the units column does not have to undergo an additional rotation, pinion 25 associated with the plane gear of this first column, is locked (Figs. 7, 1) against rotation by a detent 78 (Fig. 7) secured to main plate 1.

The upper gear 15 provided on sleeve 14 of each axle 8, cooperates with a rack 80 longitudinally displaceable on the top main plate 2 in guide lugs 79. The rack 80 serves for clearing or zeroizing the values which have been transferred into the accumulator. The rack 80 thus forms a component of the clearing mechanism, of which a slide 81 yet is shown in Figs. 1 and 2. Slide 81 is guided displaceable on two brackets 82 and 83 fastly secured to main plate 2. Restoring slide 81, according to Fig. 1, is coupled at the right hand end to a detent arm 84 which is pivoted to a bracket 85 secured to head plate 7, and which serves for cooperating with a dog 86 secured to clearing rack 80. A spring 87 engages the left-hand end (as seen in Fig. 1) of restoring slide 81; and the latter on the bottom is guided displaceably at the said end on a bracket 88 fastly secured to the lower main plate 1. Two square followers 89 each are secured to slide 81, in a lower and an upper plane, each to cooperate with a stay pin 90 (Fig. 4) secured to the internal gear 22 of the planet gear disposed in the corresponding plane.

Instead of operating main shaft 37 by hand, a motor drive also may be provided therefor. The correction mechanism described may be dispensed with, when no visible indication of the numerical values transferred into the accumulator carriage is desired, i. e. when such values are recorded in the machine. The inventive mechanism, of course, also may be applied to calculating machines which do not operate according to the decimal system. In such case, the driving

or transmission ratio for the planet gears 22—25 associated with the totalizer shafts 8, has to be selected such that, upon rotating a shaft 8 through one unit, the shaft of the next higher denominational order is rotated through the requisite fraction of such unit, in order that—after a full revolution of the said first shaft—the said second shaft has been rotated through a unit of its own denominational column.

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

1. In a calculating machine, of the Thomas type, a figure mechanism carriage with a result mechanism having results shafts disposed parallel to each other, on each of which an indicating disk together with a correcting disk attached thereto is journaled, each of said correcting discs being provided with ten actuating teeth, the result shafts and the indicating disks being mechanically connected, each through a planetary gear, so that, when an indicating disk is turned to the extent of one unit value, the indicating disk of the next higher value position will be positively turned a partial unit, for the purpose of carrying over the tens, and so that a correcting lever, which is assigned to said correcting disk, and is coupled with a common control rod, is caused to cooperate with the said actuating teeth for turning back the indicating disk as required at any time for correctly indicating the values.

2. Calculating machine as per claim 1, and in which the correcting disk is coupled with a toothed periphery of the respective planetary gear, so as to provide a certain amount of play between the planetary gear, and the correcting disk so as to make it possible to turn back the latter.

HEINRICH SUTER.

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