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CALCULATING MACHINE

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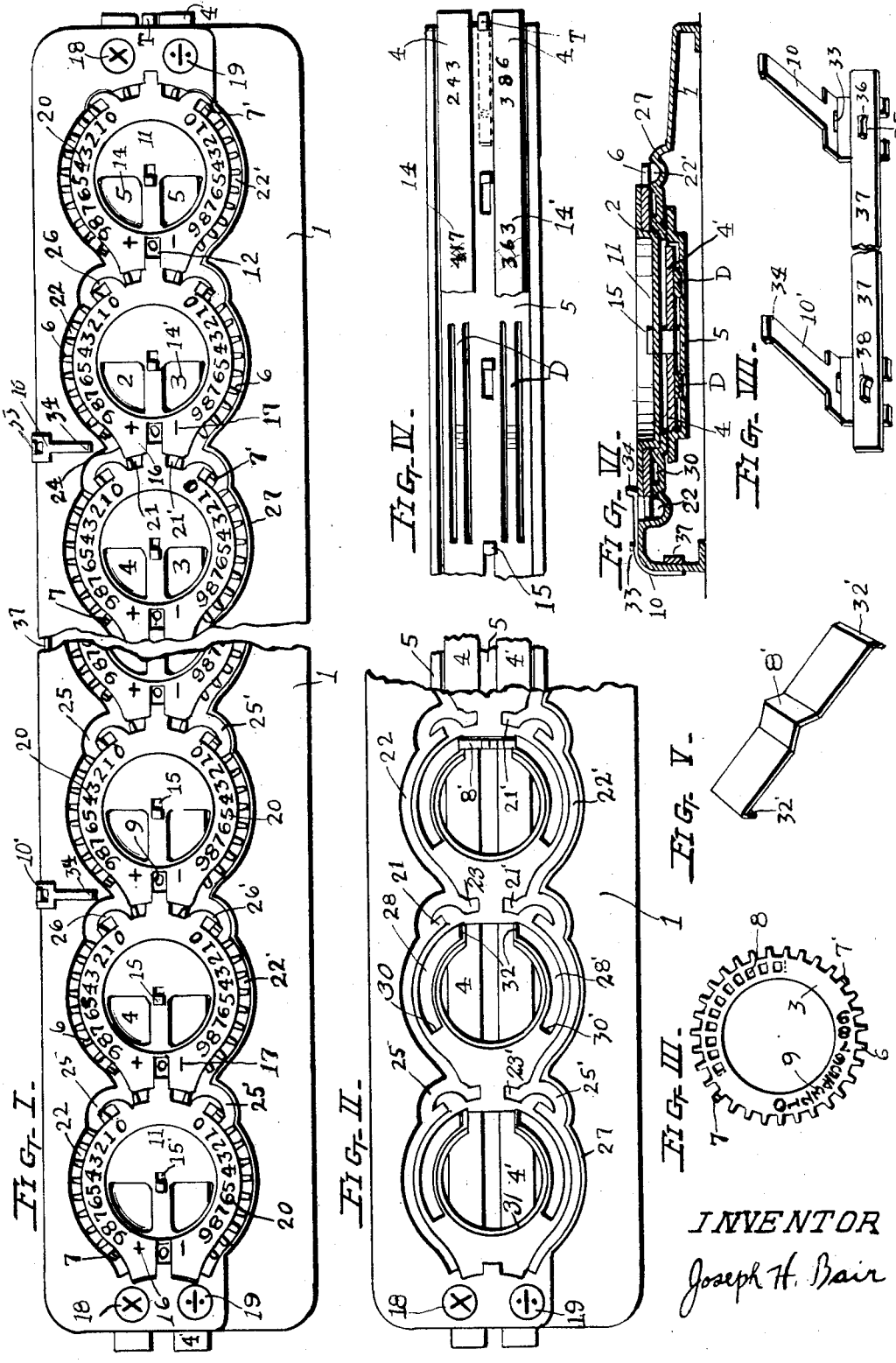

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CALCULATING MACHINE

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10 Claims. (Cl. 235—74)

My invention relates to calculating machines of the class actuated by means of a pencil or stylus, and comprising a series of toothed, annular, number-bearing disks horizontally mounted on a base, in such a manner that they are in line with each other and that the circumferences of adjacent ones fairly touch, but do not interfere with, or modify each other's limited, there-and-back rotation. The teeth are adapted to be engaged by the actuating pencil point in a race, or slot, through which they are exposed, and the disks thereby actuated in either direction to a stop. The numbers, of the series on the disk under the cover, are successively displayed through a total window in it. On the margin of this cover, for each disk is a numeral series, one above, and, one counter to it below, to indicate where the pencil is to be entered to effect a result, disclosed in the total dial, consistent with the number selected. Addition and multiplication operations take place above while those of subtraction and division take place below. There are no complements required. Each disk has one long tooth above and one below, recurved upon itself in such a manner that it serves as a pointer. It is in such a relation (above) to the setting-up numeral-series and the number displayed in the window of each disk always that any number, of the series, to the right of it added to the number showing in the window equals 9 or less than 9 while any number to the left of it added to the number displayed equals 10 or more than 10. Consequently when the number, of any transaction to be made with the machine, falls to the right of the pointer engage, the disk at that point and draw right to the stop; when it falls to the left, draw leftward to the stop which carries into the adjacent, higher-denomination wheel. Drawing leftward always carries, and if the tooth, on the disk into which to carry, blocks the actuating pencil point from driving to the bottom of the slot it is required to retract the point and into the short-curved slot leftward to the slot of the disk that blocked the carrying. Continue in this slot retracting the disk all the way and carry into the next one. If again blocked repeat, disk after disk until carrying succeeds. The reasons for operating the machine the same below for subtraction as above for addition are that the numbers to the right of the pointer tooth below are equal to or less than that shown in the window while those to the left are all greater and, consequently, require the borrowing of 10 for any number to the left of the pointer from the disk next higher up in denomination.

The purposes of the invention are: simplicity, cheapness, accuracy, adaptability, speed and portability. A seven-bank machine, instantly changeable from whole numbers to dollars and cents, and vice versa, and carrying three sets of dials, two of which are decimally shiftable to make it a practical multiplying and dividing machine is composed of but fourteen separable parts, most of which are very simple and seven of which are interchangeable. Two of the three-part denominating device are also interchangeable. The decimally shiftable parts, carrying in multiplication the multiplier and multiplicand and in division the divisor and the quotient are also interchangeable and reversible. The device cannot get out of order. It is so constructed that it can be taken apart and re-assembled at the rate of several times a minute.

Another object is to provide a calculating machine that is of a design adapted to be attached to the base of a typewriter, on the front of it and below the space-bar, so that when operated in connection with a typewriter as a billing or a listing machine, it has the capacity of the more elaborate and expensive machines and also is no mean substitute for them. In many businesses where a monthly statement is sent out to customers, a billing machine with an adder attachment operated by the numeral typing keys is employed.

With my device attached to a billing typewriter to constitute a billing adder, all the items, literal or numeral, are typed with the same facility. The printing is uniform as every printing character strikes the paper with the same force.

The bulk of small businesses cannot afford both a typewriter and a calculating machine. My calculator attached does not materially increase the cost of the typewriter, yet affords the facilities of both. In fact, it is a fair substitute for a listing machine, a billing machine and a typewriter.

A final purpose of the invention is a calculating machine that can be attached to a typewriter, and be detached from it, in a moment of time. There are times when it is desirable to take the calculating machine home, or to use it independently of the typewriter, or to use both at the same time by different operators and on different work. This is impossible on the elaborate machines and on those attachments that have no actuating means of their own. My machine is adapted to be laid on a book-keeping book, to line up across and to be slid down as the

numbers of a column are listed. When returned to the typewriter it is quickly attached again and as securely firm as though it were an integral part of the machine.

Having now described the purposes and functionings of my invention, for a fuller comprehension of its detail structure I refer to the drawing, of which:—

Figure I is a full sized, plan view of the machine.

Figure II is a plan view of a selected portion of the base. This part, like the cover, is formed up out of thin sheet-metal, and carries depressions, and races for the actuating pencil, and is adapted to house between it and the cover the calculating disks, of which,

Figure III is a detail, plan view.

Figure IV is a selected portion of a channel piece, by means of which the base and cover parts are locked together and the number carrying slides are housed. These slides are preferably white and of a cellulose material, capable of having numeral characters written thereon by a pencil, and to have them shifted decimally and erased when no more required.

Figure V is an enlarged, perspective detail of a spring shown in position in Figure II.

Figure VI is a cross section, on the line VI—VI, looking in the direction of the arrow of Figure I, enlarged.

Figure VII is an enlarged, perspective detail of the denominating device, showing its structure and method of assembling it.

1 is the base of the calculator, 2 the cover, 3 the number disks housed between base and cover, 4 and 4′ slidable strips and 5 the channel carrying them and by means of which the base and cover are locked together when the calculator is assembled. These strips 4 and 4′, preferably of white celluloid, are adapted to have numbers 14 and 14′ written thereon, in the windows 13 and 13′ exposing a portion of them, by the actuating pencil P (Fig. 8). These numbers are shiftable by sliding the strips of celluloid upon which they are written so as to display them in windows representing higher or lower decimal positions. The channel part 5, in which these slides 4 and 4′ are operated, has a series of intermediate studs 15, struck up out of the metal, which serve as a partition to keep the slides apart and in line with their respective series of windows and also afford a means of assembling the base, cover and channel and of keeping them locked firmly together as effectively as though it were done with screws. On the bottom of the channels, and integral with them, are pressure bands D. These are formed by a slot on either side and they are slightly bent up in their middles above the plane of the base so as to exert a slight pressure on the slides overlying them. This assures the slides staying in the position they are placed to expose the numbers thereon properly in the windows and at the same time makes them readily yield when sliding them to expose the figures in other windows.

The number disk 3, carrying a numeral series 9 on a sector thereof and a series of notches 8, corresponding to the numbers, in a sector opposite to the number sector, is margined by a series of equally spaced teeth 6, in relation to the numbers and the notches, and of which there is one long tooth 7 and another 7′ diametrically opposite it adapted to be recurved upon themselves and to serve as pointers, as hereinafter to be described.

The base plate 1 carries a series of pans 11′, all in line with each other, and adapted to have laid in them, flat on their bottoms, the respective counter disks 3 and to have placed over them the cover 2 in such a manner that the pans 11 thereof extend through the openings of their respective number disks, forming for them bearings and seating in the marginal depressions 31 of the corresponding pans 11′ of the base with which they are concentric. In this relation, the notched sector 8 of the disks 3 superposes the clearance races 28—28′ of the base and the end stops 29—29′ of the sector 8, in its there-and-back excursions, abut against the respective ends 30—30′ of the counter clearance raceways thus determining the limits of rotation of the disks 3. The central openings in the pans 11′ are laterally extended so as to interrupt the clearance races 28—28′. At the ends of this interruption are slots 32, the rims of which are depressed to the plane of the rest of the margin 31 of the cut away, to receive the turned down ends 32′ of the spring (shown in Figure V) which spans the gap and presses its hump 8′ (Figure II) into a notch of sector 8 of the disk overlying. The hump of the spring always cooperating with the notch in line, clicks the disk into the exact position it should be. The disk always yields readily to the actuating pencil, yet it is sure never to be left in an intermediate position.

With the cover 2 on the base 1 and the disks 3 interposed respectively between the pans 11 and 11′, as is the case when the machine is assembled and ready for use, the teeth of any disk, above and below, extend beyond the margin of the cover and are exposed in a slot 22 above and 22′ below, formed between the margin of the cover pan 11 and the rim of the base pan 11′. Through the guidance of the setting-up series, 20 above, and 20′ below, the teeth in these slots are selectively engaged and actuated by the pencil. On the upper margin, around the pan 11 of the cover is this index series, in counter-clockwise arrangement, and stepped with the teeth extending beyond it. Below, the series is in clockwise arrangement. One of the teeth 6, exposed above, is the pointer 7, and below is the pointer 7′. The index series 20 and 20′ indicate, for any number which is to enter into a transaction, where the pencil is to engage the teeth in the actuating slot exposing them. The requirement is (as already explained above) that if the pencil engages the disk to the right of the director tooth it is drawn to the right to the stop (21 if adding and 21′ if subtracting). Addition transactions take place above, as do also multiplications, which are merely repeated additions; subtraction and division (repeated subtraction) transactions take place below. If the actuating pencil engages the teeth to the left of the director tooth it is required to draw it leftward to the stop 23, or 23′, which involves carrying, i. e., advancing or retracting the adjacent, or next, higher-denomination disk one step. The result of the transaction is shown in the sight openings 12, of the cover, which display, each, that number of the underlying series of the sector 9 which happens to stop below it. All these openings 12 together show the total and are designated as the total-dial.

In the base 1, and below the slots formed by the spaces interposing the periphery of the pans 11′ and the marginal flanges of the cover pans 11 in which the teeth 6 are exposed, are half-round races 22, 22′, and 23 and 23′. These provide clearance under the exposed teeth and af-

ford the actuating pencil-point more purchase so that it is not likely to slip over them but to drive them along in the actuating stroke. The races 25 and 25' are those leading from the slots of one wheel to those of another adjacent to it. On the margin of the cover, and on the base below them are arms 26 and 26' to assure that the actuating pencil-point will not leave its required course when rapidly passing from the slots of one disk to those of the other. When the pencil is resisted from making the carrying transaction, and can, therefore, not enter the slot 23 (23' in subtraction) it is retracted and driven along the race 25 (25' in subtraction) where it enters the actuating slot 22 (22' in subtraction). It is required to push it along leftward, in engagement with the teeth and to the next carrying slot. If it can enter and effect carrying, the transaction is complete. If it is again barred by the tooth in the slot resisting actuation the leftward, procedure into the next disk's slot is repeated, and so on until carrying is successful.

Because a flange R is depressed on the base in front even below the level of the pans so that the teeth are exposed at their forward edge, a ridge 27 borders the outer edge of the pencil race 22' to keep the pencil in its course. This arrangement of the teeth extending beyond the terrace makes its easy for the finger sliding along on the flange against the terrace, from left to right, to engage the teeth of the successive disks, as it passes, and drag them to a re-set position, to show a nought (0) in all the total windows. Here is the most practical means of satisfactorily resetting the machine. By one stroke of the finger across the front, the total showing is wiped out, and there is no clearing mechanism to get out of order. It is indicated by the signs: 16 (+), 17 (−), 18 (×) and 19 (÷) printed on the machine where addition, subtraction, multiplication and division transactions take place.

The denomination indicator (Figures I, VI and VII) is a shifting device by means of which to change the machine from indicating dollars and cents to whole numbers, and vice versa. This is accomplished by two pointers 10 and 10' united by a slotted rod 37 which, when one is shifted the distance of one decimal step, the other is shifted also. The pointers 34, turned up at the free end, are made out of thin sheet metal, of a hue to contrast with that of the machine, and are bent to conform to the rear and top of the base 1 which has a longitudinal slot in the rear (not shown) for each pointer. This slot is the length of the distance between two adjacent total windows. A tongue 35 (Fig. VII), bent in from the rear of the pointer plate 10, extends through the slot in the base and the slot 36 in the connecter plate 37. A slit half through the tongue permits it to be bent up so that it cannot slip out. The band 37, being of spring material and flexed, pulls in at the two ends where it is attached to pointers 10 and 10', by means of the tongues therefrom extending through the clearance slots, presses these pointers firmly on the base and prevents them from accidentally being shifted. But at the same time it permits them to be slid to the other end of the slot when a change of denomination is wanted. A little tongue 33 behind, sticking up from the pointer, in connection with the front end 34 being bent up, provides a place to lay the actuating pencil P, to prevent it from rolling off while using the typewriter to which it is attached.

To disassemble the machine, as illustrated in Figure I, it is required to press up from beneath the tongue T in the base out of mesh with the notch *t* in the channel 5, where it serves as a latch. Push the channel unitward until the stud 15 which comes up through a square hole 15' in the cover, is against the units side of the hole, then its heel is free from its support on the other side of the hole and wholly in it and it will fall down through it and all the parts of the machine are free and can be separated.

Addition and subtraction have been explained. To multiply, for example, 425 by 335, write, with the actuating pencil, on the celluloid strip in the first three windows respectively 4—2—5, the multiplicand, above, and 3—3—5, the multiplier, below, as is illustrated in Figure I. The multiplying always takes place mentally. In the units position we note 5 in the multiplicand and 5 in the multiplier: 5×5=25. List the number where the number multiplied is, not where the number by which it is multiplied is. The first product is 25. 5 is listed in the units wheel and 2 in the tens. You have it there 25 in the total windows. 5 twos=10; list it where the 2 (multiplicand) is. 5 fours=20. List it where the four is. And you have in your total 2125. That is: 425 multiplied by 5 equals 2125. Now draw the celluloid strip 4 leftward one decimal position so that the 425 thereon is displayed in the thousands, hundreds and tens windows instead of in the hundreds, tens and units ones. Now multiply through by the second figure of the multiplier, 3. But suppose you begin at the other end of the multiplicand. This is easier. 3 fours=12. List it where the 4 is. 3 twos=6. List it where the 2 is. 3 fives=15. List it where the 5 is. You have multiplied 425 by 30 and in the same operation added it to 5 times 425. The result is 14875. Move the slide 4 another decimal step leftward till it shows in the windows. You are now multiplying 425 by 300, since the 3 of the multiplicand 335 is in the hundreds position. Multiply through: 4 by 3, 2 by 3 and 5 by 3, never forgetting to list the product each time where the multiplicand figure is. Your total shows 142.375. Return the slide 4 to its original position and you have 425×335=142375. In one dial is shown the multiplicand; in another the multiplier and in total dial, the product. Now suppose we reverse the operation and divide. We have in the total dial the dividend: 142375; in windows on the slide 4' the divisor: 335 and in the upper windows the quotient: 425. Move leftward the devisor 335 until it is displayed under the 142 of the dividend. 335 is not contained in 142 so bring down the next number 3. This is done by retracting the divisor 335 one decimal position. You now have 1423 (in the total) over 335 (the divisor). It goes 4 times. The 4 is already there of the quotient 425. Multiply through by the four (and as you are subtracting it must be done below). 4 threes=12. List it where the three is. 4 times 3 again. List it where that 3 is. 4 times 5=20. List it where the 5 is. You have 83 left. You have multiplied 335 by 4 and at the same time subtracted it from 1423, and the difference is the 83 remaining. 335 won't go into 83; so again bring down the next number 7 by retracting the divisor. You have 837 over 335 and it goes 2 times. Multiply through by 2 and you have 167 left. Bring down the last number and it goes 5 times. Multiply through and it comes out even. That is: there is nothing left in the total dial. 142375÷335=425.

My invention has been disclosed in its simplest and most practical form, but it can be modified

in many details without violating the spirit of the invention.

I claim:

1. A calculating machine comprising a number wheel of limited rotation, a number series thereon within the range of its rotation, a window exposing a number of the series thereon, a stationary number series and a director, on the adjacent wheel, adapted to range the stationary series and always in such relation to its numbers and the number exposed in the window that any number to the left of it added to the number in the window equals or exceeds 10, and any number to the right of it added to the number in the window is equal to, or less than 9, substantially as described.

2. A calculating machine comprising a number wheel of limited rotation, a number series thereon within the range of its rotation, a window to display the numbers successively, a stationary number series, stops at the ends of the arc of rotation between which are exposed means for the actuation of the wheel in stepped relation to the numbers on the stationary series and a director on the wheel, movable between said stops, and in such relation to the stationary series and the number in the window that actuation from a given number of the stationary series is always away from the director to the stop between which it and the number falls, substantially as described.

3. A calculating machine comprising a series of wheels of limited capacity for oscillation actuated by means of teeth thereon, two stationary number series for each wheel, said number series being arranged counter and reverse to each other covering arcs equal to the range of movement with the numbers in stepped relation to the teeth, and two directors on each wheel associated respectively with the said stationary series and adapted reversely to traverse them in such a relation that the number to the right of the one director added to the number to the right of its counter director always equals 9, substantially as described.

4. A calculating machine comprising a series of wheels of limited capacity for oscillation actuated by means of teeth thereon, two stationary number series for each wheel said number series being arranged counter and reverse to each other covering arcs equal to the range of movement with the numbers in stepped relation to the teeth, and two directors on each wheel associated respectively with the said stationary series and adapted to traverse them reversely in such a relation that the number to the right of one director added to the number to the right of its counter director always equals 9, and said number to the right of each counter director, in the series of wheels, in every transaction, forms the total, substantially as described.

5. In a calculating machine the combination of a plurality of setting-up series, total display windows, decimally disposed windows adapted to display an inscribed number and a decimally shifting element adapted to receive said inscribed number to display it in any selected window, or plurality of windows, substantially as described.

6. In a calculating machine constituting a base and a series of toothed number disks of limited turnability mounted thereon, the combination of a toothed number-disk, actuable in both directions by means of the teeth, a slot for the teeth in which to engage them and said slot for each disk extending into the teeth of the adjacent one to the extent of one step and an accessory slot to connect the slot of one wheel with that of the adjacent ones to make them continuous, substantially as described.

7. A calculating machine comprising a series of wheels of limited capacity for oscillation, actuable in both directions by means of teeth thereon exposed in slots to the extent of their range of movement, two stationary setting-up number series for each wheel said series being counter and reverse to each other, one for addition and one for subtraction, and two directors on each wheel, each in such relation to the other and to its respective setting-up number series over which it is adapted to range, that actuation from any number in either setting-up series is always away from its director and the number to the right of the director on the counter stationary series, in the totality of wheels actuated, always shows the result of the transactions, substantially as described.

8. In a calculating machine, a frame member providing an annular bearing and a flange in front of the bearing, a wheel mounted on the bearing for limited rotation thereon, a series of characters on the wheel, a pointer on the wheel, a plurality of sets of characters on said flange, and means for exposing a character on the wheel in each position thereof, said exposed character bearing a definite relation to the character at said pointer, substantially as described.

9. In a calculating machine, a frame member carrying an annular bearing and a flange in front of the bearing, a toothed wheel on the bearing, a series of characters on the wheel covered by the flange, a window on the flange to expose a character on the wheel, a plurality of sets of characters on the flange, and a pointer on the wheel, said wheel being rotatable to bring the pointer to positions corresponding to those of the characters on the flange and characters into the window complementary thereto, substantially as described.

10. A calculating machine comprising a plurality of setting-up series, a respective plurality of total-display windows, a respective plurality of windows adapted to display inscribed, decimally shiftable numbers and a decimally shiftable demarking and denominating device associated therewith, substantially as described.

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