No. 801,163. PATENTED OCT. 3, 1905.

S. R. STALLARD.

CALCULATING MACHINE.

APPLICATION FILED MAR. 22, 1905.

2 SHEETS—SHEET 1.

Fig. 1.

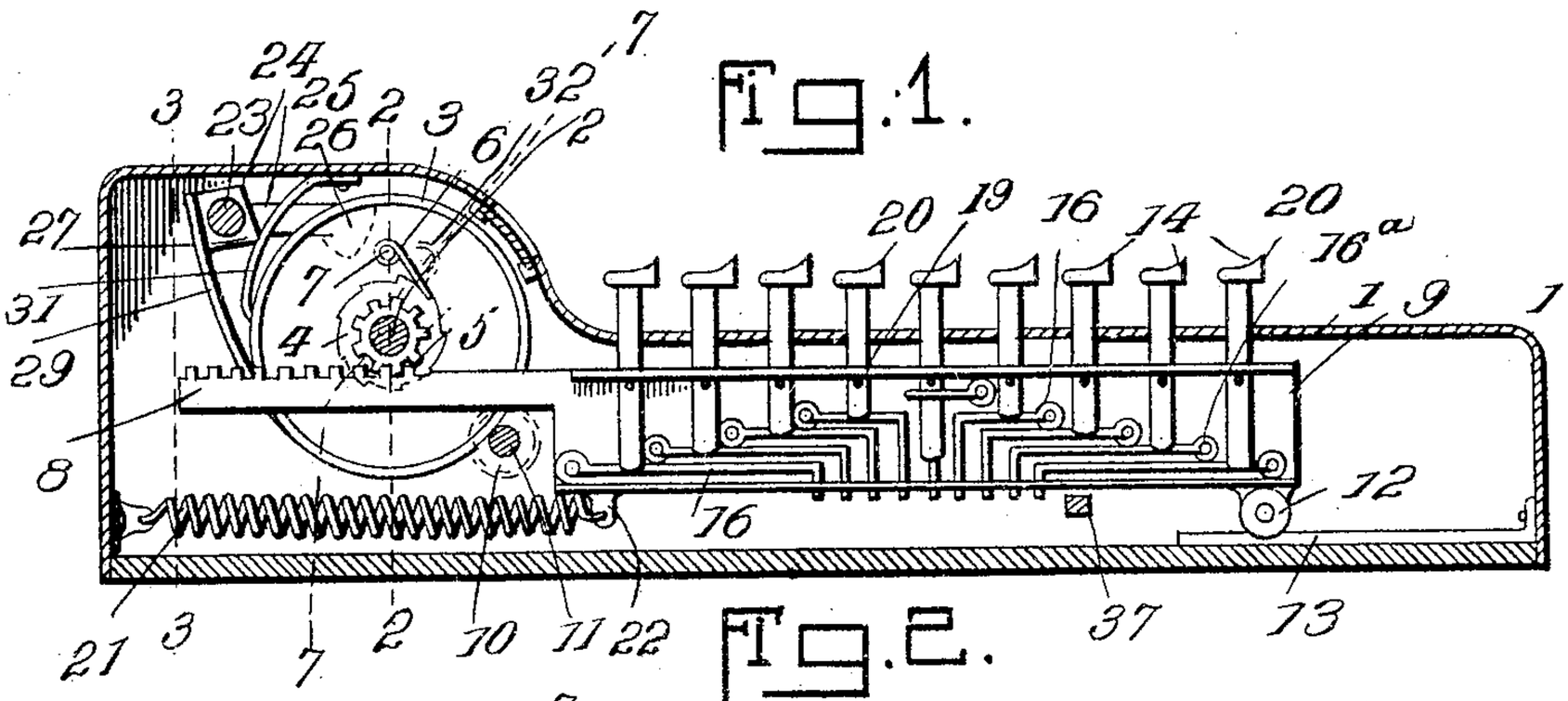


Fig. 2.

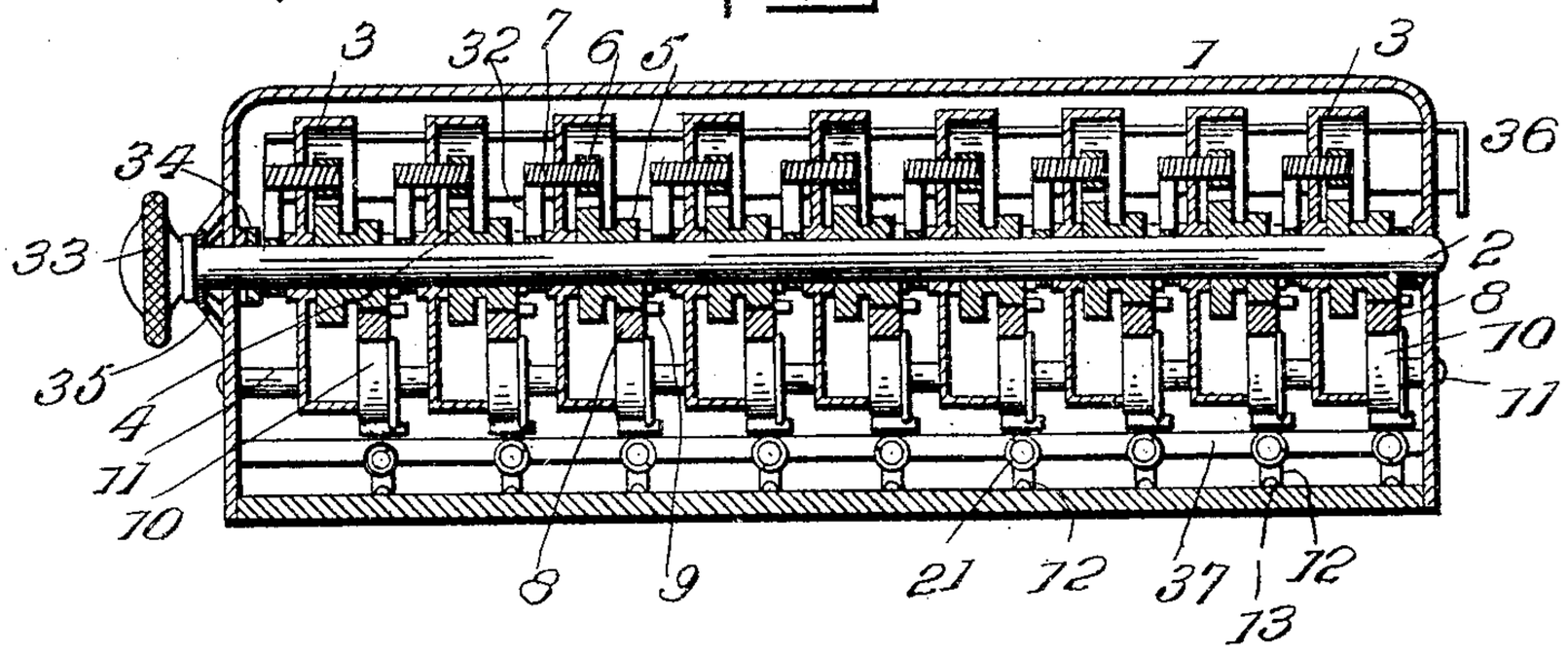
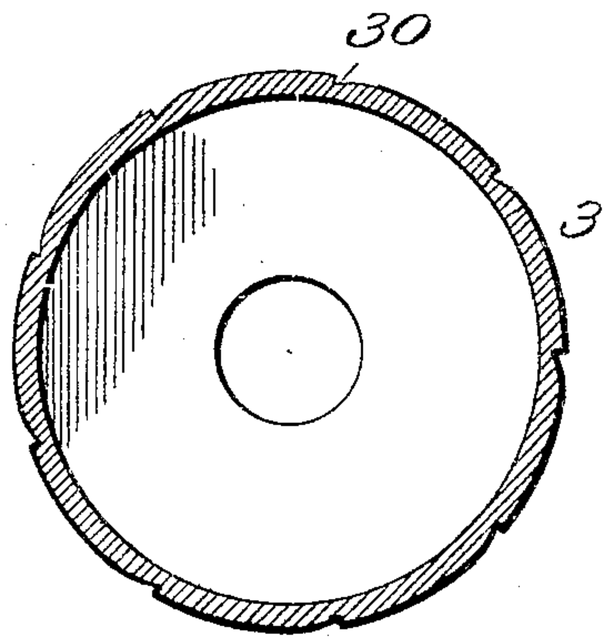


Fig. 5.



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2 SHEETS—SHEET 2.

Fig. 3.

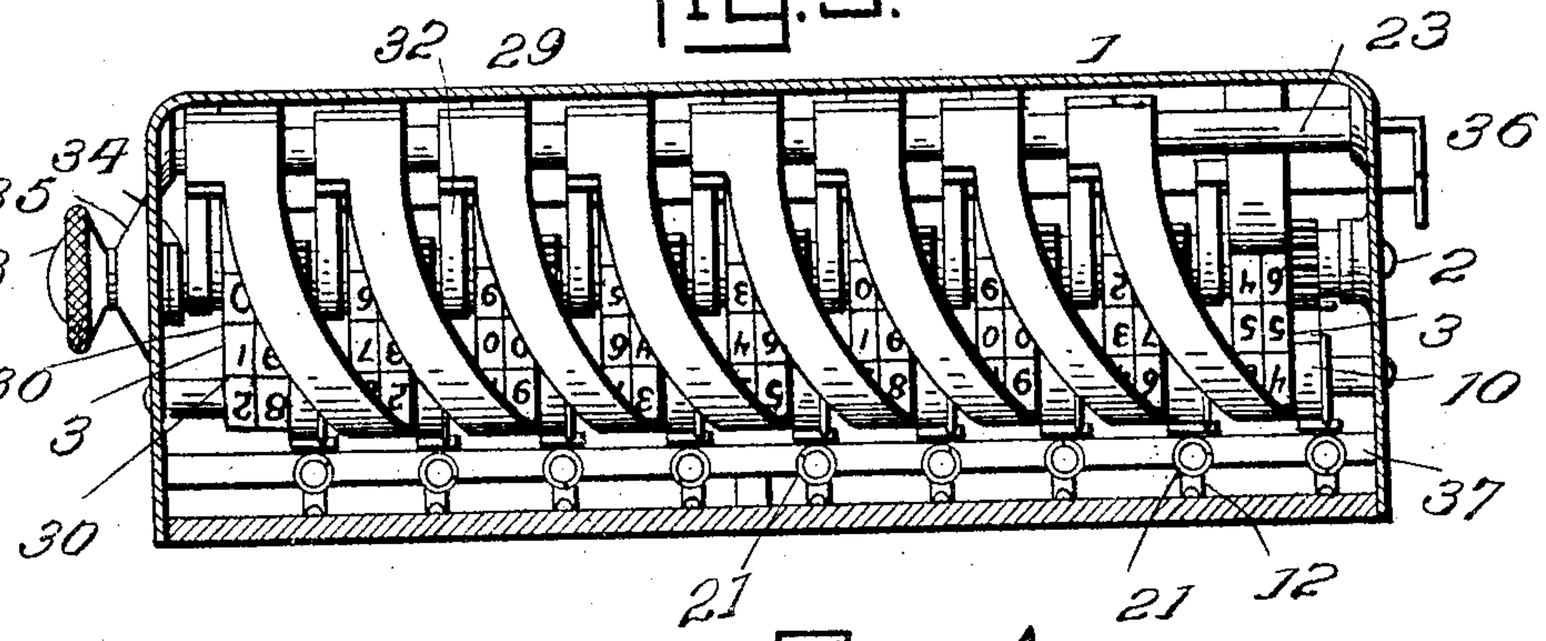


Fig. 4.

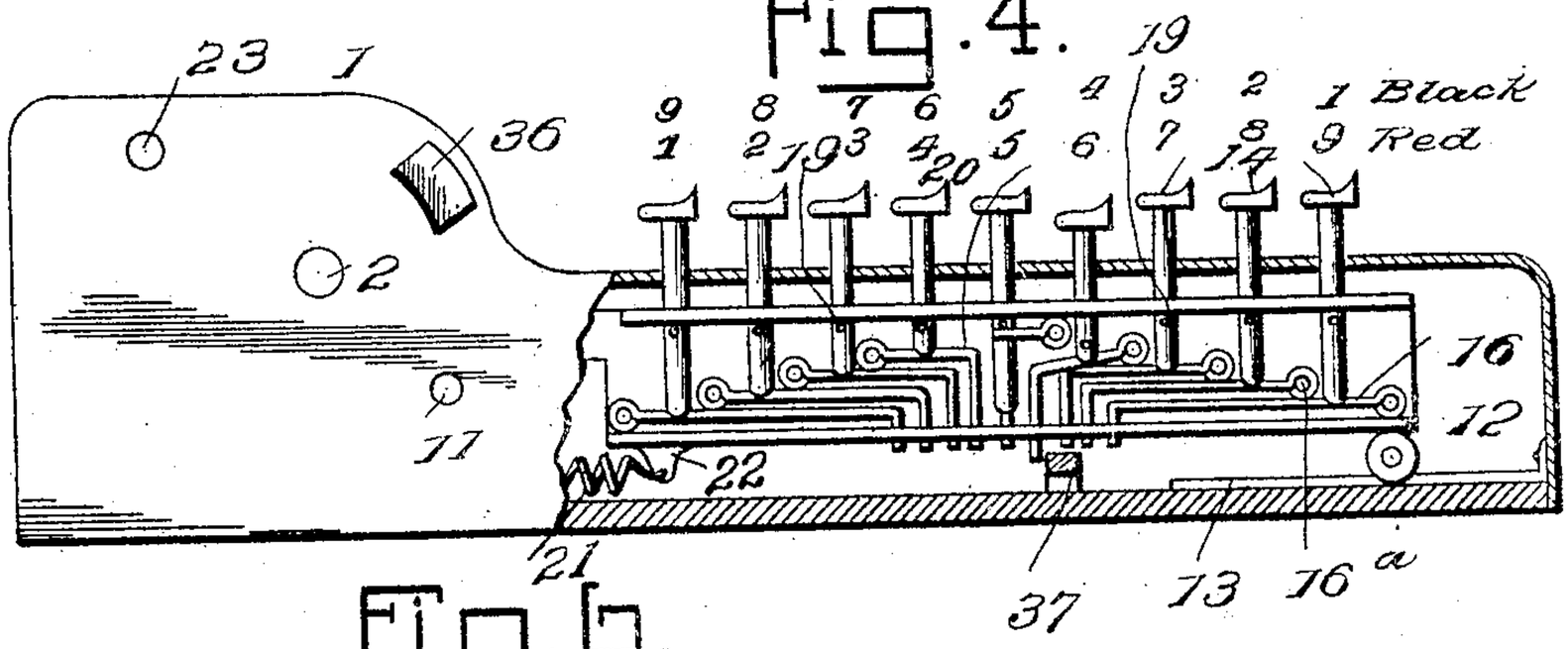


Fig. 6.

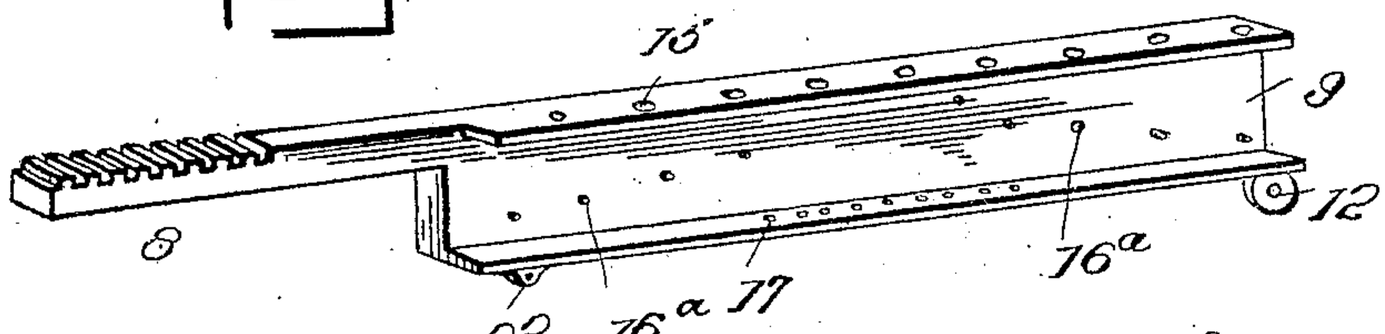


Fig. 7.

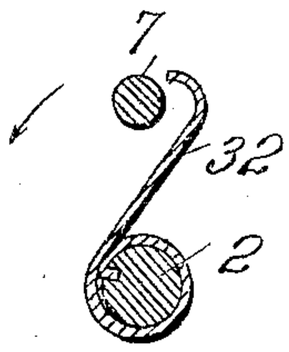


Fig. 9.

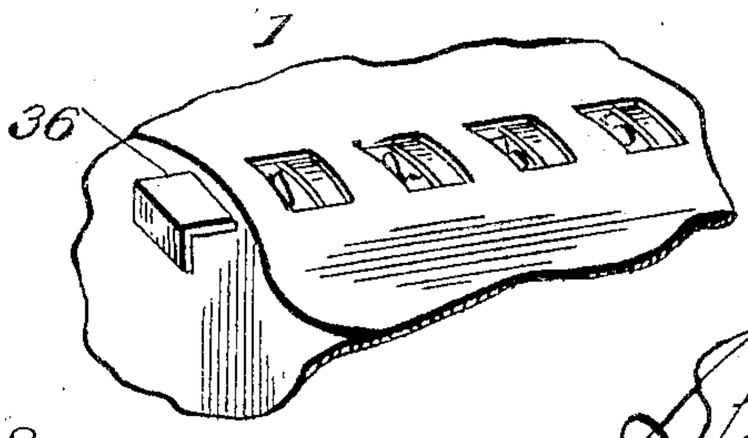
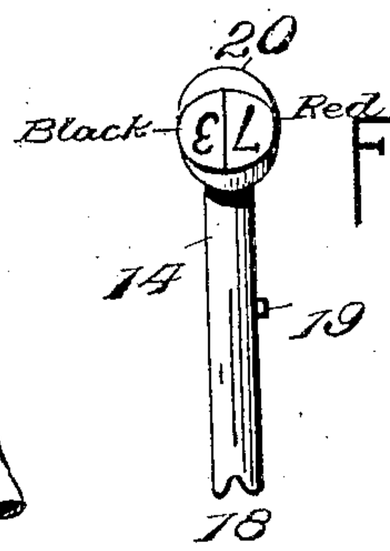


Fig. 8.



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UNITED STATES PATENT OFFICE.

SHERMAN R. STALLARD, OF EDMOND, WEST VIRGINIA.

CALCULATING-MACHINE.

No. 801,163. Specification of Letters Patent. Patented Oct. 3, 1905.

Application filed March 22, 1905. Serial No. 251,415.

To all whom it may concern:

Be it known that I, SHERMAN R. STALLARD, a citizen of the United States, residing at Edmond, in the county of Fayette and State of West Virginia, have invented certain new and useful Improvements in Calculating-Machines, of which the accompanying drawings and description are a specification.

One of the objects of my invention is to provide a calculating-machine wherein simplicity and compactness in construction and design are combined with effectiveness and accuracy in operation, and whereby fundamental arithmetic operations of addition, subtraction, multiplication, and division may be performed with rapidity and precision and with comparatively slight effort on the part of the operator.

A further object of my invention is to provide a machine of the character described that shall be useful in working mathematical problems or transacting business in which long accounts have a prominent part and whereby the danger of mistakes and errors is reduced to a minimum.

Other objects and advantages of my invention, as well as the structural features by means of which these objects are attained, will be made clear by an examination of the specification, taken in connection with the accompanying drawings, in which the same reference-numerals indicate corresponding portions throughout, and in which—

Figure 1 is a longitudinal cross-section of my machine, showing in side elevation the mechanism for operating the same. Fig. 2 is a cross-section taken on line 2 2 of Fig. 1. Fig. 3 is a cross-section taken on line 3 3 of Fig. 1, which, in conjunction with Fig. 1, illustrates the means for effecting a movement of the numeral-wheels when more than nine points has been struck on any wheel. Fig. 4 is a side elevation, partly in section, illustrating the manner in which the keys and key-guides are operated. Fig. 5 is a cross-section through one of the numeral disks or wheels and showing the grooves whereby it is held against backward rotation. Fig. 6 is a detail perspective view of one of the key-guides and the rack-bar formed integral therewith for turning the numeral-wheels. Fig. 7 is a cross-section on line 7 7 of Fig. 1, illustrating the means that I employ when setting the machine to zero, so that only naughts will be visible through the observation-holes on the top of the machine. Fig. 8 is an enlarged view of one of the operating-keys, showing two numerals thereon, the object of which will be hereinafter described, and also the means that I employ for retaining the keys in the key-guide. Fig. 9 is a partial perspective view of the face of the machine, taken at the observation-holes, and illustrates the slide that I employ for obscuring certain figures upon the numeral-wheels.

1 represents a case of any desired size and shape and which may be constructed of wood, metal, or any other suitable material, and which may be also of any preferred design. In this case is inclosed, with the exception of the key-heads, the entire working mechanism hereinafter described.

I accomplish the objects of my said invention by operating certain keys arranged in sets, and as the arrangement, operation, and construction of each set and the parts actuated thereby are identical a description of one set will suffice for all.

A shaft 2, suitably journaled in bearings, extends across the case 1 and has rotatably mounted thereon the cup-shaped wheels or disks 3. Also rotatably mounted upon said shaft is a ratchet 4 and a pinion 5, which are preferably formed integral with each other and so positioned that the ratchet is disposed within the cup or hollow portions of the wheel 3. A spring-pawl 6, secured to the wheel 3 by means of the pin 7 passing therethrough, engages the ratchet, whereby motion is imparted to said wheel or disk by means of the engagement of the pinion 5 with the rack-bar 8, formed integral with the key-guide 9, which slides backward and forward when operated, thus rotating the pinions. The rack-bar 8 is held in engagement with the pinion 4, as shown in Fig. 2, by means of the flanged wheel 10, which bears against the under side thereof and which is rotatably mounted upon a shaft 11. The rear end of the key-guide 9 is provided with a grooved wheel 12, which travels upon a rail 13, arranged in the rear end of the case 1. This key-guide 9 is further provided with numeral-keys 14 in numbers sufficient to operate the machine. As shown, each key-guide carries nine keys passing through the openings 15 and engaging the L-shaped spring-levers 16, said levers being preferably constructed of some suitable metal and secured at their upper ends to the guide by means of rivets 16^a, as shown in Figs. 1 and 4, while the other ends project through openings 17, which are arranged in the lower part

of the guide and closer together than the openings 15, so that the lower ends of the spring-levers occupy a lesser space in the lower part of the guide than the keys do in the upper part. The lower ends of the keys 14 are arched or grooved, as shown at 18, sufficient to span the spring-levers 16, the object being to prevent the keys from turning, and thus confusing the operator. In order to keep the keys in alinement, I provide the pins 19, which contact with the upper part of the key-guide and prevent the keys from being forced too far up by the spring-levers. The head of each key is circular in form and provided with two numerals, each numeral being preferably of a different color, one of which for the sake of convenience in describing the operations of my said device I have designated as red and the other as black and which correspond with numerals of like color on the wheel 3. These heads are each provided with an extension-lip 20, the object being to enable the fingers of the operator to obtain a purchase or leverage upon the keys in operating the machine. As a means of returning the key-guide to its normal position after it has been pulled backward in operating my device a spiral or helical spring 21 is employed, one end of which is attached to the case 1 and the other to the key-guide by a lug 22 or other suitable means.

A shaft 23 is suitably held upon each side of the case 1, and mounted thereon is a bell-crank lever 24, the object of which is to effect the movement of each succeeding numeral-wheel 3 to the left when more than nine points have been noted or indicated upon said wheel. For illustration, if seven, eight, or nine were indicated upon a certain wheel and five should be added thereto the result in twelve, thirteen, or fourteen would be shown upon two wheels. This lever 24 consists of an arm 25, provided with a wedge-shaped head 26, which is of any suitable length to be entirely operative, said arm being integral with the body portion 27, and secured to or formed integral with this body portion is the longer arm 29 of said lever, which is somewhat curved and arranged at an angle and which engages with the numeral-wheel to the left when viewing the machine from the rear. This arm 29 is in the nature of a leaf-spring, being comprised of some flexible and yielding material to make it operative in performing its function of turning the wheel or disk with which it contacts. The movement of the lever is effected by means of the pin 7, which only comes into contact with the wedge-shaped head 26 when more than nine points have been indicated upon the numeral-wheel. This pin 7 when contacting with the wedge-shaped head 26 tends to force it upward, causing the longer arm 29 to turn the wheel with which it contacts but one point, and to insure a perfect operation in this respect I provide small grooves or kerfs between the numerals on the wheel, as shown at 30, in which grooves or kerfs the longer arm 29 of the lever is adapted to fit and rest, the numeral-wheel and arm comprising, in effect, a ratchet and pawl. To return the lever to its normal position and at the same time prevent any backward movement of the wheel, I make use of a spring 31, one end of which is secured to the case while the other enters the small grooves or kerfs 30, and against this spring the body portion of the bell-crank lever is made to bear when the lever is operated by the pin 7; but as soon as said pin is disengaged from the lever the spring 31 will bring the aforesaid lever into its normal position, although it will still bear against the face of the numeral-wheel and in conjunction with the spring 31 will prevent said wheel from turning backward when the key-guide and keys return to their normal positions through the medium of the spring 21 after said keys and guide have been moved backward. It is obvious that the pressure of the spring 31 and lever 24 must be greater than the spring-pawl 6 in order to permit the pawl to rise and fall in the ratchet 4.

After each operation and before beginning another all the numeral-wheels should be turned back to zero, so as to show only naughts through the observation-holes, and in order that this may be accomplished I provide upon the side of each numeral-wheel a spring-pawl 32, mounted on the shaft 2, as shown in Fig. 7. When it is desired to turn back said numeral-wheels to set the machine at zero, the knob 33, mounted on the shaft 2, is turned to rotate said shaft until the spring-pawls 32 engage their hooked ends against the pin 7, thus rotating the numeral-wheels until the numerals thereon are all brought into line and only naughts are presented through the observation-holes. During the operation of the machine as the numeral-wheel 3 rotates it is obvious that the pin 6 will strike the rear of the spring-pawl 32 and, exerting force against its tension, pushes it slightly forward, so that the pin slips over the rounded part forming the hook. In order to prevent this pressure against the tension of said spring-pawl, which is only slight, from turning the shaft 2, I secure to said shaft a washer 34, bearing against the inner side of the case 1, which in conjunction with the spring-washer 35 yieldingly holds the shaft 2 against rotation while the pin 7 is passing over the spring-pawl. This spring-pawl must be so constructed as to exert but slight resistance against the pin 7 when it engages with the rear thereof, but possessing sufficient resiliency to cause it to resume its normal position immediately after the pin passes over the same.

As heretofore stated, each numeral-wheel has two rows of figures, one in black and the other in red, those in black being numbered

from one to naught, going around the face of each wheel clockwise, while those in red are numbered from naught to one clockwise—that is, opposite the black naught, a red naught; a black one, a red nine; a black two, a red eight; a black three, a red seven, and so in progression until there is a red nine opposite the black one. When the machine is operated, the movement of the wheels is the reverse of clockwise, with the result that the black numerals increase with each movement of the keys while the red numerals decrease. It is understood that as the numerals are in order upon the wheels so they are also upon the heads of the keys, as shown in Fig. 8.

As it would be confusing to have each row of numerals show at the same time, I provide a slide 36 having openings therein equal to the width occupied by one line of figures upon each numeral-wheel. The observation-holes in the case 1, as shown in Fig. 9, are equal in width and depth to the space occupied by the opposite figures upon each numeral-wheel, and when it is desired to cut out all black figures the thumb-piece upon the end of the slide is moved to the left so that only red figures are presented to view, and if moved to the right the view of the red figures is obstructed and only black figures are visible. The object of having double-faced wheels will herein more fully appear.

The black figures, both upon the numeral-wheels and keys, are used in addition and multiplication, and the red figures, both upon the numeral-wheels and keys, are used for subtraction and division. There are nine keys for each wheel, and the greatest amount that each one can register upon the numeral-wheels is nine—that is to say, the key-guide 9 can only be moved back a distance sufficient to turn nine points upon any of the numeral-wheels, and when the operations of one key is such as to indicate more than nine the transferring-lever 29 is brought into play so as to operate the next numeral-wheel. Each row of nine keys for operating one numeral-wheel contains or presents the following figures:

Red.	*Black.*
1	9
2	8
3	7
4	6
5	5
6	4
7	3
8	2
9	1
0	0

The operation of the keys is as follows: If it is desired to present the numeral "4" upon the machine with reference to the black letters, the key having the black "4" thereon is pressed downward and at the same time drawn backward, and since the pressing of the key forces one of the spring-metal levers 16 down the lower end thereof strikes a barrier 37, which prevents the key-guide 9 from moving backward a greater distance than is sufficient to indicate four points upon the numeral-wheel. Upon releasing the key the spring-lever returns the key to its place, and the key-guide, by means of the spring 21, is also returned to its normal position. It is understood that the numeral-wheel presented a black naught at the observation-hole, the red letters being hidden from view. Assume that the slide 35 is moved to the left, so that only red figures are visible through the observation-holes and leaving red naughts exposed. Now any figure exposed will necessarily be red, and in this instance we will strike the key having "9" and "1" thereon, the "9" being in red, and when the key is pressed and the guide pulled backward the red numeral "9" will be shown upon the wheel, since the black "1" allows the guide to move but one point before striking the barrier 37. If it is desired to show the numeral "6" instead of "9," the key having the red "6" and black "4" thereon would have to be pressed and the guide drawn backward, and since the guide can only move four points the red numeral "6" would show upon the wheel.

In addition the machine is operated as follows: The knob on the right is turned until only black naughts show through the observation-holes. Each set of figures to be added is struck upon the keys according to the black numbers corresponding to the digits in the respective set of figures—that is, two hundred and thirty-two is struck in the hundreds, tens, and units columns on the keys "2 3 2," which when these keys are drawn back two three two points will move the numeral-wheels a like number of points, so that they indicate "232," and should we add three hundred and sixty-three thereto the keys "3 6 3" in the hundreds, tens, and units columns would be pressed and drawn backward three six three points, likewise moving the numeral-wheels the same number of points, with the result that "595," or the sum of the two sets of figures, will be shown, it being understood that each wheel represents units, tens, hundreds, thousands, &c.

In subtraction the slide is moved so that only red figures are shown and the knob on the right is turned until red naughts are brought to view. The minuend is struck on the keys according to the red figures, and in this instance the minuend is six thousand two hundred and seventy-four, so that the key in the thousands-column containing the red "6," opposite which is the black "4," is moved backward, and since it can only move four points the red "6" will be shown upon the fourth numeral-wheel. The red "2" is struck

in the hundreds-column, and since the black "8" is the opposite figure on the same key it is manifest that the key-guide will move back eight points and the "8" from the naught will show "2" on the numeral-wheel in the hundreds-column. The red "7" opposite the black "3" is struck on the key in the tens-column, and since the key-guide carrying said key can only move back three points the "3" from the naught will indicate "7" upon the numeral-wheel in the tens-column. The key containing the red "4" and black "6" in the units-column is struck, and as the black "6" is the figure opposite the red one on said key the key-guide moves back six points, which, taken from the naught, leaves "4" showing on the numeral-wheel in the units-column. The amount that we desire to subtract is three thousand two hundred and sixty-three, which is done as follows: The black "3" is struck in the thousands-column, and since the key-guide can only move back three points it will leave "3" showing on the numeral-wheel, since three from six leaves three. The "2" is struck according to the black figures in the hundreds-column, and since it can only move two points the naught must, therefore, show upon the numeral-wheel in this column. The "6" is struck according to the black "6" in the tens-column, and as the guide moves back six points it must, therefore, turn the numeral-wheels six points, leaving "1" showing thereon. The black "3" in the units-column is struck and moved backward three points, and consequently deducts this many points or numbers from the "4" in this column, leaving "1" exposed to view, with the result that the difference between six thousand two hundred and seventy-four and three thousand two hundred and sixty-three is indicated on the numeral-wheels by the figures "3011."

In multiplication the slide is moved to the right, so that only black figures upon the numeral-wheels are visible through the observation-holes in the case of the machine, and since the multiplier contains two full hundreds it will be necessary to strike the "6" of the multiplicand in the hundred-thousands column, or the sixth column from the right. It is understood that the numeral-wheels were turned backward previous to the operation, so that only naughts were visible. The two naughts to the right of the multiplicand show the outcome of multiplying the multiplicand six thousand seven hundred and ninety-two by one hundred, the result being "679,200." By adding six hundred and seventy-nine thousand two hundred to the multiplicand the numeral-wheels will indicate "1,358,400" as the result of multiplying the multiplicand six thousand seven hundred and ninety-two by two hundred. Our next operation is to multiply each figure of the multiplicand by the ninety remaining in the multiplier and add them to the sum "1,358,400" showing on the numeral-wheels. Ninety multiplied by two equals one hundred and eighty, which we add to one million three hundred and fifty-eight thousand four hundred, changing the same to "1,358,580." We next multiply the "9" in the multiplicand by ninety, which equals eight hundred and ten, and which we add to the one million three hundred and fifty-eight thousand five hundred and eighty, changing the same to "1,366,680." The "7" of the multiplicand is multiplied by ninety, which equals six hundred and thirty, which, added to one million three hundred and sixty-six thousand five hundred and eighty, changing the same to "1,429,680." The six multiplied by ninety equals five hundred and forty, and which added to the one million four hundred and twenty-nine thousand six hundred and eighty changes the same to "1,960,680," which is the result of multiplying six thousand seven hundred and ninety-two by two hundred and ninety. It will be observed that as we mentally multiplied each figure of the multiplicand by the ninety of the multiplier we placed the first product in the first three columns from the right, the second product in the first four columns from the right, the third product in the first five columns from the right, and the fourth product in the first six columns from the right. Inasmuch as any sum can be multiplied in a similar manner it is deemed unnecessary to enter into further explanation.

In division the slide is moved to the left, so that only red numerals are visible through the observation-holes, and the knob is turned backward until only red naughts are presented to view. For illustration we will divide two thousand seven hundred and thirty-six by twelve. We strike the dividend "2736" upon the machine according to the red keys. Then, starting from the left, we commence to subtract the divisor from the dividend until nothing or a number less than the divisor remains, the operation being as follows and identical with the explanation of that pertaining to subtraction—namely, we record in red numbers upon the numeral-wheels according to the red numbers upon the keys and subtract according to the black numbers upon the keys. "2736" being recorded in red numbers upon the numeral-wheels, we will proceed to divide the same by twelve. We strike "1" and "2" in separate columns, and, according to the black letters on said keys, directly underneath the "27" part of the dividend. This will change the dividend into "1536." We again strike the "1" and "2" in same columns, according to the black letters, directly underneath the "15" part of the dividend. This changes or lessens the dividend to "336," of which the "3" to the left is what remains of the "15" after the "12" is subtracted therefrom. Now we note the

fact that we subtracted the "12" from the "27" and likewise the "12" from the "15," leaving only "3," and since twelve cannot be arithmetically subtracted from three it is necessary that we move one figure to the right, which makes "33;" but before we start to subtract from the thirty-three we note the fact that the number of subtractions from the first column was two, which is mentally noted or recorded on the machine, the said two being the beginning of the quotient. We then subtract twelve from thirty-three, which leaves "21," from which we also subtract twelve, which leaves "9," and here it will be noted that we subtracted twelve from thirty-three twice, leaving "9" as a result, from which twelve cannot be subtracted, and the two subtractions are placed to the right of the other "2" which we have previously recorded, making "22." We bring down the remaining figure of the dividend, which is "6," making the entire dividend "96," and from this we subtract twelve, which leaves "84." From eighty-four we subtract twelve, leaving "72;" from seventy-two we subtract twelve, leaving "60;" from sixty we subtract twelve, leaving "48;" from forty-eight we subtract twelve, leaving "36;" from thirty-six we subtract twelve, leaving "24;" from twenty-four we subtract twelve, leaving "12;" from twelve we subtract twelve, leaving nothing, and since we have subtracted twelve from ninety-six eight times we add the "8" to the right of the two recorded twos, making "228," which is the quotient, or the number of times that twelve will go into two thousand seven hundred and thirty-six. It is to be understood that this long operation is unnecessary, since in this particular instance the operator could double up on his divisor—that is, instead of subtracting twelve from twenty-seven he would subtract twenty-four therefrom, leaving "3." Nevertheless he would record it two subtractions. The operator would likewise know that twelve went into ninety-six eight times, and instead of unnecessarily manipulating the keys he would simply add the "8" to the quotient. Had the final letter to the right been "9" instead of "6," there would have been a remainder of three instead of naughts and the quotient would have been "$228\frac{3}{12}$" times instead of "228." Any full number can be divided by any full number, and it is therefore believed to be unnecessary to enter into a further explanation or to present other examples.

It is obvious that other mathematical problems can be solved upon this machine and that various modifications of form and arrangement of parts can be made without departing from the scope and spirit of my invention as described and shown, and I do not, therefore, desire to be limited to the construction, arrangement, and operations shown.

Having thus described my said invention, what I claim as new, and desire to secure by Letters Patent of the United States, is—

1. A calculating-machine comprising a suitable case, a shaft rotatably mounted therein, a plurality of numeral-bearing disks rotatably mounted on the shaft, integrally-formed ratchets and pinions rotatably mounted on the shaft between the numeral-disks, a pawl mounted on each disk and engaging one of the ratchets, a rack-bar meshing with each pinion, means for longitudinal reciprocation of each rack-bar whereby the disks are rotated to present the numerals thereon to openings in the case, a bell-crank lever mounted opposite each disk and having one of its arms engaging a succeeding disk to rotate the same when more than nine points have been indicated on the disk opposite the lever, means for operating said lever, a pin projecting from each disk, and spring-pawls mounted on the shaft between the disks and adapted to engage the pins whereby by rotating the shaft the numeral-disks are given reverse rotation to bring the numerals thereon into alinement.

2. A calculating-machine comprising a case, a shaft rotatably mounted therein, numeral-bearing disks rotatably mounted on the shaft, combined ratchets and pinions rotatably mounted on the shaft between each disk, pawls mounted on the disks and engaging with the ratchets whereby the disks are rotated, spring-controlled rack-bars meshing with the pinions and whereby they are rotated, spring-actuated keys mounted on the rack-bars whereby they are actuated longitudinally of the case, spring-pawls mounted on the shaft, pins mounted on the disks and adapted to engage the pawls when the shaft is given reverse rotation and whereby the disks may be reversely rotated to assemble the numerals in alinement, and yielding means holding the shaft against reverse rotation when the pins engage the rear of the pawls.

3. A calculating-machine comprising a case, a shaft rotatably mounted therein, numeral-bearing disks rotatably mounted thereon, integrally-formed ratchets and pinions rotatably mounted on the shaft, a pawl mounted on each numeral-bearing disk and engaging one of the ratchets, a rack-bar meshing with each pinion whereby rotary motion is imparted to the numeral-bearing disks through the medium of the ratchets and pawls, a key-guide formed integral with each rack-bar, spring-levers mounted on the key-guides, keys having arched ends spanning the levers and whereby the key-guides may be actuated, a spring connected with each key-guide whereby it is returned to its normal position when actuated by the keys, and a stop in the case with which the lower ends of the spring-levers engage to limit the movement of the key-guides.

4. In a calculating-machine, a case, a shaft rotatably mounted therein, numeral-bearing wheels rotatably mounted on the shaft, a fixed

shaft, levers mounted thereon, a pin projecting from each wheel and adapted to engage and operate one of the levers, a spring-arm on each lever contacting with and moving a succeeding wheel when said lever is operated by one of the pins, a spring adapted to prevent a reverse movement of said wheel when the lever is disengaged from the pin, and also operating to return the lever to its normal position.

5. In a calculating-machine, a case, a shaft rotatably mounted therein, numeral-bearing disks rotatably mounted thereon, integrally-formed ratchets and pinions rotatably mounted on the shaft, a pawl on each wheel engaging one of the ratchets, key-guides, rack-bars formed integral with the key-guides and meshing with the pinions, spring-levers mounted on the key-guides, keys mounted on the spring-levers, a cross-bar mounted in the case and adapted to limit the rearward movement of the key-guides by engaging the levers when depressed by the keys, and thereby limiting the movements of the disks.

6. A calculating-machine comprising a case, a shaft rotatably mounted therein, numeral-bearing disks rotatably mounted on the shaft, each of said disks having a plurality of grooves arranged on its periphery transversely thereof, integrally-formed ratchets and pinions rotatably mounted on the shaft, a pawl connected with each disk and engaging one of the ratchets, a rack-bar meshing with each pinion, flanged wheels supporting the rack-bars, key-guides formed integral with the rack-bars, spring-levers mounted on the key-guides, keys mounted in the key-guides and bearing numerals corresponding to those on the disks mounted in the key-guides, said keys being arranged to engage the spring-levers, and also affording means whereby rearward motion may be given the key-guides, a stop arranged in the case and adapted to be engaged by the lower ends of the spring-levers to limit the rearward movement of the key-guide, wheels supporting the rear ends of the key-guides, tracks traveled by the wheels, a spring secured to each rack-bar and adapted to return such bar and guide to its normal position, a fixed shaft, a bell-crank lever mounted thereon opposite each disk and having one of its arms engaging the succeeding disk, a pin on each disk adapted to engage one of the bell-crank levers when more than nine points have been indicated upon such disk whereupon said bell-crank lever imparts motion to a succeeding disk by means of one of its arms resting in one of the transverse grooves in the periphery of said disk, spring-pawls mounted on the rotatable shaft and adapted to engage the pins on the disks, means connected with the rotatable shaft whereby it may be given reverse rotation to bring the numerals on all the disks into alinement, and yielding means adapted to hold said shaft against reverse rotation when the pins on any of the disks contact with the rear of any of said spring-pawls.

7. A calculating-machine comprising a case, a shaft rotatably mounted thereon, numeral-bearing disks rotatably mounted thereon, a fixed shaft, a bell-crank lever mounted thereon over each disk and arranged to impart motion to a succeeding disk, integrally-formed ratchets and pinions rotatably mounted on the rotatable shaft, a pawl carried by each disk and engaging with one of the ratchets, a rack-bar meshing with each pinion, flanged wheels upon which the rack-bars are adapted to travel and be held in mesh with the pinions, a key-guide formed integral with each rack-bar, spring-levers mounted on the key-guides, numeral-bearing keys having grooved ends spanning the spring-levers, a spring secured to the end of each rack-bar which operates in conjunction with the keys to impart reciprocating motion to the rack-bars and key-guides, a stop arranged to engage with the lower ends of the spring-levers and limit the motion of the key-guides, spring-pawls mounted on the rotatable shaft, pins projecting from the disks and engaging the spring-pawls whereby, by rotating the shaft, the disks are rotated to bring the numerals thereon into alinement, said pins also engaging the bell-crank levers and imparting motion thereto, springs engaging the bell-crank levers to restore them to position when disengaged by the pins, and yielding means to hold the first-mentioned shaft against reverse rotation when the pins engage the rear of the spring-pawl.

8. A calculating-machine comprising a case, a shaft rotatably mounted therein, numeral-bearing disks rotatably mounted on the shaft, key-guides mounted in the case, wheels supporting the key-guides, spring-levers mounted on the key-guides, keys arranged on the key-guides in rows extending longitudinally thereof and bearing numerals presented successively to correspond to those on each disk, and a rack and pinion, ratchet-and-pawl connection between each key-guide and each disk whereby the disks are rotated to present the numerals thereon to openings in the case.

9. A calculating-machine comprising a case, a shaft rotatably mounted therein, numeral-bearing disks rotatably mounted on the shaft, key-guides mounted in the case and adapted to be reciprocated, spring-levers mounted on the key-guides, keys arranged on each key-guide in a row extending longitudinally thereof and bearing numerals identical with those on the disks and presented successively to correspond to their order, a rack and pinion, ratchet-and-pawl connection between each key-guide and each disk whereby the disks are rotated to present the numerals thereon successively to openings in the case, spring-pawls secured to the shaft, and pins on the

disks adapted to be engaged by the pawls whereby, when the shaft is rotated, the disks may be given reverse rotation to bring the numerals thereon into alinement.

10. A calculating-machine comprising a case, a shaft rotatably mounted therein, numeral-bearing disks rotatably mounted on the shaft, key-guides mounted in the case and adapted to be reciprocated, spring-levers mounted on the key-guides, keys arranged on each key-guide in a row extending longitudinally thereof and bearing numerals identical with those on the disks and presented successively to correspond to their order, a rack and pinion, ratchet-and-pawl connection between each key-guide and each disk whereby the disks are rotated to present the numerals thereon successively to openings in the case, spring-pawls secured to the shaft, pins on the disks adapted to be engaged by the pawls whereby, when the shaft is rotated, the disks may be given reverse rotation to bring the numerals thereon into alinement, a fixed shaft, a bell-crank lever mounted on the fixed shaft opposite each disk, a head mounted on one arm of each of said levers, and a pin mounted on each disk and adapted to engage the head and operate the lever to rotate a succeeding disk when more than nine points are indicated on the disk on which said pin is mounted.

11. A calculating-machine comprising a case, a shaft journaled therein, a plurality of numeral-bearing disks rotatably mounted thereon, a pawl carried by each disk, a plurality of spring-controlled key-guides, spring-actuated numeral-bearing keys slidably mounted in the key-guide, a rack formed with one end of each key-guide, integrally-formed ratchets and pinions rotatably mounted on the shaft, the pinions engaging the racks, and the ratchets engaging the pawls on the numeral-disks whereby the disks are rotated to present the numerals thereon to openings in the case, a pin carried by each disk, spring-pawls carried by the shaft and engaging the pins whereby the numeral-disks are rotated to bring the numerals thereon into alinement, means for yieldingly holding the shaft against rotation when the pins engage the rear of said spring-pawls, and bell-crank levers having one arm engaging one of the wheels and the other arm arranged to engage the pins, yielding means preventing the disks from rotating when the key-guides are returned to their normal position, and also operating to return the bell-crank lever to its normal position when disengaged from the pins, a grooved wheel carrying one end of each key-guide, and tracks upon which said wheels are arranged to travel.

12. In a calculating-machine, the combination, with a suitable case, of spring-retarded key-guides movably mounted therein, spring-levers mounted on each guide and having one end thereof secured to the guide, and the other end bent at right angles and passing through holes in the bottom of the guide, numeral-bearing keys having grooved ends spanning and engaging the levers, and pins mounted on the keys to contact with the upper part of the guides and limit the action of the keys.

13. In a calculating-machine, the combination, with a suitable case, of spring-retarded key-guides movably mounted therein, spring-levers mounted on each guide and having one end thereof secured to the guide, and the other end bent at right angles and passing through holes in the bottom of the guide, numeral-bearing keys having grooved ends spanning and engaging the levers, pins mounted on the keys to contact with the upper part of the guides and limit the action of the keys, and a stop mounted in the case and adapted to be engaged by the free ends of the levers and limiting the movement of the guides.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 23d day of February, 1903.

SHERMAN R. STALLARD.

Witnesses:
W. S. KERNS,
T. M. YOUNG.