No. 809,446. PATENTED JAN. 9, 1906.

F. G. JOHNSON.

CALCULATOR.

APPLICATION FILED JUNE 20, 1903.

4 SHEETS—SHEET 1.

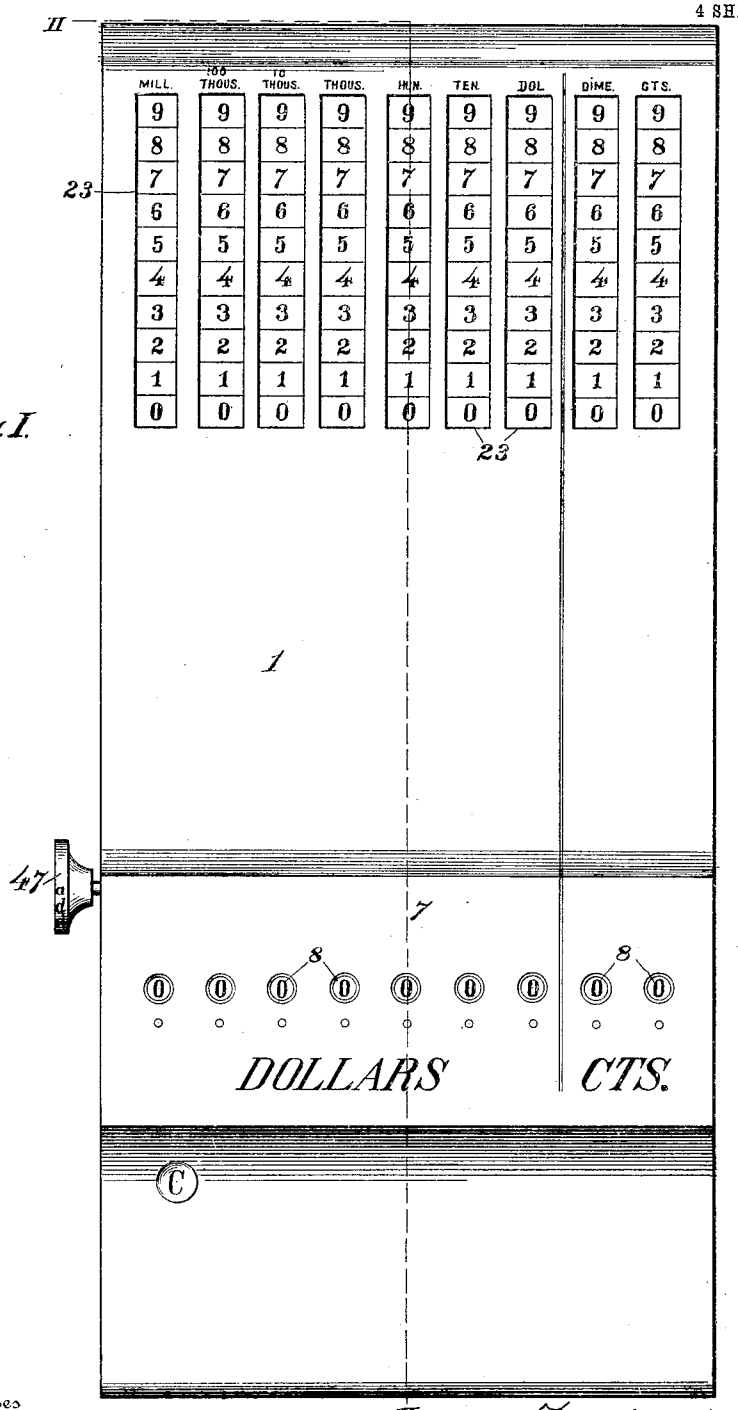

Fig. I.

Witnesses
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4 SHEETS—SHEET 2.

Fig. II.

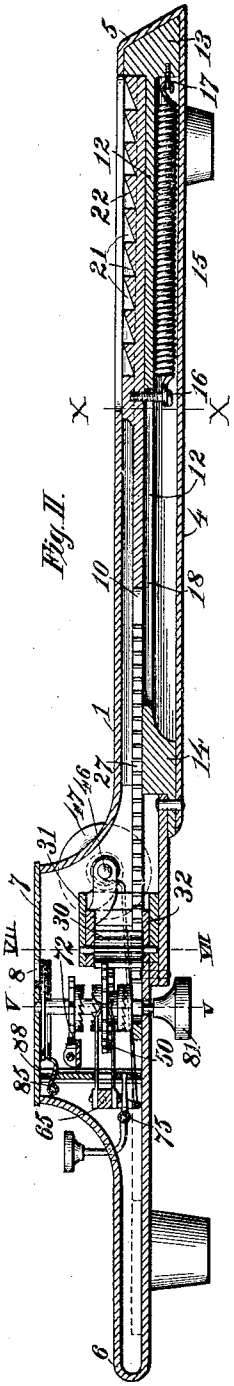
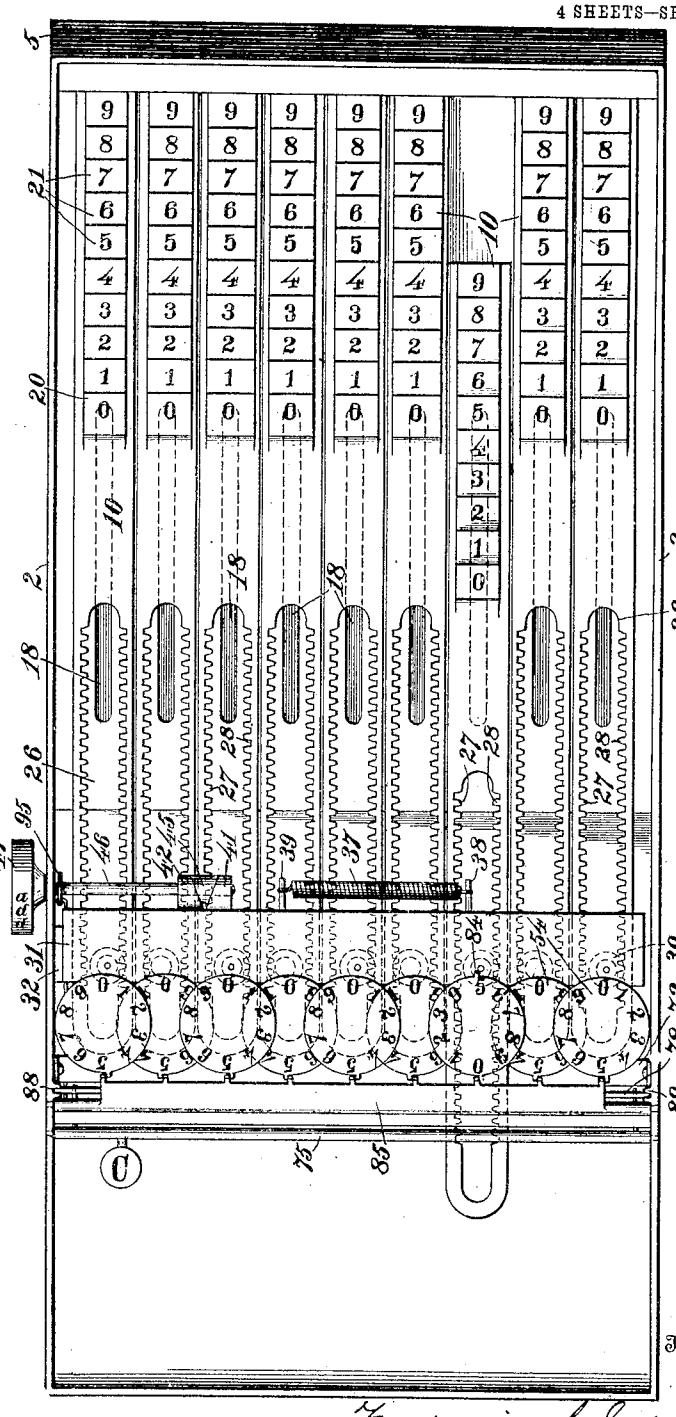


Fig. III.



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4 SHEETS—SHEET 3.

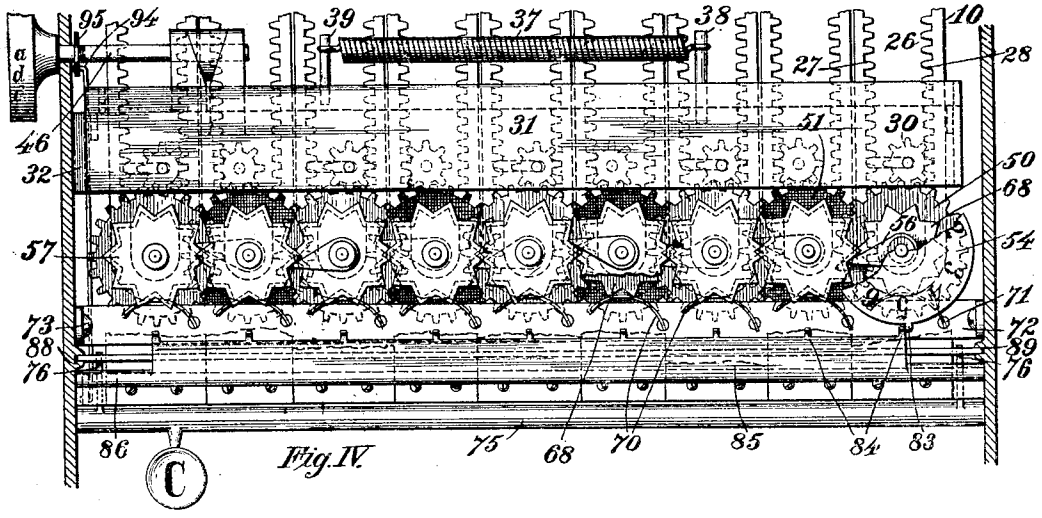


Fig. IV.

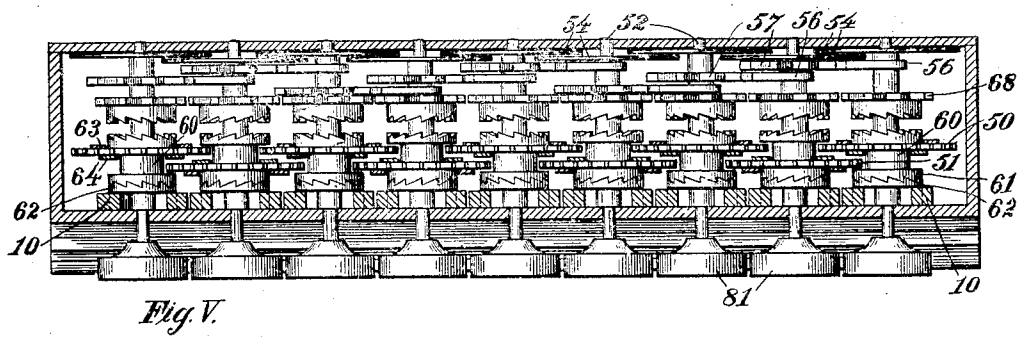
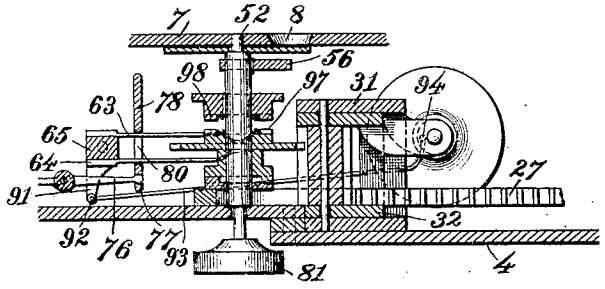


Fig. V.

Fig. VI.



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CALCULATOR.

APPLICATION FILED JUNE 20, 1903.

4 SHEETS—SHEET 4.

Fig. VII.

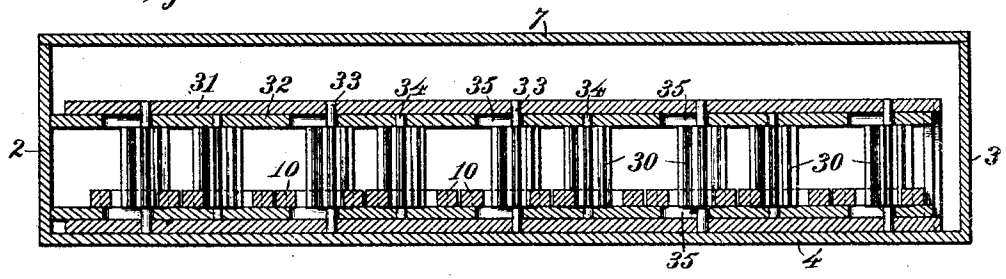

Fig. VIII.

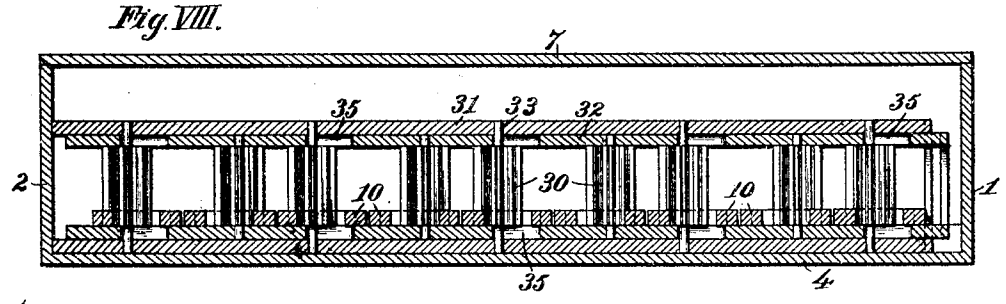

Fig. IX.

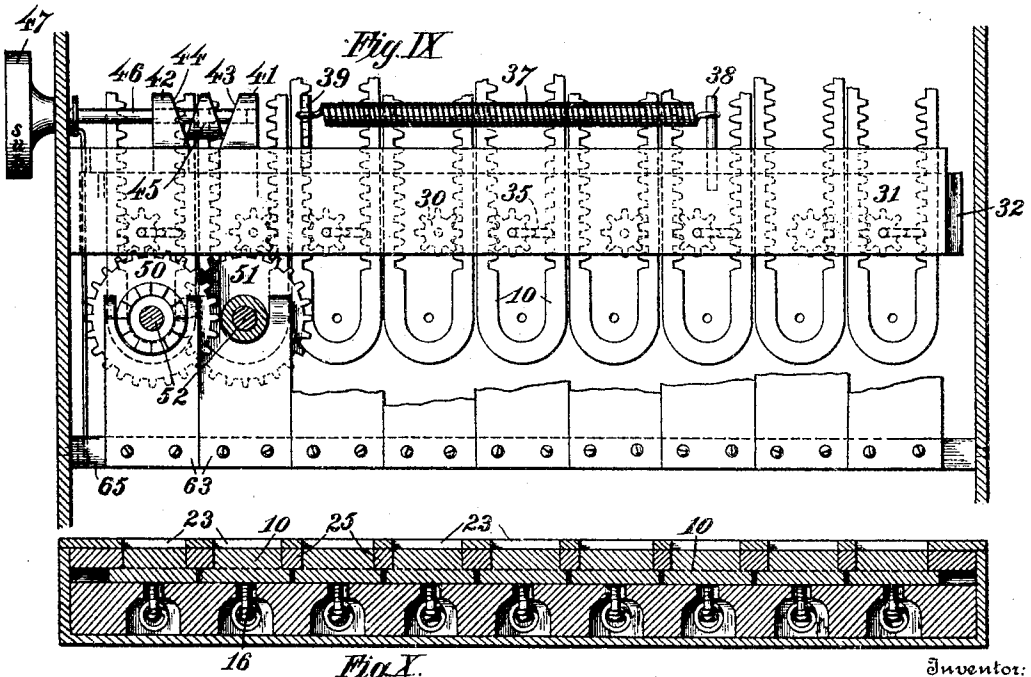

Fig. X.

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By James F. Atkins,

Attorney.

Witnesses

H. S. Austin

Frank J. Keat

UNITED STATES PATENT OFFICE.

FREDERICK G. JOHNSON, OF HARTFORD, CONNECTICUT.

CALCULATOR.

No. 809,446. Specification of Letters Patent. Patented Jan. 9, 1906.

Application filed June 20, 1903. Serial No. 162,370.

To all whom it may concern:

Be it known that I, FREDERICK G. JOHNSON, of Hartford, in the county of Hartford, State of Connecticut, have invented certain new and useful Improvements in Calculators, of which the following is a complete specification, reference being had to the accompanying drawings.

The object of my invention is to produce a cheap, accurate, convenient, practicable, and durable machine for mechanically performing the operations of addition and subtraction, which include, of course, multiplication, which is a method of addition, and subdivision, which is a method of subtraction.

In the accompanying drawings, Figure I is a top plan view of a preferred form of embodiment of my machine complete, the operative parts being all set at zero and ready for performing the functions of addition. Fig. II is a section on the line II II of Fig. I. Fig. III is a view similar to Fig. I, but showing the top skin-plate removed and the dollar-actuating bar shifted to register the unit "5." Fig. IV is a view of a portion of the subject-matter of Fig. III upon a slightly-enlarged scale and with all but a portion of one of the dial-plates removed, the dollar-actuating bar being retracted to the normal position. Fig. V is a section on the line V V of Fig. II. Fig. VI is a detail sectional view illustrative of the pinion-shifting mechanism and its connection with the clutch-shifting mechanism. Fig. VII is a section on the line VII VII of Fig. II, the pinions being shown in the position for performing the function of adding. Fig. VIII is a similar view showing the pinions shifted to perform the subtractive function. Fig. IX is a view somewhat similar to Fig. IV, the pinions being shown in the reverse or subtractive position from that which they occupy in Fig. IV, a portion of the mechanism shown in Fig. IV being omitted. Fig. X is a section on the line X X of Fig. II.

Referring to the numerals on the drawings, and particularly to Figs. I, II, and III thereof, 1 indicates the top skin-plate, 2 and 3 side pieces, 4 a bottom plate, and 5 and 6 end plates, which, assembled as illustrated and united by any suitable means, constitute the case of my machine, which is completed by the addition of a plate 7, which being provided with a series of apertures 8 for displaying the figures on the dial-plate one by one may be designated as the "display-front" of the machine.

Within a case or protective covering, consisting substantially of the parts above enumerated or other suitable equivalent structure, I provide a requisite plurality of longitudinally-movable sliding or actuating bars 10. The actuating-bars preferably slide freely from one end to the other of the case, working during said backward-and-forward movement upon a medial wall or septum 12, extending between blocks 13 and 14, which, confined between the plates 1 and 4, constitute a suitable support for the bars. The bars are urged to a common normal position, as by coiled springs 15, secured each at one end to a screw 16, projecting from the bottom of said bar, and at the other end to an eyelet 17, extending from the lower part of the block 13. Each spring 15 being made of requisite but not excessive tensile strength tends to confine each its respective bar to a relatively corresponding position, which is the normal position of the bar within the case, a slot 18 in the septum 12 being provided for the accommodation of the travel of the screw 16 without interfering with the longitudinal motion of the bar 10 which carries it.

The several actuating-bars 10 are identical, and a description of any one applies to all. Referring accordingly to Figs. II and III for convenience, it may be specified that each bar is provided at its upper end—to wit, the end adjacent to the end plate 5—with a longitudinal projection or thickening-rib 20, made of a thickness to accommodate a series of nine notches 21 each, upon the broad facet 22 of each of which is displayed a numeral. The numerals upon the facets 22 are arranged in consecutive order running upwardly, beginning with "1" and ending with "9." The series of facets of each bar is displayed through an oblong slot 23 in the skin-plate 1, there being as many slots 23 as there are bars employed in the machine, nine bars and nine slots being shown in the drawings. The end 24 of the slot 23 performs the mechanical function of a stop-piece for the actuating instrument or stylus (not illustrated) by which each bar may be and is designed to be manipulated or drawn back against the tension of its spring 15. It is in order to engage readily with the stylus that the notches 21 are provided.

From the foregoing description, in view of the drawings, it will appear that if a unit of any denomination be selected and the notch 21 of the bar appropriate to that denomina-

tion bearing the corresponding unit-numeral be engaged by the point of a stylus or similar instrument the bar may be drawn back through the tractile force exerted on the stylus against the resistance of its spring 15 until the stylus meets the stop-piece 24, when its movement will be interrupted and a definite movement proportionate to the particular unit-number of the notch 21 selected for engagement by the stylus will have been imparted to the bar. This important feature may be clearly apprehended from a comparison of Figs. II and III, observing that the zero-mark, which may be omitted, is located upon the rib 20 and not upon a facet 22 of a notch 21, that the facet marked "1" of each bar indicates the shortest movement which may be imparted by the manipulation above described to the bar, and that the longest movement which may be imparted in like manner to the bar is made by engagement of the stylus with a facet 9. It is therefore clear that the lengths of the several pockets 21 or facets 22 being equal each bar is adapted to receive through manipulation in the manner above described a step-by-step movement of nine equal intervals. Provision being thus made for imparting to each bar a determinate movement for each one of its numbered facets with facility and accuracy, it remains to provide means for converting and registering the movement referred to in order to perfect a material form of embodiment of my invention.

Having premised that the skin-plate 1 is preferably provided upon its under side with a series of spacing-bars 25, (see Fig. X,) which serve as tracks or alining members to compel true and smooth reciprocatory motion of the several bars 10, I specify that in a preferred form of embodiment of my invention I employ for convenience of effecting the registering of the various movements of each bar 10 means for converting the positive reciprocatory movement of each bar—that is, the movement which it receives by the manipulation in opposition to the force of its spring—into rotary movement. The conversion of movement referred to is employed chiefly because of compactness of structure and facility of reading which it affords in a machine.

As a means for converting reciprocatory into rotary motion, as above set forth, I prefer to employ upon each of the bars 10 a rack-bar, and for reasons which will presently be explained employ a slot 26 and rack-bars 27 and 28 upon opposite sides of the said slot. Each rack 27 and 28 alternately intermeshes with a pinion 30. If the rack 28 engage with the pinion, positive reciprocatory movement of the actuating-bar which carries said rack will produce rotation of the pinion in one direction, while if the engagement of said pinion be with the rack 27 rotation of the pinion in the opposite direction will be produced by the reciprocatory movement of the bar. Consequently, the two racks being toothed alike, it follows that if provision be made for shifting the engagement of the pinion from one rack to the other reverse rotary movement of the pinion may be imparted and measured by means of the aforesaid shifting of the pinion. This fact may be taken advantage of to effect a registering of a rotation of the pinion in one direction, which is additive, and of a rotation thereof in an opposite direction, which would be subtractive. It is this feature of my invention which renders my machine available both for performing the function of addition and of subtraction.

As a convenient means of shifting all of the pinions 30 into engagement with their several racks 27 or 28 at will I illustrate a simple form of mechanism for the purpose, consisting of a pair of relatively longitudinally movable oblong rectangular boxes 31 and 32. (Compare, for example, Figs. VII and VIII.) In these boxes the several pinions 30 are journaled, as upon spindles 33 and 34. The spindles 33 extend through slots 35 in the box 32 and permit the requisite relative movement of the two boxes which carry the spindles. In Fig. VII one position of the pinions 30 is shown, and in Fig. VIII the shifted position thereof is illustrated. The alternate arrangement of the pinions 30 shown in these figures and elsewhere throughout the drawings should be observed, because it is through such arrangement that the necessary relative conversions of the reciprocatory movement of the several bars 10 into rotary movement in the required direction are effected.

The boxes 31 and 32 are held in a normal position—for example, that which I shall call the "additive" position, or that position in which the machine is adapted to perform the function of addition—as by a coiled spring 37, secured at one end to a pin 38 and at the other to a pin 39, projecting, respectively, from the boxes 32 and 31. 41 and 42 indicate lugs correspondingly projecting from said boxes and designed to constitute portions of mechanism for producing relative movement of the boxes 31 and 32 in opposition to the force of the spring 37 which unites them, and consequently for shifting the position of the pinions 30. They are to that end provided with oppositely-inclined faces 43 and 44, respectively, between which is located a cylindrical wedge 45. The wedge 45 is secured to a shaft 46, revolubly mounted in the lugs 41 and 42 and terminating beyond the side wall 2 in a disk head 47, by which it may be rotated. Through the rotation of the disk head 47 the wedge 45 may be operatively set in one of two positions. (Clearly shown, for example, in Figs. IV and X, respectively.) When

set in one position, as in the former figure, the machine is ready to perform the function of addition. When set in the other position, it is ready to perform the function of subtraction. For that reason I prefer to provide an indicator upon the disk 47, preferably upon its edge, of the position of the wedge 45. The word "Add," as shown in Fig. IV, may be employed to indicate the one position, and the abbreviation "Sub.," as shown in Fig. X, may be employed to indicate the other position.

The various pinions 30 are somewhat elongated, as illustrated, in order to adapt them indiscriminately to mesh with gears disposed in different planes, besides being adjustable from one parallel plane to another. There are nine gears, each of which intermeshes with its respective pinion 30. Five of them, for the sake of compactness, are arranged in one plane and four in another. These gears are otherwise substantially identical in form and function, but for the purpose of distinction may be severally designated by the reference-numerals 50 and 51. Each gear 50 or 51 is carried upon its appropriate staff, each of which may be indicated without confusion by the reference-numeral 52, and it is carried in suitable bearings provided for it in the top and bottom plates of the case. The primary function of the gear 50 or 51 is to legibly record the degree of rotative movement derived from its appropriate pinion 30. To that end it carries a fixed dial-plate 54, whose face is divided into ten equal parts, each part being designated by a distinct number ranging from "1" to "0," both inclusive. It is these numerals which are displayed one by one through apertures 8 in the plate 7, above specified. (See Figs. I and VI.) Besides the primary object of the gears 50 51 and their respective staffs 52 the series of gears 50 and 51 bear such relations to each other that a complete rotation of any one gear of those series should impart a tenth of a revolution to the gear of the next higher denomination, this of course being perfectly obvious to one skilled in the art. I therefore provide upon each staff 52 a finger 56, which once in each complete revolution operatively engages a tooth of a ten-toothed star-wheel 57, secured to the staff 52, designed through its rotation to record units of the next higher denomination. The several fingers 56 and star-wheels 57 are disposed in series of threes in different levels, as clearly shown in Fig. V, in order to economize space.

In order to provide for the registering of one of the positive movements, as above defined, of the several actuating-bars 10, I mount the several gears 50 and 51 each upon a hub 60, revolubly and longitudinally loose upon its staff 52. The hub 60 carries a crown-tooth clutch member 61, adapted to engage a corresponding member 62, secured to the staff 52. Yielding engagement between the clutch members 61 and 62 is compelled, as by a pair of springs 63 and 64, carried upon a rock-bar 65, extending from end to end of the case and mounted in suitable bearings therein. (See Fig. VI.) The opposing force of the springs 63 and 64 is such as to compel operative engagement of the clutch members 61 and 62 in response to rotative movement of the gear 50 or 51 in one direction and to permit, through the functional operation of the clutch, free movement of the said gear in the opposite direction without corresponding movement of the staff. It is of course necessary to preserve the relative positions of the several staffs 52, and consequently of their dials 54, to which they are advanced through the manipulation of the several actuating-bars 10. To that end each staff may be provided with a ten-tooth notched wheel 68 fixed to it, the notches of said wheel being engaged by a spring-dog 70. That dog may be conveniently carried by its proper split stud 71, of which the entire number may be ranged upon a bar 72, extending between the side walls of the case, to which it is secured, as by a screw 73. (See Fig. IV.)

It has been specified that the several hubs 60 are not only revolubly loose upon their respective staffs 52, but that they are also longitudinally movable and loose thereon. The purpose in mounting them revolubly upon their staffs is to accommodate them to their clutch functions, as specified. The additional object of making them longitudinally movable is twofold—first, to facilitate the resetting of all of the dial-plates 54 to zero, as shown in Fig. I, and, second, to adapt the same dial-plates to read subtractively as well as additively. To enable them to perform the first function, I provide a rock-shaft 75, mounted in the opposite side walls 2 and 3 of the case. The rock-shaft 75 is provided with a key C for operating it and at opposite ends with arms 76, pivotally connected, respectively, as indicated at 77, with a plate 78, longitudinally slotted, as indicated at 80, so as to snugly fit the several pairs of springs 63 and 64. Full downward pressure upon the key C is adapted to completely disengage the hubs 60 from any connection with their respective staffs 52. The staffs are therefore severally free to turn and are provided with knurled disk heads 81, arranged in a row upon the bottom of the case. So arranged, a sweep of the finger of an operator across the row of knurled heads is sufficient to restore the dial-plates 54 to the zero or starting point. In order to limit the respective movements of the staffs 52 to the zero or starting point of the dial-plates 54, I provide upon each dial-plate, as upon its periphery, a lug 83 and in the path of this lug a lug 84, the several lugs 84, there being one for each dial-plate, being arranged upon an eccentric

leaf 85 of a rock-bar 86, parallel to the rock-bar 75 and like it mounted in bearings in the side plates 2 and 3. The plate 78, sliding loosely in the bearing indicated at 88 and 89 in the side plates 2 and 3, respectively, is so proportioned as to bring the lugs 84 into the paths of the respective lugs 83 with each full depression of the key C, and by that means the fixing of the starting-point of the several dial-plates is accomplished.

It has been specified that the shifting of the pinions 30 reverses the functions of the machine; but in order to facilitate the reading of the dial-plates 54 and to cause them to register subtractive operations legibly—that is, by consecutive advancement in all respects, as in the performance of the additive function—I provide for each of the hubs 60 additional movement and function to that last specified. To this end the rock-bar 65 is provided with a crank-arm 91, to which, as at 92, is pivoted one end of a pitman 93, pivoted at the other end, as indicated at 94, eccentrically to a collar 95, fixed to the shaft 46. The members of the crank-and-pitman connection above described are so disposed that when the abbreviation "Sub." on the disk head 47 is displayed each of the hubs 60 is shifted to the third position, in which, disengaging the clutch members 60 and 61, it engages other corresponding but reversed clutch members, thereby accomplishing the object aimed at of causing the dial-plate 54 to register consecutively the subtractive operations of the machine. The clutch members last referred to consist of a crown-tooth clutch member 97 upon the hub 60 and a corresponding clutch member 98, secured to the staff 52.

The operation of my machine, which has been referred to from time to time in the foregoing specification, may be by way of summary briefly described as follows: Assuming that the operator wishes to combine a series of numbers by addition commencing at zero the first manipulation of the machine is to restore its several dial-plates 54, if need be, to the starting-point, or to that relative disposition of the several dial-plates in which each one exhibits a zero through its aperture 8 in the plate 7. To accomplish this, he presses the key C, thereby releasing the several hubs 60 and, holding it depressed, by a sweep of the finger across the disk heads 81 sets the machine. Then by manipulation of the respective actuating-bars 10 in the manner specified, preferably employing a stylus for the purpose, he draws down unit after unit of different denominations to its stop-piece 24, it being immaterial that the denominations be manipulated in consecutive order. If the selective operation and manipulation of the several actuating-bars 10 be correctly performed, the reading of the dial-plates will at any time correctly register the sum-total. The subtractive operation may be substituted for the additive of the machine by simply turning the disk head 47 and continuing the manipulation as before. It is obvious that this function of the machine may be utilized to advantage for correcting errors of manipulation in the operation of the machine for the accomplishing of addition.

What I claim is—

1. In a calculator the combination with a case provided with a septum, reciprocatory actuating-bars and their alining members on one side of the septum, and actuating bar-springs upon the other side of the septum, of means for imparting measured movement to the respective bars, and means for registering the degree of movement so imparted.

2. In a calculator the combination with a case provided with a septum, reciprocatory actuating-bars and their alining members on one side of the septum, and actuating bar-springs upon the other side of the septum, of means for imparting measured movement to the respective bars, and means for registering collectively the degree of movement so imparted.

3. In a calculator the combination with a case, spring-retracted actuating-bars provided respectively with a pair of racks, registering mechanism including pinions adapted to mesh with said racks, and means for shifting the pinions from engagement with one set of racks to the other.

4. In a calculator the combination with a case, spring-retracted actuating-bars provided respectively with a pair of racks, registering mechanism including pinions adapted to mesh with said racks, and means for shifting the pinions from engagement with one set of racks to the other, said means for shifting the pinions consisting of a pair of relatively adjustable pinion-bearing boxes.

5. In a calculator the combination with a case, spring-retracted actuating-bars provided respectively with a pair of racks, registering mechanism including pinions adapted to mesh with said racks, means for shifting the pinions from engagement with one set of racks to the other, said means for shifting the pinions consisting of a pair of relatively adjustable pinion-bearing boxes, and means for fixing the adjustment of the said boxes.

6. In a calculator the combination with a case, a plurality of spring-retracted actuating-bars, and registering mechanism including a corresponding plurality of staffs and dial-plates, of mechanism operatively connecting the respective bars and staffs, including clutch mechanism, whereby the positive movements only of the bars are registered, and mechanism for disengaging the clutch mechanism.

7. In a calculator the combination with a case, spring-retracted actuating-bars, and registering mechanism comprising respec-

tively staffs and dial-plates, of pinions operatively connecting the staffs and their respective bars, means for reversing the operative relations between said pinions to their bars, and means for simultaneously reversing the operative relations of said pinions to their dial-plates.

In testimony of all which I have hereunto subscribed my name.

FREDERICK G. JOHNSON.

Witnesses:
THOMAS STANDISH,
JOHN A CARROLL.