

May 16, 1933.

A. KOTTMANN

1,908,986

AUTOMATIC ROUNDING OFF MECHANISM FOR CALCULATING MACHINES

Filed Oct. 9, 1930

6 Sheets-Sheet 1

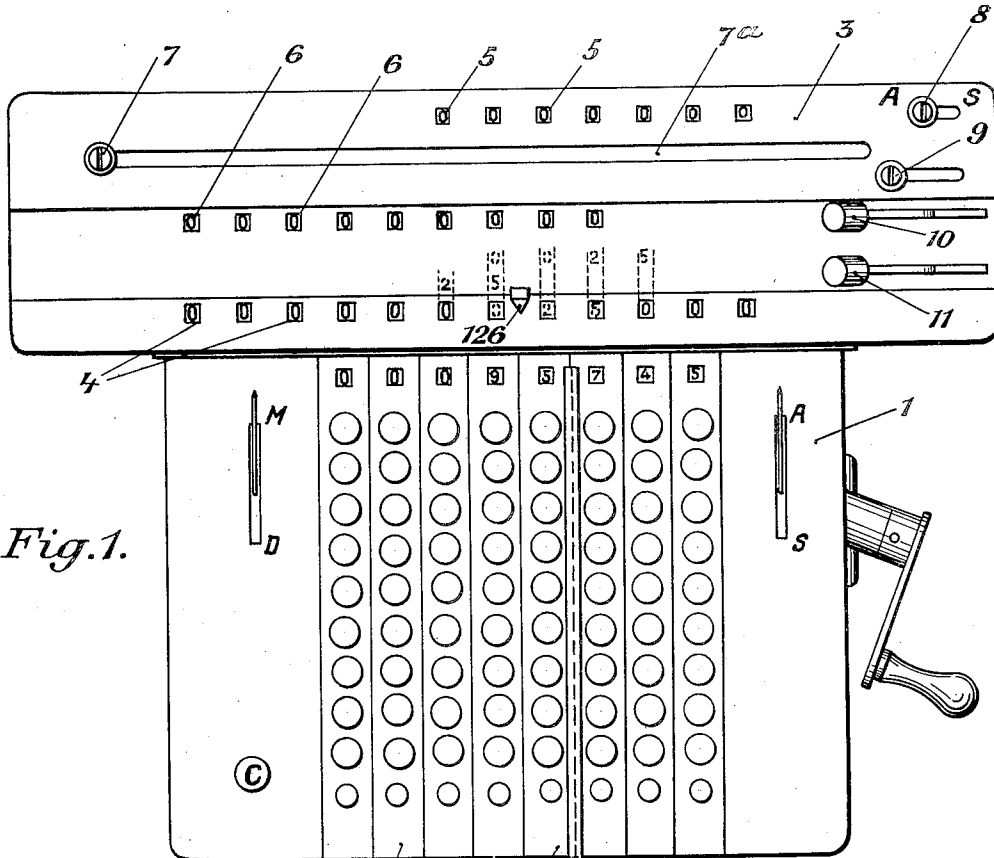


Fig. 1.

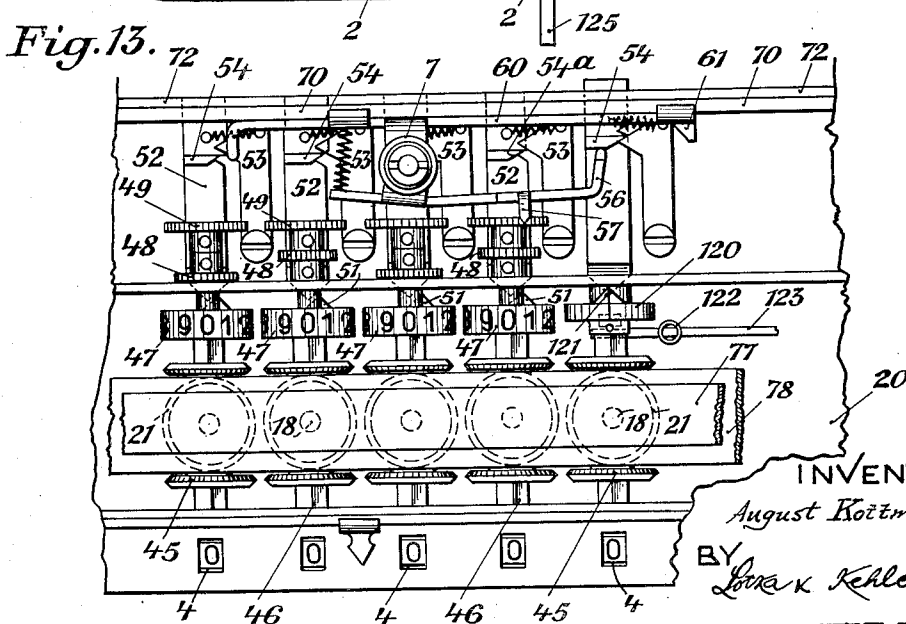


Fig. 13.

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6 Sheets-Sheet 2

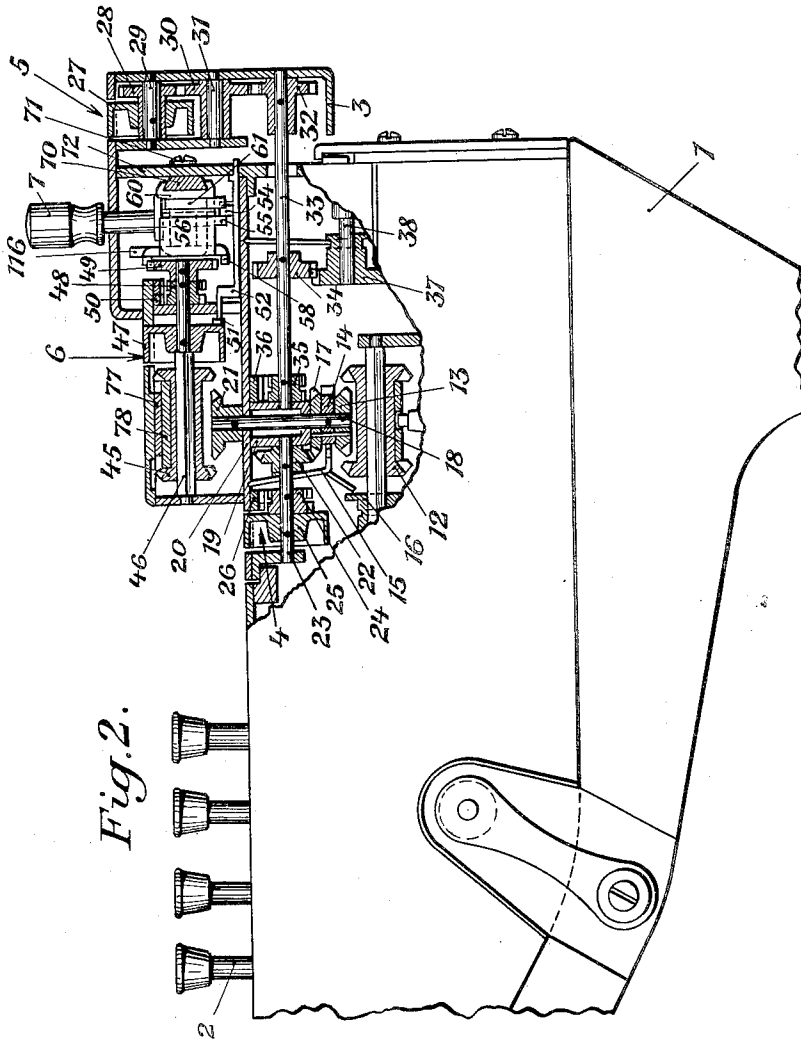


Fig. 2.

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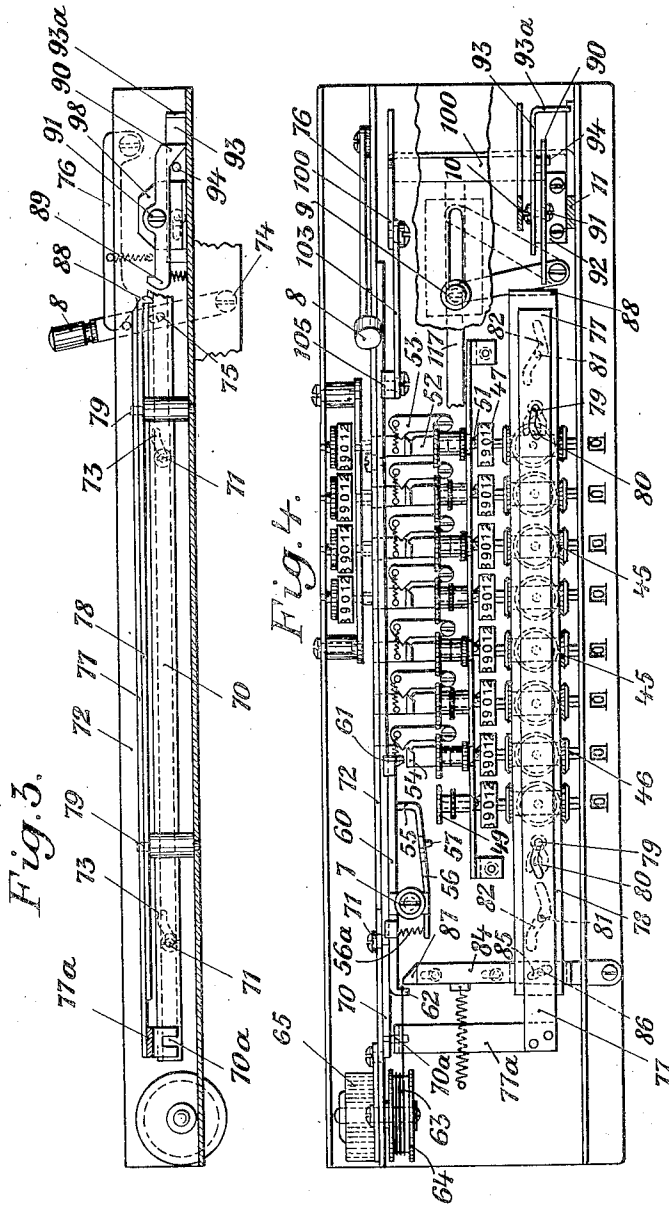
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6 Sheets-Sheet 3



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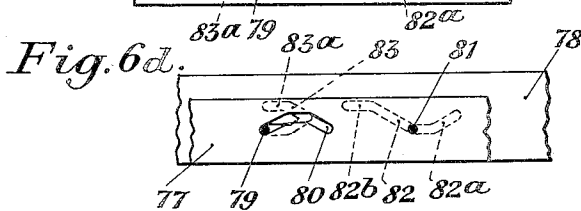
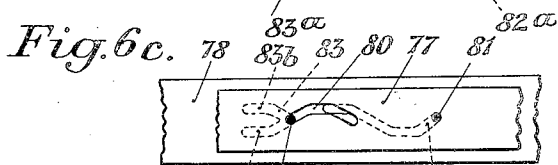
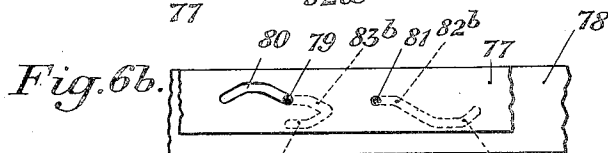
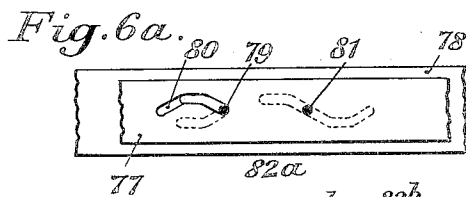
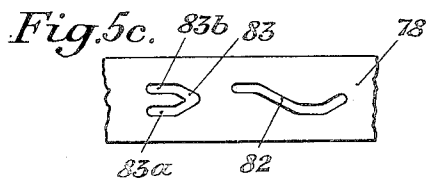
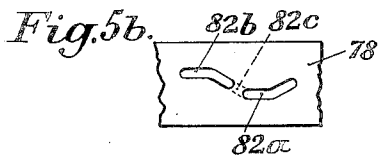
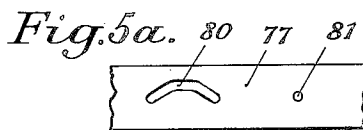
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AUTOMATIC ROUNDING OFF MECHANISM FOR CALCULATING MACHINES

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6 Sheets-Sheet 4



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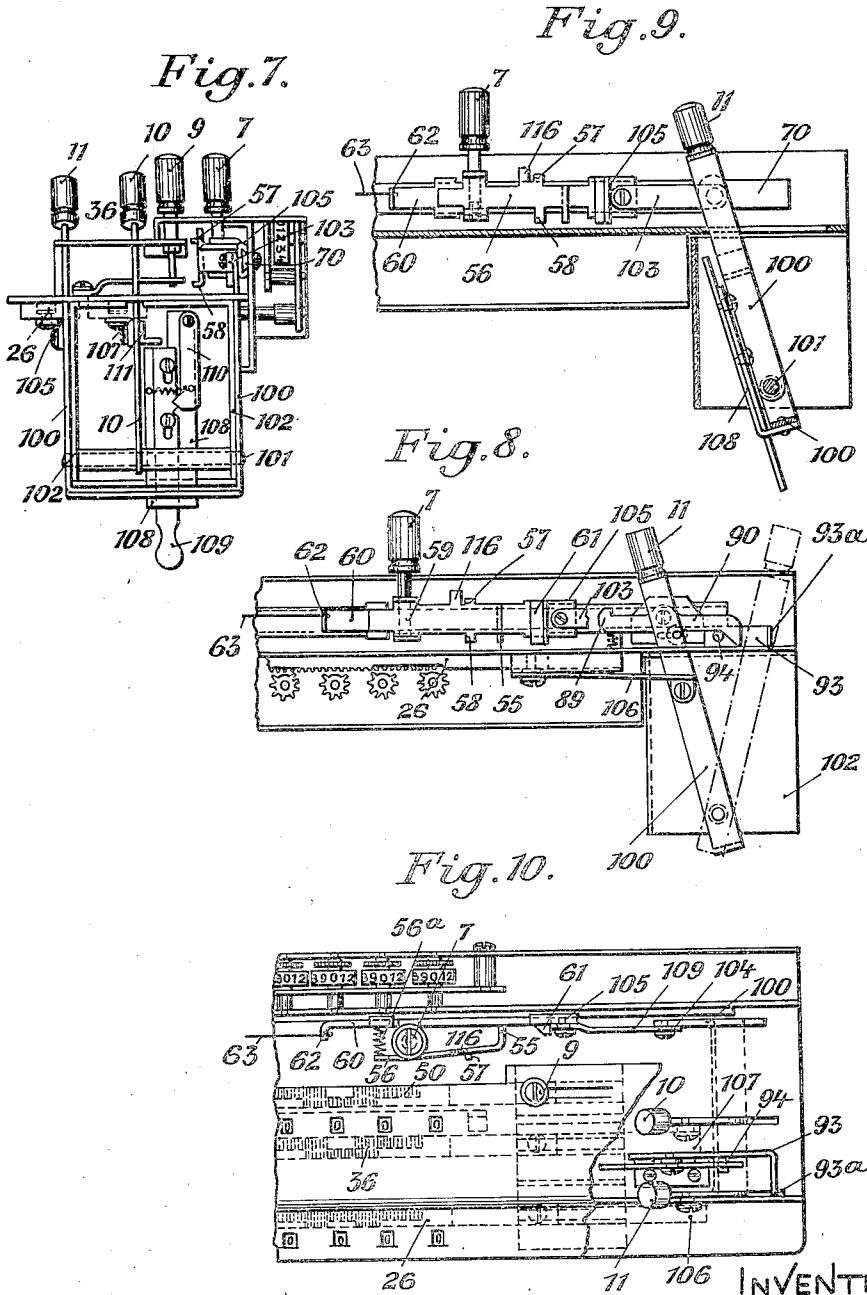
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AUTOMATIC ROUNDING OFF MECHANISM FOR CALCULATING MACHINES

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6 Sheets-Sheet 5



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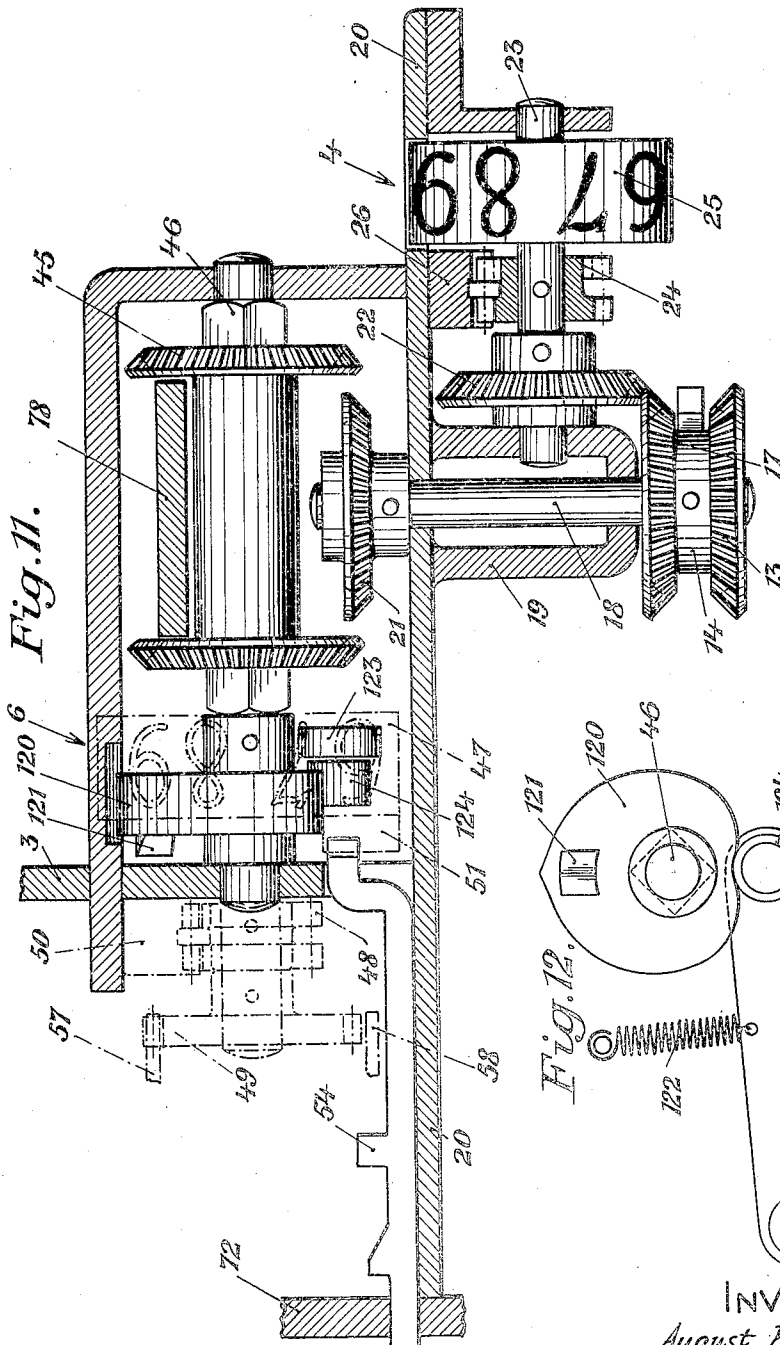
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AUTOMATIC ROUNDING OFF MECHANISM FOR CALCULATING MACHINES

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6 Sheets-Sheet 6



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## UNITED STATES PATENT OFFICE

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## AUTOMATIC ROUNDING OFF MECHANISM FOR CALCULATING MACHINES

Application filed October 9, 1930, Serial No. 487,463, and in Germany November 28, 1929.

The present invention relates to calculating machines of the type disclosed in German Patent No. 509,745 which have, in addition to the usual result mechanism, an accumulator mechanism into which the results computed in the result mechanism are transferred, and in which the results of a plurality of consecutive individual calculations are added or subtracted. More particularly, the present invention relates to machines of the type indicated which are provided with mechanism for automatically dropping the lowest places in a result and for rounding off the last remaining place or decimal.

The improved automatic rounding off mechanism disclosed in my present application has been devised to meet the special requirements of calculating machines of the type set forth in the aforesaid German Patent No. 509,745, and such improved mechanism is simpler and cheaper to manufacture than the automatic rounding off mechanisms produced or proposed hitherto.

In the accompanying drawings there is illustrated by way of example a preferred embodiment of the invention; in said drawings, Fig. 1 is a plan view of a calculating machine constructed in accordance with the present invention; Fig. 2 shows a side view of the machine partly in section; Fig. 3 is a vertical section illustrating the carriage of the computing mechanism; Fig. 4 is a plan view of the carriage shown in Fig. 3, the cover plate being almost entirely cut away to show the interior structure; Figs. 5a, 5b, 5c, 6a, 6b, 6c and 6d are views showing certain details of the machine as will be explained hereinbelow; Fig. 7 shows a side view in section of the clearing mechanism with its coupling devices; Fig. 8 is a front view of the mechanism shown in Fig. 7; Fig. 9 is a view similar to Fig. 8 but with parts omitted to expose to view other parts not visible in Fig. 8; Fig. 10 illustrates a plan view of the mechanism shown in Figs. 7 to 9; Fig. 11 shows the rounding off mechanism in vertical section; Fig. 12 illustrates a detail of Fig. 11; and Fig. 13 is a plan view of Figs. 11 and 12.

The calculating machine as shown in Fig. 1 includes a frame 1, a keyboard 2 and a car-

riage 3. The latter carries the product computing mechanism 4, the rotary computing mechanism 5 and the accumulator or sum-computing mechanism 6.

A slide 60 (Figs. 2, 4, 7, 8, 9, 10) operated by a knob 7 and movable back and forth across the whole width of the computing mechanisms 4 and 6 corresponding to the length of the slot 7a, (Fig. 1), serves to transfer the individual products from the product computing mechanism 4 into the accumulator 6. By operating the lever 8 the transfer of the product into the accumulator is preparatively set for addition or subtraction, that is, the transfer is made additive or subtractive. A clearing key 9 is associated with the accumulator, a clearing key 10 with the rotary mechanism, and a clearing key 11 with the product computing mechanism.

The product computing mechanism 4 is operated in the usual manner by means of stepped drums which are not shown on the drawings as they form no part of the present invention, the drive being communicated to such mechanism by means of a double bevelled gear 12 (Fig. 2). When the main driving crank is in its initial or zero position, the double bevel gear 12 is out of engagement with a bevel gear 13; it engages the gear 13, however, as soon as the driving crank leaves its initial position. The transfer of the products from the product computing mechanism 4 to the accumulator 6 always occurs when the drive is at rest, that is, when the bevel gears 12 and 13 are out of engagement. The adjustment of the number wheels 25 of the product mechanism 4 to zero position is accomplished by means of the zero positioning wheels 24 which are engaged by a zero positioning rack 26 operated by the clearing key 11 by means of the guide-bar 106 (Figs. 7, 8, 10 and 11).

The tens transfer in the product computing mechanism takes place in the usual manner. Upon the shafts 18 of the bevel gears 13, which drive the number wheels 25 through the bevel gears 17, 22 and the shafts 23, are located the setting lugs 14 (Figs. 2 and 11), which actuate the levers 15 and thereby shift the tens transfer wheels 16.

The latter come into engagement in their shifted position with the tens transfer cams of the stepped drum shafts.

The shafts 18 of the bevel gears 13 are journalled in the plate 20 forming part of the casing of the machine and in the U-shaped brackets 19, and carry, in addition to the bevel gears 13, 17 and the tens setting lugs 14, also the bevel wheels 21 which lie above the plate 20.

The accumulator 6 is composed of the number wheels 47. To transfer number values from the product mechanism into the accumulator the double bevel gears 45 are brought into mesh with the bevel gears 21. The double bevel gears 45 are loosely mounted upon square shafts 46 which, at the same time, serve as the shafts for the number wheels 47 and carry the zero-positioning pinions 48 and likewise the tens transfer wheels 49. A clearing rack 50 operated from the clearing key 9 is arranged to engage the pinions 48.

The number wheels 47 of the accumulator 6 carry tens transfer preparing or setting lugs 51. Upon rotation of the number wheels from 0 back to 9, or from 9 to 0, the lugs 51 move the tens setting slides 52 (Fig. 2) toward the right. The tens setting slides 52 carry upwardly extending projections 54, provided with inclined surfaces 54a (Fig. 13) and are held in their right and left-hand end positions by means of holding spring-pressed pawls 53 (Fig. 4).

The slide 60, which effects the transfer of the products and is shifted by means of the manually operated knob 7 (Figs. 1, 2 and 3), slides upon a track 70 along the wall 72. A spring located within a housing 65 pulls the slide 60 toward the left (Figs. 3 and 4) by means of a cord or cable which is wound upon the drum 64 and is attached to the bent end 62 of such slide. The bent end 62, when the slide 60 is moved toward the right engages the shifter 87 of a lever 84 shortly after the slide 60 leaves its initial position, and swings such lever toward the right, whereupon the drive 21, 45 is brought into operation as described hereinbelow. The slide 60 further on moves past the number wheels of the accumulator 6 during its idle movement and shortly before the end of its travel strikes against a shifter 105 (Figs. 7, 8, 9, 10), which is likewise guided upon the track 70 and is connected through a member 103 to a bail 100 (Figs. 4, 7, 8, 9, 10) fixed to the clearing key 11. As the slide 60 moves the shifter 105 it oscillates thereby the clearing member 11 and in this way adjusts the product computing mechanism to its zero position and effects the transfer of the product into the accumulator 6 through the thrown-in drive 45. After the zero position is reached, the slide 60 and shifter 105 are moved somewhat farther to

the right, whereupon the clearing key 11 is given an additional stroke and throws the bevel gears 21, 45 out of engagement in a manner to be more fully described hereinbelow.

The slide 60 carries an oscillating lever 56 (Figs. 2, 4, 7, 8, 9, 10) upon a pin 59. The lever 56 carries laterally projecting tens transfer cams 57, 58 and likewise the upwardly directed abutment 116 and the downwardly directed abutment 55. The lever 56 is normally held in position with its bent end, which carries the abutment 55, against the slide 60. The latter carries at its right end a projection 61 whose function will be explained below.

After the transfer of the product and after the disengagement of the drive 21, 45 upon the movement of the slide 60 to the right, the latter returns to its initial position due to the pull of the spring in the housing 65. During this movement the slide 60 slides along all the number wheels 47 of the accumulator. If, now, any tens transfer mechanisms have been preparatively set in any of the denominations of the accumulator upon the transfer thereinto of a product, that is, if any of the tens setting slides 52 have been shifted to the right in Fig. 2 (which is the same thing as upwardly in Figs. 4 and 13), then the upwardly directed projections 54 of such slides provided with the inclined surfaces 54a lie in the path of the downwardly directed projection 55 of the lever 56, whereupon as the slide 60 moves toward the left (Fig. 4), the lever 56 is pressed toward the tens transfer wheels 49. By such swinging of the lever 56, the tens transfer cam 57 engages in the tens transfer wheel 49 (Figs. 2, 4, 11 and 13), of the next higher denomination and rotates the latter additionally for one division upon continued movement of the slide 60. If other tens transfer devices have been set in any of the other denominations of the accumulator, the lever 56 completes the tens transfer at these places also as it sweeps past them. The same tens transfer cam thus accomplishes in succession the tenstransfer in all of the prepared denominations of the computing mechanism. The projection 61 upon the slide 60 moves the previously set tens setting slides 52 back into their inoperative position.

During the movement of the slide 60 toward the right, no number value is transferred into the number wheels of the accumulator, and no tens transfer has been prepared. Therefore no projection 54 will be in the path of the projection 55 of the lever 56, and thus the projection 55 will be able to travel freely in the rear of all the projections 54 during such movement of the slide 60 to the right.

The rail 70 upon which the slide 60 glides is guided in curved slots 73 (Fig. 3) in the wall 72. Upon swinging the lever 8 to the position for subtraction (that is, for subtractive transference of the product into the accumu-

lator) the rail 70 is shifted somewhat towards the right by means of a pin 75 on the lever 8, and is raised a short distance due to the outline of the curved slots 73. The transfer slide 60 and the lever 56 are at the same time also raised, whereupon instead of the tens transfer cam 57 the tens transfer cam 58 engages in the tens transfer wheels 49 of the number wheels 47 of the accumulator computing mechanism. The number wheels are now rotated in opposite direction by cam 58 during the tens transfer.

A pin 70a upon the rail 70 engages in the forked end of an arm 77a (Figs. 3 and 4) attached to the bar 77 and shifts the latter to the right when the lever 8 is swung to the position for subtraction.

A rail 78 lies under the bar 77 and is operative to shift the double bevel gears 45 and in this manner throws the bevel gears 21, 45 into or out of engagement. The bar 77 and rail 78 are carried and guided by the supporting pins 79.

The bar 77 is movable upon the pins 79 which pass through two curved slots 80 in such bar; the rail 78 is likewise movable upon the supporting pins, the latter engaging in curved slots 83 having the two branches 83a and 83b (Fig. 5c). A pin 81 on the bar 77 engages in a curved slot 82 (Figs. 4 and 5c) of the rail 78, which slot as can be seen from Fig. 5b is composed of three parts 82a, 82b and 82c. The part 82a is similar to the curved slot 83a, and the part 82b to the slot 83b. The part 82c functions merely as a connection between the two slot portions 82a and 82b. The curved slot 80 of the bar 77 is a mirrored image of, i. e., is symmetrical with, the joined slot portions 82a and 82c of the slot 82. When the lever 8 is adjusted to the position for addition, the position of the bar 77 and rail 78 is that shown in Fig. 6a. Shifting of the rail 78 toward the right then causes it to be shifted downwardly for a short distance at the pin 81 by the curved slot 82 (that is, the part 82b), as shown in Fig. 6b. The pin 79 in such case slides in the curved slot portion 83b. The double bevelled gears 45 are then brought into engagement with the gear 21 (Fig. 2) by the shifting of the rail 78 in the manner necessary for the additive transfer of products from the product computing mechanism into the accumulator.

Upon swinging the lever 8 to the position for subtraction, the bar 77 is shifted toward the right upon the supporting pin 79 in the curved slot 80. The pin 81 in such event slides along the curved slot 82 (in consequence of the symmetrical form of the curved slots 80 and 82a and 82c) to the right end of such slot (Fig. 6c). If the rail 78 is now shifted to the right (Fig. 6c), the pin 81 and slot 82 (that is, the portion 82a) force it downwardly (instead of upwardly as in the preceding case). The pin 79 in such event slides in the

slot branch 83a. The double bevel gears 45 then come into engagement with the bevel gear 21 through such shifting in the manner necessary for subtractive product transference.

The rail 78 (Fig. 4) is connected with the lever 84 through the slot 85 and pin 86. The lever 84, as stated above, is oscillated by the bent end 62 of the slide 60 upon actuation of the latter and moves the rail 78 in such manner that the gears 21, 45 are brought into engagement. The slide 87 at the end of the lever 84 is shiftable longitudinally of such lever to permit the bent end 62 to position itself behind the same upon return of the slide 60.

The rail 78, which has been shifted toward the right, passes with its downwardly bent end 88 behind the nose 89 of a spring pressed pawl 90 (Figs. 3 and 4) which is rotatably mounted upon a stud 91 fixed to a support 98. A slide 93 provided with an end portion 93a bent at right angles to the body thereof is guided upon the support 98. Upon the transference of a product and upon the accompanying adjustment to zero position of the product computing mechanism, the clearing key 11, which, after the zero positioning is complete, is additionally oscillated, as above described, strikes against the bent end of the slide 93 and moves it toward the right. The pawl 90 is simultaneously swung by the pin 94 and the rail 78 released. As a result, the drive 21, 45 is again thrown out after the zero positioning and transference of the product is complete.

According to the invention, there is arranged a further blind computing denomination near the lowest column or denomination of the accumulator (Figs. 11, 12, 13); in such additional denomination the numeral wheel 47 is replaced by a heart-shaped cam 120 while the zero positioning pinion 48, the tens transfer wheel 49 and likewise the end of the square shaft 46 otherwise necessary to carry these wheels are omitted. The cam 120 is connected with the square shaft 46 and carries a tens transfer setting cam 121 which is so arranged that it comes into action when the cam 120 is rotated from the value 4 position to the angular position corresponding to the value 5.

If now during the transference of a product the heart-shaped cam is rotated from 4 to 5 or reversely from 5 to 4, the transfer setting cam 121 comes into action. A tens transfer is thus prepared so that upon return of the transfer slide, the numeral value in the lowest denomination of the accumulator computing mechanism is in the case of addition increased by 1, and in the case of subtraction decreased by 1, as is required for rounding off the number.

When after the transference has been completed the double bevelled gear 45 becomes

disengaged from the bevelled gear 21, a spring 122 which presses a roller 124 against the periphery of the heart-shaped cam by means of the lever 123, returns the shaft 46 into the zero position.

In the operation of the machine, for example, to carry out the multiplication  $95.745 \times 0.25 = 23.94$ , the product to be rounded off at the second decimal place, the following steps are performed.

The multiplicand 95.745 is set up on the key board as far to the right as possible (Fig. 1) the decimal point being indicated by suitably adjusting a decimal bar 125. A decimal slide or pointer 126 which serves simultaneously for the product and for the accumulator computing mechanism is so adjusted that two denominations in the accumulator lie to the right thereof. The multiplier 0.25 is then imagined to be so set up in the product mechanism that the decimal pointer 126 lies between the same numerals between which the decimal is located in the written multiplier. The carriage 3 is then so shifted that the denomination of the product mechanism in which the first numeral other than zero, in the present case the 2, would be located, stands over the denomination of the key board in which the units of the multiplicand are inserted, that is, over the denomination lying immediately to the left of the decimal bar 125. The multiplication is now performed in the usual manner and the complete product appearing in the result mechanism is transferred into the accumulator whereupon the rounding off takes place in an accurate manner.

In general it may be stated that if the result in the accumulator is to be rounded off at " $n$ " denominations after the decimal point, then the decimal pointer 126 is so positioned that " $n$ " denominations in the accumulator lie to the right thereof, and the calculation is in other respects performed exactly as above described.

In Fig. 1 there is shown the multiplier in the sight openings of the product mechanism 4 in the manner in which the multiplier 0.25 of the above given example must be imagined as set up. The numerals are shown in dotted lines to indicate that the multiplier is not actually set up in the machine but exists only in the mind of the operator. Above the sight openings of the result mechanism 4 there is indicated how the setting-up of the multiplier 25 or 0.025 would appear in the imagination. Whether the multiplier is 25.00, 0.25 or 0.025, in all three cases, the carriage must be so shifted before the multiplication is commenced that the numeral 2 of the multiplier lies over the units place of the multiplicand, in other words, over the denomination immediately to the left of the adjusted decimal bar 125.

Various modifications may be resorted to within the scope of the appended claims with-

out departing from the spirit of my invention.

I claim:

1. In a calculating machine, a product mechanism having number wheels of different denominations, an accumulator mechanism likewise having number wheels of different denominations, means for coupling number wheels of like denomination of both mechanisms, zero-setting means for said product mechanism, said accumulator mechanism having a blind computing denomination with a heart-cam to the right of the lowest denomination, means for coupling said cam with a number wheel of the product mechanism at the time of transferring a product to the accumulator mechanism, a tens transfer setting cam on said heart-cam, and means, controlled by said transfer setting cam, for preparing a rounding-off operation in the lowest denomination of the accumulator mechanism whenever said heart-cam turns from the position corresponding to the digit 4, to the position corresponding to the digit 5.

2. In a calculating machine, a product mechanism having number wheels of different denominations, an accumulator mechanism likewise having number wheels of different denominations and also having a tens transfer device, means for coupling number wheels of like denomination of both mechanisms, zero-setting means for said product mechanism, said accumulator mechanism having a blind computing denomination with a heart-cam to the right of the lowest denomination, means for coupling said cam with a number wheel of the product mechanism at the time of transferring a product to the accumulator mechanism, a tens transfer setting cam on said heart-cam, means, controlled by said transfer setting cam, for preparing a rounding-off operation in the lowest denomination of the accumulator mechanism whenever said heart-cam turns from the position corresponding to the digit 4, to the position corresponding to the digit 5, and means whereby the said tens transfer device of the accumulator mechanism will carry out the rounding-off operation prepared by the action of the said transfer setting cam.

In testimony whereof I have hereunto set my hand.

AUGUST KOTTMANN.