(No Model.)

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6 Sheets—Sheet 1.

L. BOLLEE.

CALCULATING MACHINE.

No. 556,720. Patented Mar. 17, 1896.

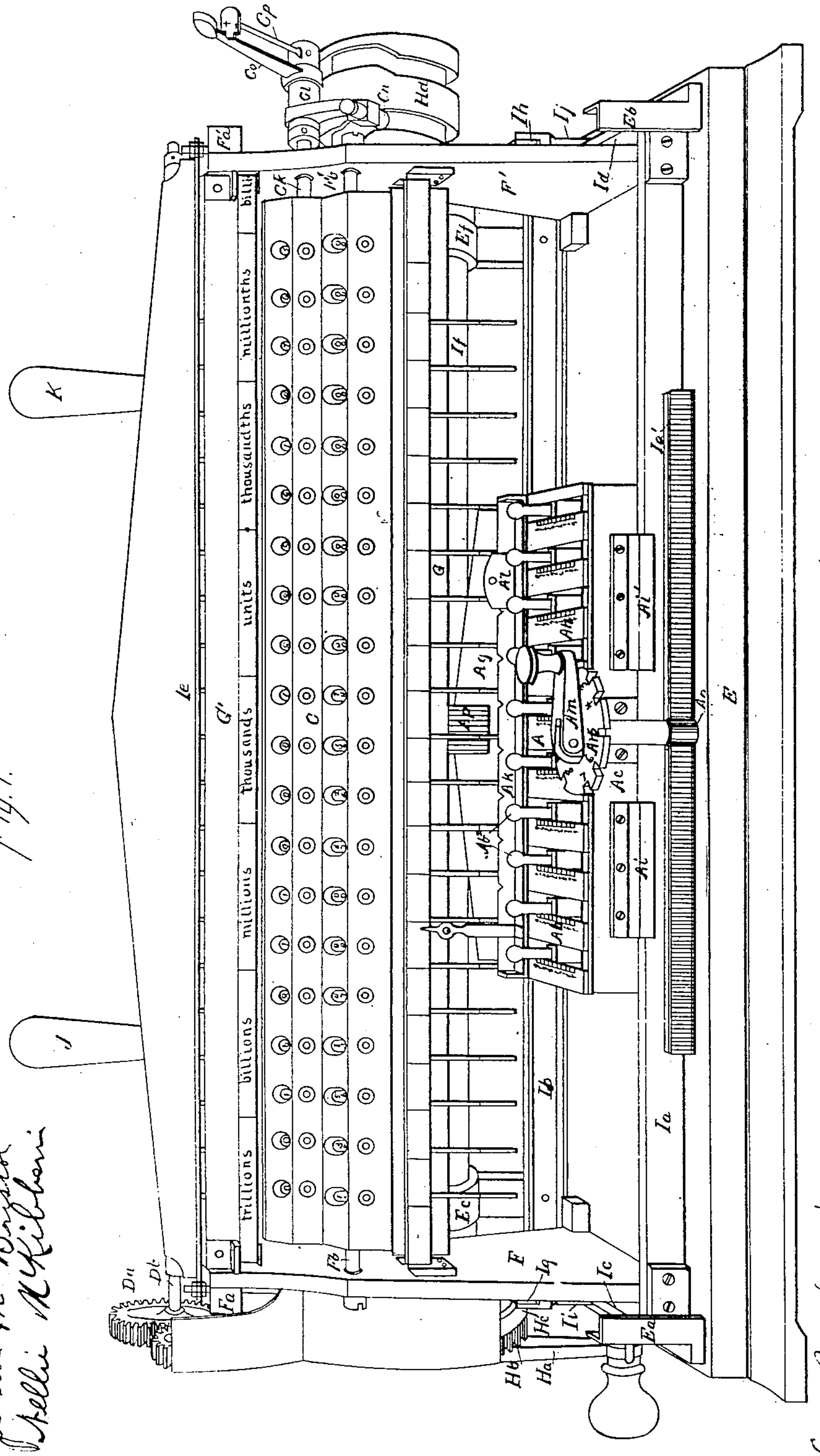

Fig. 1.

WITNESSES,

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ATTORNEYS,

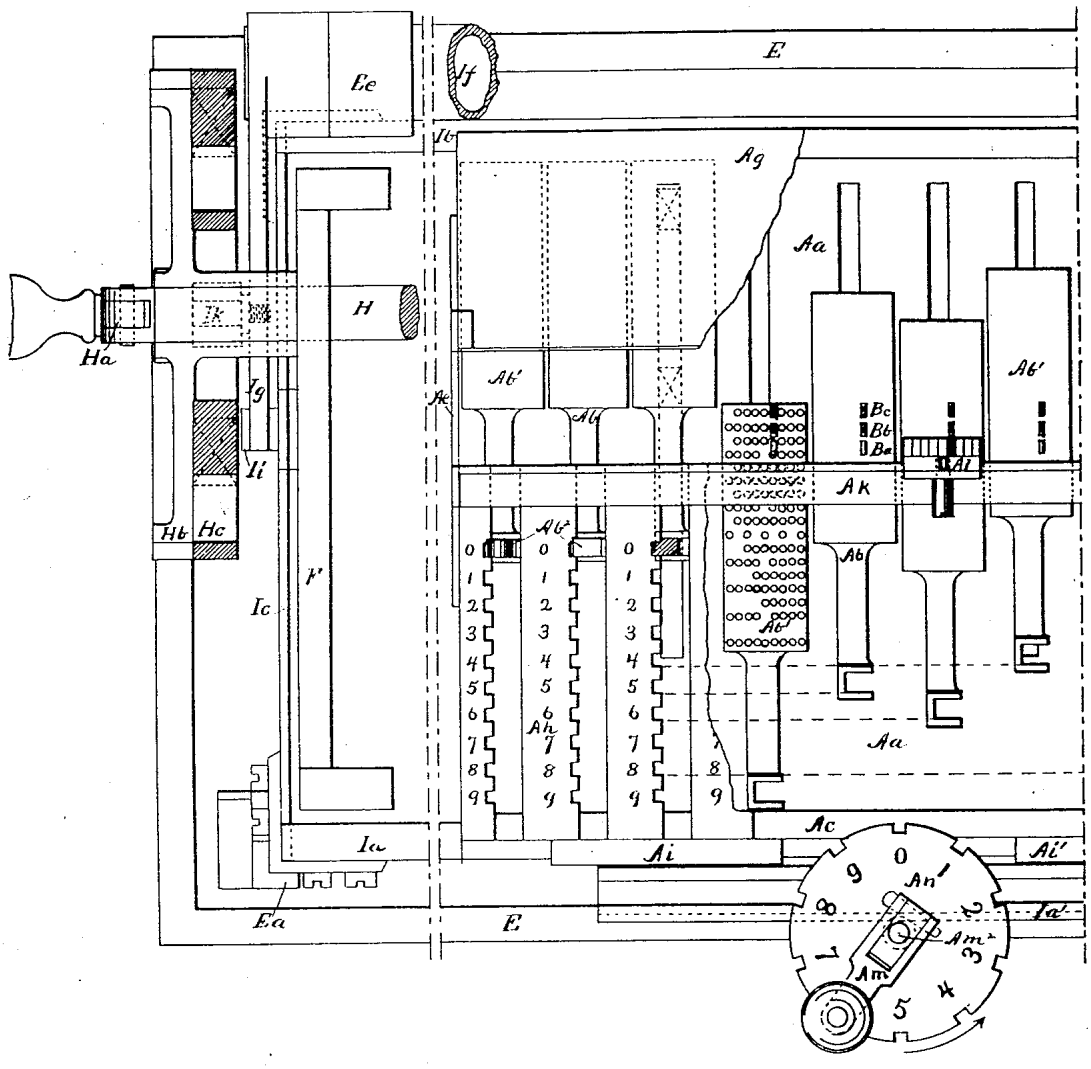
(No Model.) 6 Sheets—Sheet 2.

L. BOLLÉE.

CALCULATING MACHINE.

No. 556,720. Patented Mar. 17, 1896.

Fig. 2



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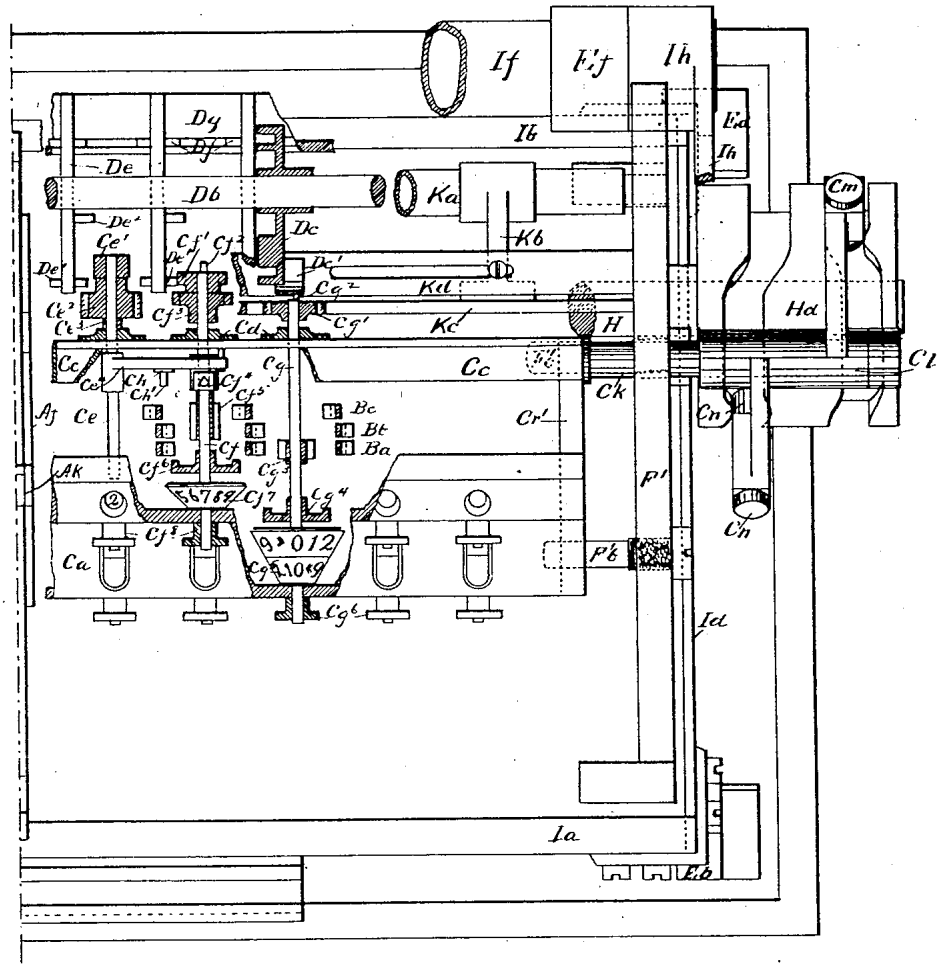
(No Model.) 6 Sheets—Sheet 3.

L. BOLLÉE.

CALCULATING MACHINE.

No. 556,720. Patented Mar. 17, 1896.

Fig. 2a.



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(No Model.)

6 Sheets—Sheet 4.

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CALCULATING MACHINE.

No. 556,720. Patented Mar. 17, 1896.

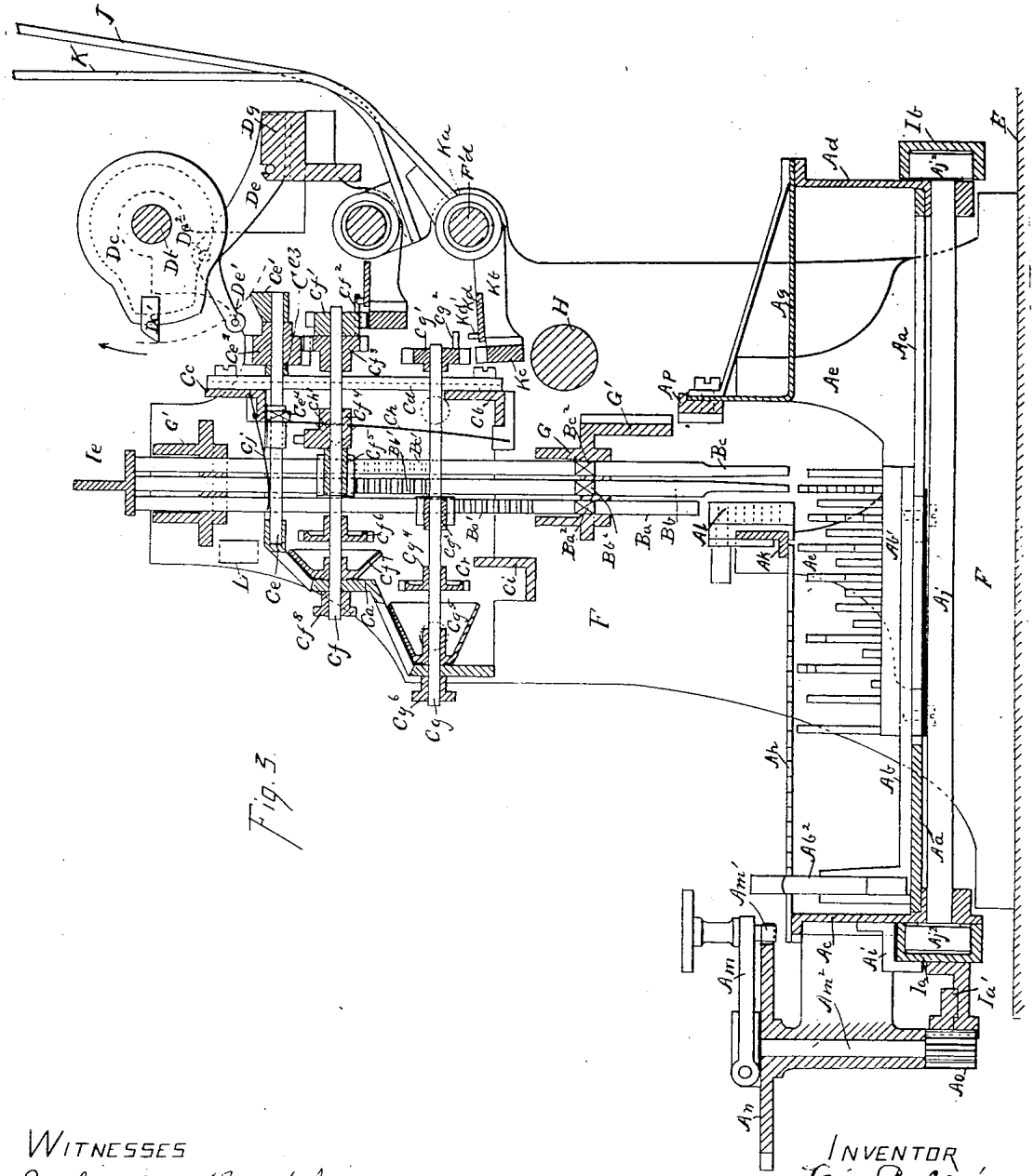

Fig. 3.

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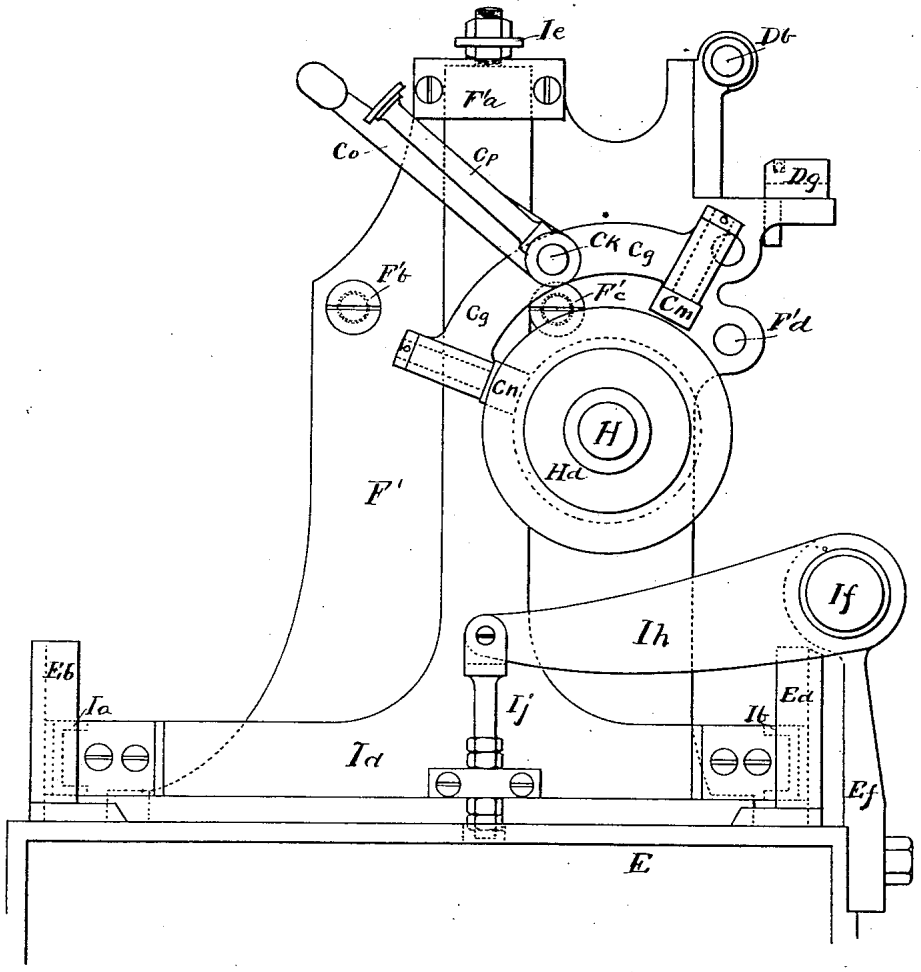
L. BOLLÉE.

CALCULATING MACHINE.

No. 556,720. Patented Mar. 17, 1896.

Fig. 4.



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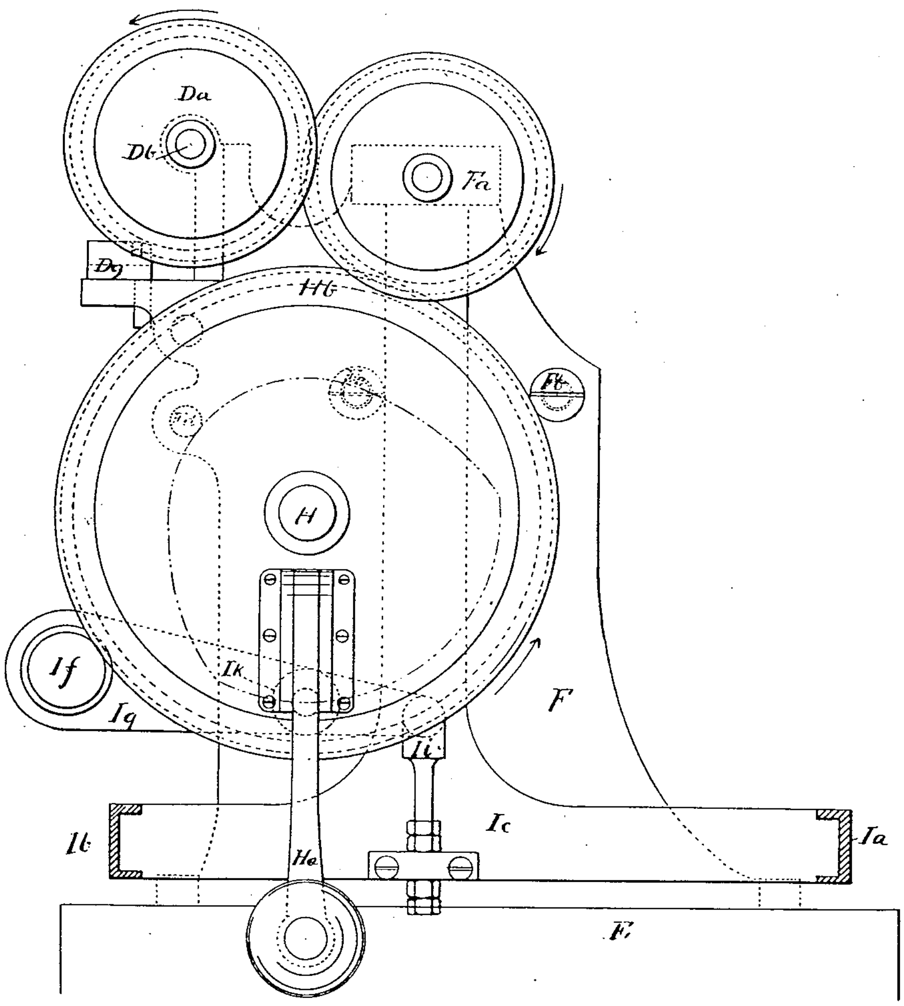
L. BOLLÉE.

CALCULATING MACHINE.

No. 556,720. Patented Mar. 17, 1896.

Fig. 5.



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UNITED STATES PATENT OFFICE.

LÉON BOLLÉE, OF MANS, FRANCE.

CALCULATING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 556,720, dated March 17, 1896.

Application filed November 16, 1895. Serial No. 569,205. (No model.) Patented in France September 20, 1889, No. 201,033; in England October 22, 1889, No. 16,677, and in Belgium March 11, 1891, No. 94,099.

To all whom it may concern:

Be it known that I, LÉON BOLLÉE, a citizen of the French Republic, residing at Mans, in the Province of Sarthe and Republic of France, have invented certain new and useful Improvements in Calculating-Machines, (for which I have obtained Letters Patent in France, No. 201,033, dated September 30, 1889; in Great Britain, No. 16,677, dated October 22, 1889, and in Belgium, No. 94,099, dated March 11, 1891,) of which the following is a specification.

This application is filed in the place of and as a continuation of my original application for Letters Patent of the United States, Serial No. 330,157, filed November 13, 1889, for the same invention, and which application was permitted to become abandoned by my attorneys without my knowledge or consent by failure to respond to the action of the office within two years, as required by the statutes.

My invention relates to that class of devices known as "calculating-machines," and designed primarily for the operations of multiplication and division, but which can be used for addition and subtraction, as well as any mathematical calculations employing these operations.

By the use of my device numbers with several decimal places can be multiplied or divided with much greater rapidity than by the use of logarithmic tables, and with absolute accuracy which is not attainable by the use of logarithms.

As before stated, my invention is designed primarily for multiplication and division, and contains a series of what I call "controllers," which may be described as material embodiments of the multiplication-table—that is, mechanical means, consisting in my invention of pins of varying lengths mounted upon a plate, so arranged that when adjusted for the product of one figure by another figure two pins will, by their varying lengths, represent the units and tens of the product, which may be transmitted by rack-bars or otherwise to the units and tens wheels having indicating-figures. By employing a plurality of these plates and adjusting them individually in one direction to represent the figures of a multiplicand, and adjusting them as a unit in another direction to represent successively the figures of the multiplier, and transmitting the amounts of each partial product as soon as obtained, the product of a multiplicand of any desired length can be obtained by setting the plates as a unit and operating the transmitter as many times as there are figures in the multiplier. As compared with the mental operation of multiplying two numbers, the machine is much faster, as instead of multiplying the figures of the multiplicand one at a time by each figure of the multiplier it multiplies all the figures of the multiplicand at a time by each figure of the multiplier, and instead of setting down these partial products separately, as is done mentally, it adds them as fast as obtained to the sum of those previously obtained, so that upon multiplying by the last figure of the multiplier you have the total product instead of a series of partial products yet to be added together.

It also embodies, as a primary and fundamental structure, a series of racks, which are moved simultaneously, and a corresponding series of gear-wheels connected to numeral wheels or dials mounted in a frame and movable therewith from their normal position out of the plane of movement of said racks into the plane thereof during such portion of the movement of said racks as it may be desired to register, and out of the plane thereof during the remainder of the movement, together with means for carrying over on each wheel or dial to the next higher one in succession, from the lowest to the highest denominations, any tens that may have accrued by a dial passing over a zero-indication during the portion of the movement of the racks or operation of the machine that the gear-wheels are not in the plane of movement of the racks. These racks may be straight, and in that case they would have to reciprocate, or they may be curved, in which case they might reciprocate or move forward continuously. The differential movement of the gear-wheels desired may be effected in several ways, such as by moving the racks a differential distance at each operation, or by moving them a uniform distance and previously adjusting them so that the teeth will only be engaged for the

differential distance desired, or by having selecting means to throw the wheels out of or into mesh with the racks at different periods of the operation.

My invention also relates more specifically to the use of controllers, as mentioned above, for determining the differential movements of the racks co-operating with the wheels, as above referred to. If it is desired to employ the machine for addition solely, in which each number may be considered as the product of itself by one, it will not be necessary to have controllers arranged for a multiplier of all figures, but only for the figure 1, which simplifies the controller greatly.

My invention also relates to various other features for simplifying and making effective the various mechanical structures necessary in calculating-machines, and such features, as well as the ones before metioned, will be more fully set forth in the following description, as well as in the claims annexed.

I have illustrated my invention in the accompanying six sheets of drawings, in which the same reference-letters are used to designate identical parts in all the figures, of which—

Figure 1 is a perspective view of the front of the machine. Figs. 2 and 2ª together constitute a plan, partly in section, taken on different planes. Fig. 3 is a transverse vertical section taken through the axis of the handle of the controlling apparatus, and Figs. 4 and 5 are views of the opposite ends of the machine.

E is the base-plate, from which, nearly at its ends, rise two standards F and F′ fixed parallel to each other, and which support the receiver C and the two horizontal cross-bars G and G′, which are properly perforated to serve as guides for the vertical rack-bars B constituting the transmitter. These standards F and F′ also support a shaft H, which passes through them, and upon the left-hand end of which are fastened in order a crank-handle H*a*, a gear-wheel H*b*, and a cam-disk H*c*, while the right-hand end carries also rigid therewith a grooved drum H*d*.

The controlling mechanism or controller A is carried by hollow rails I*a* and I*b* at the front and rear respectively, which are connected by cross-bars I*c* and I*d* of an inverted-T shape at either end, and which in turn are connected at the top of the machine by a cross-bar I*e*, which is vertically adjustable by means of screws and nuts. The frame formed by the bars I*a*, I*b*, I*c* and I*d* is fitted in the four guides E*a*, E*b*, E*c* and E*d* placed at the four corners of the base-plate and in two other guides F*a* and F′*a* at the top and exterior of the standards F and F′

At the rear of the machine is a rock-shaft I*f*, turning in bearings E*e* and E*f*, rising from the base-plate, and having fast thereon at the left and right hand ends, respectively, the two levers I*g* and I*h*, from which are suspended by links I*i* and I*j*, respectively, the cross-bars I*c* and I*d*. The lever I*g* also carries an outwardly-projecting friction-roller I*k*, which runs in a cam-groove, (indicated by dotted line in Fig. 5,) upon the inner face of the disk H*c*, so that during each rotation of the shaft H by its handle H*a* the hollow rails I*a* and I*b* will be raised parallel to each other and to the same height and then lowered to initial position. The guide F*a* also carries a stub-shaft, upon which is mounted an intermediate gear-wheel which transmits motion from the gear-wheel H*b* to a pinion D*a* of one-half its diameter, which is fast to the end of the shaft D*b* of the carrying mechanism journaled in the upper and rear portions of the standards F and F′.

The principal parts of the machine are the controller A, the transmitter B, receiver C, and carrying mechanism D, to which may be added the handles J and K and connected mechanism for resetting to zero and the tape L for locating the decimal-point and reading the result.

The controller consists of a base-plate A*a*, having ten parallel slots therein serving as guides for the ten controlling-plates A*b* sliding thereon, supported by projecting shoulders upon the flanged lower portions of the plates A*c* and A*d* at the front and rear, respectively, which, together with the connecting side pieces A*e* and A*f* at the right and left, respectively, serve to form the framework of the controller. The side pieces A*e* and A*f* also serve to support the horizontal plate A*g* extending forward thereto from the top of the plate A*d*.

At the front of the controller are eleven plates A*h*, supported upon and between the top of the plate A*c* and the horizontal angle-bar A*k*, which connects the front upwardly-extending portions of the side pieces A*e* and A*f*, as seen in Figs. 2 and 3. The left-hand ten of the plates A*h* are notched and numbered from 0 and 1 to 9 for the purpose of adjusting and retaining the controlling-plates A*b* by their handles A*b*³, the spaces between the plates A*h* permitting this adjustment. The sliding piece A*l*, stepped for a purpose to be afterward mentioned, is adjustable by notches (see Fig. 1) in the angle-bar A*k* which supports it, and serves as a decimal-pointer.

The controller is supported by horizontal shafts A*j* and A*j*′, journaled in the shoulders forming the lower portions of the plates A*c* and A*d*, and which have rollers A*j*² at their ends, guided in the hollow rails I*a* and I*b*. The double-angled plates A*i* and A*i*′, fastened to the front of the plate A*c*, take over the hollow rail I*a* and serve to guide the controller in its horizontal movements.

The controller is adjusted to the right or left, as may be desired, by means of the handle A*m* rotatable over a dial A*n*, projecting forward from the plate A*c*, having ten notches for determining the movement of the controller and locking the handle by means of a

lug Am' upon its lower side engaging with said notches. This handle Am is pivotally mounted in the top of a vertical shaft Am^2 mounted in said dial An and having at its lower end a small pinion Ao gearing in the rack Ia' projecting forward from the hollow rail Ia, so that the rotation of the handle Am will move the controller A a distance (in this machine) of 3.3 millimeters for each notch of the dial An, or thirty-three millimeters for a complete rotation. The cross-bar G has a downwardly-projecting portion G' with teeth on its rear face with a pitch of 3.3 millimeters, and the co-operating rack Ap supported by an upturned flange on the forward end of the plate Ag has similar teeth. If the crank-handle Am is not exactly in a notch of the dial the teeth of Ap will abut against the teeth of G and prevent the controller from rising, and similarly, the teeth, when meshed, prevent its horizontal displacement, thus avoiding any danger of damaging the rack-rods of the transmitter B. These rods are steel, rectangular in section and sixty in number, arranged in three rows Ba Bb Bc, forming twenty groups thirty-three millimeters apart. The rods of the rows Ba and Bb have rack-teeth Ba' and Bb' on the right-hand side, while those of the row Bc have similar teeth on the left-hand side. The pitch of their teeth is 3.3 millimeters, and each rod is provided with a lug or shoulder Ba^2 resting on the cross-bar G to prevent the rods descending too far.

The controlling-plates Ab, like the groups of rods of the transmitter, are placed thirty-three millimeters apart from center to center and each has a vertical spring-pressed lever Ab^3 pivoted thereto, which serves to place and retain it in the notches of its associated plate Ah. The plates Ab', which are placed on the rear portion of the plates Ab, are each provided with eighteen rows of pins arranged in nine groups of two rows in each group, the front row of each group representing units and the rear row thereof representing tens carried over from each partial product, and their positions and lengths are determined in the following manner: The lever Ab^3 of one plate is placed in the notch 1 of its plate Ah and the crank-handle Am is also placed in the notch 1 of its dial An, and as the product of these numbers is one a pin equal in height to the pitch of the rack on the rod Bb, 3.3 millimeters, is placed under said rod Bb, no pin being placed under the rod Bc, as the product has no tens to be carried over. Then turn the handle to the notch 2, the product being two multiplied by one, equaling two, and place a pin of twice the length of the first beneath the rod Bb and none beneath Bc. When the whole row has been thus placed, the lever Ab^3 is placed in the second notch of the plate Ah and the crank-handle is again moved successively into the notches 1, 2, 3, 4, 5, 6, 7, 8 and 9 of the dial An, and the pins are placed under the rod Bb of lengths proportional to 2, 4, 6, 8, 0, 2, 4, 6 and 8—that is to say, the units of the products of 2 by 1, 2, 3, 4, 5, 6, 7, 8 and 9, respectively, and under the rod Bc pins of a length proportional to 0, 0, 0, 0, 1, 1, 1, 1 and 1, which represent the tens of these same products to be carried forward. Similarly for the other rows. In this manner a controlling plate or member, which is a material embodiment of the multiplication-table, is obtained, and the ten plates Ab' are identical in structure.

The sliding piece Al is adjustable along the notched bar Ak and has a stepped piece at its back which can be fixed over any of the controlling-plates Ab. The different heights of the steps correspond, starting from the left hand, to 1, 2, 3, 4, 5, 6, 7, 8, and 9—that is to say, when the handle Am is in notch 7 the stepped plate Al will, in rising with the whole controller A, push up the rack-rod Ba to a height corresponding to seven of its teeth, and it thus serves to set up the successive figures of the multiplier or quotient, depending upon whether multiplication or division is being performed.

The receiver C has a framework composed of the front plate Ca having a section, as shown in Fig. 3, provided with two rows of twenty sight-apertures each, and have end pieces Cr and Cr' connected with each other by the cross-pieces Cb, Cc, and Ci. The cross-bars Cb and Cc serve to support a series of plates Cd, which, together with the front plate Ca, serve as bearings for three rows of superposed shafts Ce, Cf, and Cg, each twenty in number, and placed at a horizontal distance of thirty-three millimeters from each other. Upon each shaft Ce are placed a lug Ce', a ten-toothed pinion Ce^2 loose thereon, and a fixed collar Ce^3, all to the rear of its plate Cd, and between the plates Cd and Ca is a fixed arm Ce^4 which extends to the right between the adjoining shafts Ce and Cf, where it is supported by a pin in one of the plates Cd, as shown in Fig. 2^a. Upon each of the shafts Cf, to the rear of its plate Cd, are fixed a ten-toothed pinion with two of its teeth removed and carrying a pin Cf^2 projecting rearwardly, and a ten-toothed pinion Cf^3 gearing with the pinion Ce^2 immediately above it, and between the plates Cd and Ca are fixed the cam-pin Cf^4, a ten-toothed pinion Cf^5, a ten-toothed star-wheel Cf^6, a dial Cf^7, bearing the figures 0 and 1 to 9, and outside the plate Ca is fixed a milled knob Cf^8 for setting the shaft to any desired position. Upon each one of the shafts Cg, to the rear of the plate Cd, is fixed an eleven-toothed pinion Cg', from which two teeth have been removed, and having a pin Cg^2 projecting rearwardly therefrom, and between the plates Cd and Ca are the eleven-toothed pinion Cg^3, an eleven-toothed star-wheel Cg^4, and a dial Cg^5 bearing two sets of figures 0 and 1 to 9 and a blank space, arranged in reverse order, and outside the plate Ca is the milled knob Cg^6, similar to Cf^8. When a dial Cf^7 passes from 9 to 0, or from 0 to 9, the cam-pin Cf^4, taking against a double beveled lug Ch' fast upon a leaf-spring

C*h*, which is fastened at its lower end in an extension of the cross-bar C*b* and has its upper end bearing against the arm C*e*⁴ of the shaft C*e*, immediately to the left of the shaft C*f*, whose cam-pin C*f*⁴ takes against the lug C*h*, causes the leaf-spring to move the shaft C*e* to the rear as a preliminary step in the carrying of the tens, which will be further explained. Upon a cross-bar (not shown) are spring-detents (not shown) for co-operating with the star-wheels C*f*⁵ and C*g*⁴ for preventing accidental movements of the shafts C*f* and C*g*. The shaft C*e*, which does not rotate, but reciprocates longitudinally, as above stated, has a bearing in the plate C*a* of a sufficient depth to permit this, and a strong leaf-spring C*j* fast upon the cross-bar C*c* serves to hold it yieldingly in either position.

F*b*, F′*b*, F*c*, and F′*c* are pins fixed in the end standards F F′, upon which the receiver C is carried by corresponding holes in its end plates C*r* and C*r*′. The receiver C also carries rigid therewith at its right-hand end an axis C*k*, upon which, outside of the standard F′, is rotatably mounted a sleeve C*l*, which has two arms C*g*, carrying at their ends friction-rollers C*m* and C*n*, one or the other of which arms is by its roller engaged in the cam-grooves of the drum H*d* before referred to and is there retained by a spring-lever C*o* rigid with said sleeve C*l* and held in one or the other of the notches + or − upon a standard C*p* rigid with the axis C*k*. The two grooves of the drum H*d* being symmetrical and inverse in direction, it follows that if by a given rotation of the drum H*d* the receiver is moved to the left when the lever is in the notch + a similar rotation will move it to the right when the lever is in the notch −.

The carrying mechanism D consists of the shaft D*b*, on which is fast the pinion D*a*, which transmits thereto in the ratio of two to one the rotary movement of the gear-wheel H*b*. The shaft D*b* carries twenty cams D*c*, (of which only one is shown in Fig. 3 to prevent confusion,) so arranged that each is placed at an angular advance of four degrees thirty-one minutes from its left-hand neighbor, from which it is distant thirty-three millimeters. Each cam D*c*, by means of a groove (indicated in dotted lines in Fig. 3) in its left-hand face, at each rotation moves downward a lever D*e*, pivoted by trunnions D*f* in notches in the cross-bar D*g* connecting the standards F and F′, and which has a laterally-projecting pin D*e*² co-operating with the cam-groove of the cam D*c*. This lever D*e* has a pin D*e*′ at its end, projecting laterally at both sides, which on the lever being depressed by the cam passes behind the pinion C*e*³ if it is in a forward position or engages therewith and rotates it one tooth if it is in a rearward position. Before the lever rises a lug D*c*′ upon the cam D*c* strikes the lug C*e*′ and moves it forward, if not already in that position, after which the lever is free to rise.

The object in having the cams arranged to act in succession instead of simultaneously is to prevent any possible failure to carry, such as would occur if the dials C*f*⁷ showed the amount of 999,999 and by the operation of the machine 1 was to be added to the sum already indicated. If the cams were arranged to act simultaneously, the sum shown would be 999,000 instead of 1,000,000, as it should be and will be if the cams act in succession.

As the mechanisms J and K for resetting the upper and lower dials to zero are the same, but one of them will be described. This mechanism consists of a hand-lever K, fixed to a sleeve K*a*, which is capable of sliding longitudinally and turning upon two pins F*d* and F′*d*, fixed in the standards F and F′. The sleeve K*a* is provided with arms K*b*, carrying a rack K*c* and a bar K*d*, which is free to rise with the rack when the hand-lever K is moved backward, but is prevented from moving horizontally with said rack if the hand-lever is moved longitudinally. The bar K*d* is provided with small pins K*d*′, so arranged that when the bar K*d* is raised and the mutilated portions in the pinions C*g*′ are downward (the dials C*g*⁵ being then at zero) the pins will abut against the left-hand face of the pins C*g*², which are also held at their lowest position. Thus in order to return the dials C*g*⁵ to zero when placed in any position it is simply necessary to raise the rack and move the hand-lever K from right to left. The pinions C*g*′ are caused to turn so long as the teeth are in gear with the rack K*c*, but are out of gear when the mutilated portion of the gear is downward. At this moment the small-pins K*d*′ abut against the pins C*g*² and stop and retain the dials C*g*⁵, which are now at zero. On then lowering and returning the rack the pinions are free to move.

The traveling band L is endless and is placed above the apertures, (being possibly threaded in two parallel slots in each of the standards F and F′,) but preferably mounted on two spools depending from lugs at the front and top of the standards F and F′, as seen in Fig. 1, and starting from the decimal-point is divided into spaces extending over three of the dials and bearing the names of the orders of figures, as "units," "thousands," "millions," &c.

One revolution of the crank-handle may be considered as divided into nine parts, in each of which the principal parts of the machine perform one function. If the lever C*o* be placed in the + notch:

First. The receiver is moved to the right, gearing the teeth of the pinions C*f*⁸ in the racks B*c* of the transmitter.

Second. The controller A is raised, pushing up the rack-rods B*a*, B*b*, and B*c* of the transmitter distances corresponding to the height of the parts contacting therewith. The rod B*a* is raised by the stepped plate A*l* and the rods B*b* (representing the units of the product of the number denoted by the position of the

controlling-plates by the figure denoted by the position of the multiplying-crank Am on its dial Aa) are raised by the pins on the plates Ab' and none of them produce any action, not being in gear with their pinions; but the racks Bc, which alone are in gear and which represent the tens of the product ot be carried over, rotate the dials Cf^1 to an extent corresponding to the number of teeth which they are raised.

Third. The receiver is placed slightly to the right of its middle position.

Fourth. The levers De, by their pins De', engage in succession and rotate to the extent of one tooth those of the pinions Ce^2 (which are on their left hand) which have been moved back. As the pinions Ce^2 are broad enough to mesh with the pinions Cf^3 directly beneath them, whichever position they may be in, this causes the dials Cf^1 to be advanced one space, and the tens are thus carried over.

Fifth. The receiver is shifted entirely to the left, causing the pinions Cf^3 and Cg^3 to gear with the racks Bb and Ba, respectively, which were raised free and held in their raised position by the controller.

Sixth. The controller redescends and the racks are lowered by gravity, assisted by the cross-bar Ie, if necessary, so as to rotate the dials Cg^5 and Cf^1 the number of divisions they have been raised. The rods Bc, being free, no longer act.

Seventh. The receiver returns a little to the right of its middle position.

Eighth. The levers De carry over any tens which may have to be carried forward.

Ninth. The receiver places itself exactly in the center, which was its original position.

If the receiver-lever Co is placed in the notch the same actions will take place; but all the left-hand positions will be transferred to the right, so that those racks which were in gear in rising will be in gear descending, and vice versa, and the pinions Ce^2, which were geared by the levers De on their right will be geared by the levers which are on their left. The receiving-dials thus turn in a reverse direction to the previous case, and as when turning in the first direction the numeration increases, in the other direction it diminishes. Thus, for example, to multiply 956.48 by 638, the levers Ab^3 of the controlling-plates are placed in the notches of the figures corresponding, respectively, to those of the number 956.48, care being taken to place the slider Al, carrying the stepped plate, above the figure 6 of the units, after which the multiplying-crank is placed successively in the notches Nos. 6, 3, and 8 corresponding to the figures of the multiplier passing over zero between each stoppage and moving it in the direction of the arrow in Fig. 2. After each stoppage the crank-handle Ha is moved one turn. The product 610,234.24 is indicated on the upper dials at the same time that 638 appears on the lower ones. The tape L is then moved so as to bring the decimal-point to the right of the 8 of the figures 638, and the result is immediately found divided into groups of three figures, in integers and decimals, of which the names may be read off from the tape. The result in this case is 610 thousand, 234 units, and 24 hundredths.

Addition is only a special instance of multiplication, as a number is considered as its product by one, so that if the calculating-plates are adjusted successively to certain numbers, leaving the multiplying-handle at 1, and the handle Ha be turned each time, the machine will produce the sum of these products and consequently of the numbers themselves. If the receiver-lever is in the negative notch the products, instead of being added, will be subtracted from a number previously set up on the machine and the difference will be indicated.

Division is but multiplication reversed—that is to say, worked from the negative notch.

As regards other operations—such as involution, evolution, &c.—they are obtained by suitably combining the four fundamental operations of arithmetic.

It will be understood that my invention is capable of numerous modifications of the structure shown and described and all within the scope thereof, and with which it is unnecessary to cumber this specification, and that I do not desire to be limited to the exact form shown and described, but only to those structures and combinations within the terms of the following claims.

I claim—

1. In a calculating-machine, the combination of the controlling-frame and the guides therefor, with the rotary operating-handle, a disk rotated thereby, and links reciprocated by said disk and connected to said controlling-frame.

2. In a calculating-machine, the combination of the controlling-frame and the guides therefor, with the rotary operating-handle, a disk rotated thereby, a rock-shaft and connections with said disk for reciprocating said shaft, and links connecting arms on said shaft with said frame.

3. In a calculating-machine, the combination of the controlling-frame and the guides therefor, with the rotary operating-handle, a disk rotated thereby having a cam, an arm on a rock-shaft reciprocated thereby, and links connecting arms on said shaft with said frame.

4. In a calculating-machine, the combination of a framework, a receiving-carriage reciprocating therein, a series of registering gear-wheels mounted in said carriage, with an operating-handle, a shaft rotated thereby, a cam upon said shaft, connections with said carriage controlled by said cam, and a series of reciprocating racks with which said gear-wheels intermesh in one position of said carriage.

5. In a calculating-machine, the combination of a framework, a receiving-carriage reciprocating therein, with an operating-handle,

a shaft rotated thereby, a disk containing a cam-groove upon said shaft, and a connecting-piece controlling the position of said carriage, and carrying a friction-roller co-operating with said groove.

6. In a calculating-machine, the combination of a framework, a receiving-carriage reciprocating therein, with an operating-handle, a shaft rotated thereby, a disk containing two inverse and symmetrical cam-grooves upon said shaft, and a rod connected with said carriage, and carrying a sleeve rotatable thereon, with two arms carrying friction-rollers co-operating with said grooves, and means for retaining one or the other of said rollers in its groove.

7. In a calculating-machine, the combination of a framework, a receiving-carriage reciprocating therein, with an operating-handle, a shaft rotated thereby, a disk containing two inverse and symmetrical cam-grooves therein mounted on said shaft, a connecting-piece controlling the position of said carriage, and carrying two friction-rollers co-operating with their respective grooves, and means for holding one or the other of said rollers in position.

8. In a calculator, the combination of the controlling-frame, means for reciprocating said frame, with the controlling-carriage mounted therein, and controlling-plates in said carriage adjustable at right angles to the line of movement of said carriage.

9. In a calculator, the combination of the controlling-frame, means for reciprocating said frame, with the controlling-carriage, shafts therein carrying rollers traveling in ways in said frame, and controlling-plates in said carriage adjustable at right angles to the line of movement of said carriage.

10. In a calculator, the combination of the controlling-frame, means for reciprocating said frame, with the controlling-carriage mounted therein, and controlling-plates in said carriage adjustable at right angles to the line of movement of said carriage with notched scales for adjusting and retaining said plates.

11. In a calculating-machine, the combination of the controlling-frame, means for reciprocating said frame, with the controlling-carriage mounted therein, a scale thereon and means for controlling the movement of said carriage by said scale, and controlling-plates adjustable in said carriage at right angles to its line of movement.

12. In a calculator, the combination of the controlling-frame, means for reciprocating said frame, with the controlling-carriage mounted therein, a dial thereon, a shaft carrying a handle co-operating with said dial and a pinion gearing with a longitudinal rack on said frame, and controlling-plates adjustable in said carriage at right angles to its line of movement.

13. In a calculator, the combination of the controlling-frame, with the controlling-carriage adjustably mounted therein, and a dial with a handle co-operating therewith, a pinion upon one of said parts, moved by said handle, co-operating with a rack upon the other of said parts.

14. In a calculator, the combination of the main frame of the machine, a serrated plate rigid therewith, with a controlling-frame movable in said frame, and a controlling-carriage adjustable in said controlling-frame, and carrying a serrated plate co-operating with said first-named serrated plate to prevent movement of said controlling-frame unless the controlling-carriage is exactly adjusted, and to insure its regular movement.

15. In a calculator, the combination of the series of racks, with the controlling-carriage carrying controlling mechanism and laterally adjustable to determine the extent of movement imparted to the racks by the controlling mechanism, and a dial and co-operating index for adjusting said carriage so arranged that when the index passes over zero of the dial the controlling mechanism shall pass into register with the next adjoining racks so as to effect a higher or lower order as the case may be, substantially as described.

16. In a calculator, the combination of a series of racks, with the controlling-plates bearing a series of pins co-operating therewith, a controlling-carriage carrying said plates and laterally adjustable to determine which of said pins shall engage the racks, and a dial and co-operating index for adjusting said carriage so arranged that when the index passes over zero of the dial the plates shall pass into register with the next adjoining racks so as to effect a higher or lower order as the case may be.

17. In a calculator, the combination of the series of racks, with the controlling-plates bearing a series of pins co-operating therewith, means for adjusting said plates to determine the figures of a multiplicand or divisor, a controlling-carriage carrying said plates and laterally adjustable to determine which of said pins shall engage the racks, and a dial and co-operating index for adjusting said carriage so as to determine the individual figures of the multiplier or quotient, so arranged that when the index passes over zero of the dial the plates shall pass into register with the next adjoining racks to effect a higher or lower indication as the case may be.

18. In a calculator, the combination of the racks representing different orders of figures with the controlling-carriage movable from one order to another, and the stepped plate *Al* carried thereby and co-operating with said racks in succession.

19. In a calculator, the combination of the racks representing different orders of figures, with the controlling-carriage movable from one order to another and whose position relative to the orders determines the figures of the multiplier or quotient, and the stepped plate *Al* carried thereby, and adjustable thereon relative to the orders and co-operating with the racks in succession.

20. In a calculator, the combination of the series of dials with the adjustable tape co-operating therewith marked into divisions for the different orders of figures, integral and decimal.

21. In a calculator, the combination of the series of units and tens racks, means for reciprocating said racks, with a carriage containing a series of numeral gear-wheels meshing directly with said racks, carrying means interposed between said gear-wheels, and means for adjusting said carriage so that the units-racks will gear with certain wheels during their movement in one direction and so that the tens-racks will gear with the wheels of the next higher order during their movement in the other direction.

22. In a calculator, the combination of the series of units and tens racks, a rotary handle and connections for reciprocating said racks, with a carriage containing a series of numeral gear-wheels meshing directly with said racks, carrying means interposed between said gear-wheels, a cam-groove upon a shaft rotated by said handle, and connections with said groove for adjusting said carriage so that the units-racks will gear with certain gear-wheels during their movement in one direction, and so that the tens-racks will gear with the wheels of the next higher order during their movement in the other direction.

23. In a calculating-machine, the combination of the receiving-carriage, a series of register-wheels on shafts mounted therein, with a series of relatively stationary carrying members, and connections whereby when the carriage is in one position said carrying members will add one by their operation, and when in the other position they will subtract one by their operation.

24. In a calculating-machine, the combination of the receiving-carriage, a series of register-wheels on shafts mounted therein, gears rigid with said shafts, with a series of relatively stationary carrying members, and connections whereby when said carriage is in one position said carrying members will move said gears a tooth in one direction by their operation, and when in the other position they will move said gears a tooth in the other direction.

25. In a calculating-machine, the combination of a series of register-wheels on shafts, with another series of shafts parallel thereto, means for moving longitudinally one of said second series of shafts when its corresponding shaft of the first series passes from 9 to 0, or vice versa, a loose pinion on each shaft of said second series gearing with a pinion fixed on its corresponding shaft of said first series, and a series of arms for moving said loose pinion one tooth when its shaft is in its abnormal position.

26. In a calculator, the combination of a series of register-wheels on shafts, with another series of shafts parallel thereto, means for moving longitudinally one of said second series of shafts when its corresponding shaft of the first series passes from 9 to 0, or vice versa, a loose pinion on each shaft of said second series gearing with a pinion fixed on its corresponding shaft of said first series, a series of arms for moving said loose pinions one tooth when its shaft is in its abnormal position, and a series of cams helically arranged upon a rotating shaft for operating said arms.

27. In a calculator, the combination of the shaft C*f*, cam C*f*^{4}, and pinion C*f*^{3} thereon, with the shaft C*e*, lug C*e*^{4}, and loose pinion C*e*^{2} thereon, the spring C*h* and its cam, the arm D*e*, pin D*e*′, and the cam D*e* co-operating therewith.

28. In a calculator, the combination of the shaft C*f*, cam C*f*^{4}, and pinion C*f*^{3} thereon, with the shaft C*e*, lug C*e*^{4}, lug C*e*′, and loose pinion C*e*^{2} thereon, the spring C*h* and its cam, the arm D*e*, pin D*e*′, cam D*e*, and its lug D*c*′ co-operating therewith.

29. In a calculator, the combination of the mutilated pinions C*g*′ carrying the pin C*g*^{2}, with the sliding rack K*c* and the relatively fixed plate K*d* carrying the pin K*d*′, and means for swinging said rack into mesh with the pinion.

30. In a calculator, the combination of a series of racks, means for moving said racks, with a series of registering gear-wheels normally out of the plane of said racks, carrying means between said wheels settable thereby, and means for moving said series of wheels into the plane of said racks during a portion of the movement of said racks, and operating said carrying means successively when said wheels are not in the plane of said racks.

31. In a calculating-machine, the combination of the series of racks, means for reciprocating said racks, with a series of registering gear-wheels normally out of the plane of said racks, carrying means between said wheels settable thereby, and means for moving said series of wheels into the plane of the racks during their movement in one direction, and operating said carrying mechanisms successively when said wheels are not in the plane of said racks.

32. In a calculator, the combination of a series of racks, a graduated series of projections for moving said racks in one direction, with a series of registering gear-wheels normally out of the plane of movement of said racks, carrying means between said wheels settable thereby, and means for moving said series of wheels into the plane of movement of said racks during their movement in one direction, and operating said carrying means successively when said wheels are not in the plane of movement of said racks.

33. In a calculator, the combination of a series of racks, a graduated series of projections for moving said series of racks in one direction, with a series of registering gear-wheels normally out of the plane of movement of said racks, carrying means between said wheels settable thereby, and cams for moving said

series of wheels into the plane of movement of said racks during said movement in one direction and operating said carrying means successively when said wheels are not in the plane of movement of said racks.

34. In a calculator, the combination of a series of racks, a graduated series of projections for moving said series of racks in one direction, with a series of registering gear-wheels normally out of the plane of movement of said racks, carrying means between said wheels settable thereby, a cam for moving said series of wheels into the plane of movement of said racks during their movement in one direction, and a series of cams for operating said carrying means successively when said wheels are not in the plane of movement of said racks.

35. In a calculator, the combination of the series of racks, a graduated series of projections for moving said racks in one direction, with a series of registering gear-wheels normally out of the plane of movement of said racks, carrying means between said wheels settable thereby, a cam for moving said series of wheels into the plane of movement of said racks during their movement in one direction, and a rotary cam-shaft having a series of helically-disposed cams for operating said carrying means successively when said wheels are not in the plane of movement of said racks.

36. In a calculator, the combination of a series of racks, means for reciprocating said racks, with a series of registering gear-wheels normally out of the plane of movement of said racks, carrying means between said wheels settable thereby, a cam for moving said wheels into the plane of movement of said racks during their movement in one direction, and a series of cams for operating said carrying means successively when said wheels are not in the plane of movement of said racks.

37. In a calculator, the combination of a series of racks, means for reciprocating said racks, with a series of registering gear-wheels normally out of the plane of movement of said racks, carrying means between said wheels settable thereby, a cam for moving said wheels into the plane of movement of said racks during their movement in one direction, and a rotary cam-shaft having a series of helically-disposed cams for operating said carrying means in succession when said wheels are out of the plane of movement of said racks.

38. In a calculator, the combination of a series of racks, a graduated series of projections for moving said racks in one direction, with a series of registering gear-wheels normally out of the plane of movement of said racks, carrying means between said wheels settable thereby, a rotary cam for moving said series of wheels into the plane of movement of said racks during their movement in one direction, and a rotary cam-shaft having a series of helically-disposed cams for operating said carrying means successively when said wheels are not in the plane of movement of said racks.

39. In a calculator, the combination of a series of racks, with a series of registering gear-wheels normally out of the plane of movement of said racks, carrying means between said wheels settable thereby, and means for moving said racks in one direction, and moving said series of wheels into the plane of movement of said racks during their movement in one direction and operating said carrying means successively when said wheels are not in the plane of movement of said racks.

40. In a calculating-machine, the combination of a series of racks, a graduated series of projections engaging with said racks for moving them in one direction, with a series of registering gear-wheels normally out of the plane of movement of said racks, carrying means between said wheels settable thereby, and means for moving said graduated series of projections and moving said series of wheels into the plane of movement of said racks during their movement in one direction and operating said carrying means successively when said wheels are not in the plane of movement of said racks.

41. In a calculator, the combination of a series of racks, with a series of registering gear-wheels normally out of the plane of movement of said racks, carrying means between said wheels settable thereby, and means for reciprocating said racks and moving said series of wheels into the plane of movement of said racks during their movement in one direction and operating said carrying means successively when said wheels are not in the plane of movement of said racks.

42. In a calculator, the combination of a series of racks, with a series of registering gear-wheels normally out of the plane of movement of said racks, carrying means between said wheels settable thereby, means for reciprocating said racks, a cam for moving said series of wheels into the plane of movement of said racks during their movement in one direction, and a series of cams for operating said carrying means successively when said wheels are not in the plane of movement of said racks.

43. In a calculator, the combination of a series of racks, with a series of registering gear-wheels normally out of the plane of movement of said racks, carrying means between said wheels settable thereby, means for reciprocating said racks, a cam for moving said series of wheels into the plane of movement of said racks during their movement in one direction, and a rotary cam-shaft with a helically-arranged series of cams thereon for operating said carrying means successively when said wheels are not in the plane of said racks.

44. In a calculator, the combination of a series of racks, a graduated series of projections for moving said racks in one direction, with a series of registering gear-wheels normally out of the plane of movement of said racks, carrying means between said wheels settable thereby, means for reciprocating said series of projections and rotating a cam for moving said series of wheels into the plane of move-

ment of said racks during their movement in one direction and rotating a cam-shaft having a helically-arranged series of cams for operating said carrying means successively when said wheels are not in the plane of said racks.

45. In a calculator, the combination of a series of reciprocating racks, a graduated series of projections controlling the movement of said racks, with a series of registering gear-wheels normally out of the plane of movement of said racks, carrying mechanism between said wheels, and means for moving said series of wheels into the plane of movement of said racks during their movement in one direction.

46. In a calculator, the combination of a series of reciprocating racks, a graduated series of projections controlling the movement of said racks, with a series of registering gear-wheels normally out of the plane of movement of said racks, carrying means between said wheels, and means for moving said series of wheels into the plane of movement of said racks during their movement in one direction and reciprocating said projections.

47. In a calculator, the combination of a series of reciprocating racks, a graduated series of projections controlling the movement of said racks, with a series of registering gear-wheels normally out of the plane of movement of said racks, carrying means between said wheels, a rotary cam for moving said series of wheels into the plane of movement of said racks during their movement in one direction, and means for reciprocating said projections.

48. In a calculator, the combination of the reciprocating rack, a graduated series of projections controlling the movement of said rack, with a registering gear-wheel normally out of the plane of movement of said rack, and means for causing one of said projections to register with said rack and to move it, and for moving said wheel into the plane of movement of said rack during its movement in one direction.

49. In a calculator, the combination of the reciprocating rack, a graduated series of projections controlling the movement thereof, with a registering gear-wheel normally out of the plane of movement of said rack, means for causing one of said projections to register with said rack and to move it, and a rotary cam for moving said wheel into the plane of movement of said rack during its movement in one direction.

50. In a calculator, the combination of a series of racks with a series of registering gear-wheels normally out of the plane of movement of said racks, carrying mechanisms between said wheels, and a rotary handle and connections therewith for reciprocating said racks, having said gear-wheels into the plane of movement of said racks during their movement in one direction, and actuating said carrying mechanisms successively when said wheels are not in the plane of movement of said racks.

51. In a calculator, the combination of a series of racks with a series of registering gear-wheels normally out of the plane of movement of said racks, carrying mechanism between said wheels, a shaft carrying a helically-arranged series of cams co-operating with said carrying mechanisms, and a rotary handle and connections therewith for reciprocating said racks, moving said gear-wheels into the plane of movement of said racks during their movement in one direction, and rotating said shaft to actuate said carrying mechanisms successively when said gear-wheels are not in the plane of movement of said racks.

52. In a calculator, the combination of a series of racks, with a series of registering-wheels normally out of the plane of movement of said racks, carrying mechanism between said wheels, a shaft carrying a helically-arranged series of cams co-operating with said carrying mechanism, a rotary handle and a link connecting it to a frame for reciprocating said racks, a cam fast on said shaft and connections for thereby moving said gear-wheels into the plane of movement of said racks during their movement in one direction, and rotating said shaft so that it shall actuate said carrying mechanisms successively when said wheels are not in the plane of movement of said shaft.

53. In a calculator, the combination of a series of racks, with a series of registering gear-wheels normally out of the plane of movement of said racks, carrying mechanisms between said wheels, a shaft carrying a helically-arranged series of cams co-operating with said carrying mechanisms, a rotary handle, a frame for reciprocating said racks, a link reciprocated by said rotary handle and connecting it to said frame, a cam fast on said rotary handle and connections for thereby moving said gear-wheels into the plane of movement of said racks during their movement in one direction, and connections to said rotary handle for rotating said shaft for actuating said carrying mechanisms successively when said wheels are not in the plane of said racks.

54. In a calculator, the combination of the series of racks, with a series of registering gear-wheels normally out of the plane of movement of said racks, carrying mechanisms between said wheels, a shaft carrying a helically-arranged series of cams co-operating with said carrying mechanisms, a rotary handle upon a shaft, a frame for reciprocating said racks, a pivoted lever rocked by said rotary handle, and a link for connecting said frame and pivoted lever, a cam fast on said handle-shaft and connections for thereby moving said gear-wheels into the plane of movement of said racks during their movement in one direction, and connections to said handle-shaft for rotating said first-named shaft for actuating said carrying mechanisms successively when said wheels are not in the plane of said racks.

55. In a calculator, the combination of the series of racks, with a series of registering gear-wheels normally out of the plane of move-

ment of said racks, carrying mechanisms between said wheels, a shaft carrying a helically-arranged series of cams co-operating with said carrying mechanisms, a rotary handle rigid with a shaft, a sliding frame for reciprocating said racks, a rock-shaft carrying an arm rocked by a disk rotated by said handle, arms on said rock-shaft, and links connecting said arms and frame, a cam fast on said handle-shaft and connections for thereby moving said gear-wheels into the plane of movement of said racks during their movement in one direction, and connections with said handle-shaft for rotating said first-named shaft for actuating said carrying mechanisms successively when said wheels are not in the plane of said racks.

56. In a calculator, the combination of a series of racks, with a series of registering gear-wheels normally out of the plane of movement of said racks, carrying mechanisms between said wheels, a shaft carrying a helically-arranged series of cams co-operating with said carrying mechanisms, a rotary handle and a link connecting it to a frame for reciprocating said racks, a disk rotated by said handle and having a cam-groove, and a piece reciprocated thereby with connections for moving said gear-wheels into the plane of movement of said racks during their movement in one direction, and connections with said handle for rotating said shaft and actuating said carrying mechanisms successively when said gear-wheels are not in the plane of movement of said racks.

57. In a calculator, the combination of a receiver, two series of numeral-wheels therein, with a series of racks co-operating with one of said series of numeral-wheels, a series of controlling devices arranged in pairs and representing in their structure the units and tens of the products of the digits, and adjustable for determining the movement of said racks, and means for registering upon the other series of wheels the successive adjustments of said controlling devices.

58. In a calculator, the combination of the receiver, two series of numeral-wheels therein, with controlling mechanism representing in its structure the separate values of the units and tens of the products of the digits, and adjustable to determine the movements of said wheels, transmitting mechanism between said controlling mechanism and one of said series of wheels for actuating said wheels simultaneously, and similar mechanism between said controllers and the other series of wheels to actuate said latter ones successively.

59. In a calculator, the combination of a receiver, two series of numeral-wheels therein, with controlling mechanism representing in its structure the separate values of the units and tens of the products of the digits, and adjustable in one way to determine the multiplicand or divisor and in another way to determine the figures of the multiplier or quotient, and transmitting mechanism for transferring the result of both adjustments to one series of wheels, and of the adjustments for the multiplier or quotient to the other series of wheels.

60. In a calculator, the combination of a receiver, two series of numeral-wheels therein, with controlling mechanism representing in its structure the separate values of the units and tens of the products of the digits, and adjustable in one way to determine the multiplicand or divisor and in another way to determine the figures of the multiplier or quotient, and transmitting mechanism, including a series of racks normally disconnected from said wheels, for transferring the results of both adjustments to one series of wheels, and of the adjustments for the multiplier or quotient to the other series of wheels by connecting, by the movement of said receiver, said wheels and said racks during the movement of said racks in one direction.

61. In a calculator, the combination of a movable carriage, a series of register-wheels mounted therein, with carrying mechanisms interposed between said wheels and settable thereby, register-operating means for said wheels disengageable therefrom, and means for actuating said carrying mechanisms successively when said wheels are disengaged from said register-operating means.

62. In a calculator, the combination of a movable carriage, a series of register-wheels mounted therein, with carrying mechanisms interposed between said wheels settable thereby, register-operating means for said wheels disengageable therefrom, relatively-fixed means for actuating said carrying mechanisms successively, and means for moving said carriage from engagement with said register-operating means to said carrying-operating means.

63. In a calculator, the combination of a movable carriage, a series of register-wheels mounted therein, carrying mechanisms interposed between said wheels and settable thereby, with register-operating means normally disengaged from said wheels, relatively-fixed means for operating said carrying mechanisms successively, and means for reciprocating said carriage to engage first with the register-operating mechanism and then with the carrying-operating means.

64. In a calculator, the combination of a movable carriage, a series of register-wheels mounted therein, carrying mechanisms interposed between said wheels and settable thereby, with register-operating means normally disengaged from said wheels, a rotary shaft carrying a helically-disposed series of cams for operating said carrying mechanisms successively, and means for reciprocating said carriage to engage first with said register-operating means and then with the cams on said shaft.

65. In a calculator, the combination of a movable carriage, a series of register-wheels mounted therein, carrying mechanisms inter-

posed between said wheels and settable thereby, with register-operating means normally disengaged from said wheels, a rotary shaft carrying a helically-disposed series of cams for operating said carrying mechanisms successively, and a rotary handle and connections for reciprocating said carriage to engage first with said register-operating means and then with the cams on said shaft.

66. In a calculator, the combination of a movable carriage, a series of register-wheels mounted therein, carrying mechanisms interposed between said wheels and settable thereby, with register-operating means normally disengaged from said wheels, relatively-fixed means for operating said carrying mechanisms successively, and a rotary handle and cams operated thereby for reciprocating said carriage to engage first with the register-operating means and then with the carrying-operating means.

67. In a calculator, the combination of a movable carriage, a series of register-wheels mounted therein, carrying mechanisms interposed between said wheels and settable thereby, with register-operating means normally disengaged from said wheels, a rotary shaft carrying a helically-disposed series of cams for operating said carrying mechanisms successively, and a rotary handle and connections for reciprocating said carriage to engage first with said register-operating mechanism and then with the cams on said shaft and rotating said cam-shaft.

68. In a carrying mechanism, the combination of a series of register-wheels, with a series of reciprocating shafts co-operating therewith, means for adjusting any shaft of said series when its primary co-operating wheel passes from 9 to 0, teeth on said shaft for co-operating with its secondary register-wheel to advance it one step, and means for operating successively the teeth on any of said shafts that may have been adjusted, substantially as described.

69. In a calculator, the combination of a series of register-wheels upon shafts, pinions fixed on each of said shafts, with a series of reciprocating shafts co-operating therewith parallel to said first series, means for adjusting any shaft of said series when its primary co-operating wheel passes from 9 to 0, teeth on said reciprocating shafts for co-operating with the pinion on its secondary register-wheel shaft to advance it one space, and means for operating successively the teeth on any of said reciprocating shafts that may have been adjusted, substantially as described.

70. In a calculator, the combination of a series of register-wheels upon shafts, pinions fixed upon each of said shafts, with a series of reciprocating shafts co-operating therewith parallel to the first series, means for adjusting any shaft of said series when its primary co-operating wheel passes from 9 to 0, teeth on said reciprocating shafts for co-operating with the pinion on its secondary register-wheel shaft to advance it one space, and a helically-arranged series of cams upon a shaft for operating successively the teeth on any of said reciprocating shafts that may have been adjusted, substantially as described.

71. In a calculator, the combination of a series of shafts carrying a registering-wheel and a pinion fixed on each, with a series of reciprocating shafts carrying means for co-operating with said pinions, connections for adjusting any one of said reciprocating shafts when its primary registering-wheel passes from 9 to 0, or vice versa, and a helically-arranged series of cams upon a shaft for operating successively the carrying means upon said reciprocating shafts that have been adjusted, to advance their co-operating pinions one tooth.

72. In a calculator, the combination of a series of reciprocating racks, with a series of registering gear-wheels normally out of the plane of said racks, carrying mechanisms interposed between said wheels and settable thereby, a frame, a rotary disk, connections between said frame and disk for reciprocating said racks, means for moving said series of wheels into the plane of said racks, and means for operating said carrying mechanisms successively when said wheels are not in the plane of said racks.

73. In a calculator, the combination of a series of reciprocating racks, with a series of registering gear-wheels normally out of the plane of said racks, carrying mechanisms interposed between said wheels and settable thereby, a frame, a rotary disk, connections between said frame and disk for reciprocating said racks by the rotation of the disk, a cam for moving said series of wheels into the plane of said racks, a series of helically-arranged cams for operating said carrying mechanisms successively when said wheels are not in the plane of said racks, and means for operating said disk and cams.

74. In a calculator, the combination of a series of reciprocating racks, with a series of registering gear-wheels normally out of the plane of movement of said racks, carrying means interposed between said wheels and settable thereby, a frame, a rotary disk, a link connecting said disk and frame for reciprocating said racks by the rotation of said disk, a cam for moving said series of wheels into the plane of said racks, a series of helically-arranged cams for operating said carrying mechanisms in succession when said wheels are out of the plane of said racks, and means for operating said disk and cams.

75. In a calculator, the combination of a series of reciprocating racks, with a series of registering gear-wheels normally out of the plane of movement of said racks, carrying means interposed between said wheels and settable thereby, a frame, a rotary cam-disk, a link operated by said cam and connected to said frame for reciprocating said racks by the rotation of said disk, a cam for moving said series of wheels into the plane of said racks.

a series of helically-disposed cams for operating said carrying mechanisms successively when said wheels are not in the plane of said racks, and means for operating said disk and cams.

76. In a calculator, the combination of a series of reciprocating racks, with a series of registering gear-wheels normally out of the plane of movement of said racks, carrying mechanisms interposed between said wheels and settable thereby, a frame, a rotary cam-disk, a rock-shaft carrying an arm reciprocated by said disk, a link connecting said frame and rock-shaft for reciprocating said racks by the rotation of said disk, a cam for moving said series of wheels into the plane of said racks, a series of helically-disposed cams for operating said carrying mechanisms successively when said wheels are out of the plane of said racks, and means for operating said disk and cams.

77. In a calculator, the combination of a series of registering gear-wheels, carrying mechanisms interposed between said wheels and settable thereby, with a series of reciprocating racks co-operating with said wheels during their movement in one direction, plural series of projections varying in height, one series for each rack, means for determining which projection in each series shall co-operate with its rack, and means for reciprocating said projections to move the racks and for operating said carrying mechanisms successively when said racks and wheels are not in operative engagement.

78. In a calculator, the combination of a series of registering gear-wheels, carrying mechanisms interposed between said wheels and settable thereby, with a series of reciprocating racks co-operating with said wheels during their movement in one direction, plural series of projections varying in height, one series for each rack, means for determining which projection in each series shall co-operate with its rack, means for reciprocating said projections to move the racks, and means for operating said carrying mechanisms successively when said racks and wheels are not in operative engagement.

79. In a calculator, the combination of a series of registering gear-wheels, carrying mechanisms interposed between said wheels and settable thereby, with a series of reciprocating racks co-operating with said wheels during their movement in one direction, plural series of projections varying in height, one series for each rack, means for determining which projection in each series shall co-operate with its rack, means for reciprocating said projections to move the racks, and a shaft carrying a helically-arranged series of cams for operating said carrying mechanisms successively when said racks and wheels are not in operative engagement.

80. In a calculator, the combination of a series of registering gear-wheels, carrying mechanisms interposed between said wheels and settable thereby, with a series of reciprocating racks co-operating with said wheels during their movement in one direction, plural series of projections varying in height, one series for each rack, means for determining which projection in each series shall co-operate with its rack, a rotary handle, a frame, a link connecting said handle and frame for reciprocating said projections to move the racks, and a shaft operated by said handle and carrying a helically-arranged series of cams for operating said carrying mechanisms successively when said racks and wheels are not in operative engagement.

81. In a calculator, the combination of a series of registering gear-wheels, carrying mechanisms interposed between said wheels and settable thereby, with a series of reciprocating racks co-operating with said wheels during their movement in one direction, plural series of projections varying in height, one series for each rack, means for determining which projection of each series shall co-operate with its rack, a rotary disk, a frame, connections between said frame and disk for reciprocating said projections to move said racks, and means for rotating said disk and operating said carrying mechanisms successively when said racks and wheels are not in operative engagement.

82. In a calculator, the combination of a series of registering gear-wheels, carrying mechanisms interposed between said wheels and settable thereby, with a series of reciprocating racks co-operating with said wheels during their movement in one direction, plural series of projections varying in height, one series for each rack, means for determining which projection in each series shall co-operate with its rack, a rotary handle, a disk revolved thereby, a frame, a link connecting said disk and frame for reciprocating said projections to move the racks, and means for operating said carrying mechanisms successively when said racks and wheels are not in operative engagement.

83. In a calculator, the combination of a series of registering gear-wheels, carrying mechanisms interposed between said wheels and settable thereby, with a series of reciprocating racks co-operating with said wheels during their movement in one direction, plural series of projections varying in height, one series for each rack, means for determining which projection in each series shall co-operate with its rack, a rotary handle, a cam-disk revolved thereby, a frame, a link connecting said disk and frame for reciprocating said projections to move the racks, and a shaft operated by said handle and carrying a helically-arranged series of cams for operating said carrying mechanisms successively when said racks and wheels are not in operative engagement.

84. In a calculator, the combination of a series of registering gear-wheels, carrying devices between said wheels and settable there-

by, with a series of reciprocating racks actuating said wheels during their movement in one direction, controlling devices for said racks representing units and tens of the products of the digits, and adjustable in one direction to vary the digits of the multiplier, means for reciprocating the controlling devices to move said racks, and means for operating said carrying devices successively while the racks are not actuating the wheels.

85. In a calculator, the combination of the series of registering gear-wheels, carrying devices between said wheels and settable thereby, with a series of reciprocating racks actuating said wheels during their movement in one direction, controlling devices for said racks representing units and tens of the products of the digits, and adjustable in one direction to vary the digits of the multiplier, and means for reciprocating the controlling devices to move the racks, and for operating said carrying devices successively while the racks are not actuating the wheels.

86. In a calculator, the combination of the series of registering gear-wheels, carrying devices between said wheels and settable thereby, with a series of reciprocating racks actuating said wheels during their movement in one direction, controlling devices for said racks representing units and tens of the products of the digits, and adjustable in one direction to vary the digits of the multiplier, a rotary handle and connections for reciprocating said controlling devices to move the racks, and means for operating said carrying devices successively while the racks are not actuating the wheels.

87. In a calculator, the combination of the series of registering gear-wheels, carrying devices between said wheels and settable thereby, with a series of reciprocating racks actuating said wheels during their movement in one direction, controlling devices for said racks representing the units and tens of the products of the digits, and adjustable in one direction to vary the digits of the multiplier, and a rotary handle and connections for reciprocating said controlling devices to move the racks, and for operating said carrying devices successively while the racks are not actuating the wheels.

88. In a calculator, the combination of a series of registering gear-wheels, carrying devices between said wheels and settable thereby, with a series of reciprocating racks actuating said wheels during their movement in one direction, controlling devices for said racks representing the units and tens of the products of the digits, a rotary handle, a link connecting said handle and controlling devices for reciprocating said controlling devices to move the racks, and connections with said handle for operating said carrying devices successively while the racks are not actuating the wheels.

89. In a calculator, the combination of the series of registering gear-wheels, carrying devices between said wheels and settable thereby, with a series of reciprocating racks actuating said wheels during their movement in one direction, controlling devices for said racks representing the units and tens of the products of the digits, a rotary handle, a disk rotated thereby, a link connecting said disk and controlling devices for reciprocating said controlling devices to move said racks, and a shaft operated by said handle and carrying a series of helically-disposed cams for operating said carrying devices successively while said racks are not actuating the wheels.

90. In a calculator, the combination of a series of registering gear-wheels, carrying mechanisms interposed between said wheels and settable thereby, with a series of racks co-operating with said wheels, reciprocating controlling mechanism for moving said racks, an operating-handle connected by links with said controlling mechanism, and connections with said handle for bringing said racks and wheels into the same plane during a portion of the movement of said racks, and for operating said carrying mechanisms successively when said racks and wheels are in different planes.

91. In a calculator, the combination of a series of registering gear-wheels, carrying mechanisms interposed between said wheels and settable thereby, with a series of racks co-operating with said wheels, reciprocating controlling mechanism for moving said racks, a rotary handle, a disk rotated thereby links reciprocated by said disk and connected to said controlling mechanism, and connections with said handle for bringing said racks and wheels into the same plane during a portion of the movement of said racks, and for operating said carrying mechanisms successively when said racks and wheels are in different planes.

92. In a calculator, the combination of a series of registering gear-wheels, carrying mechanisms interposed between said wheels and settable thereby, with a series of racks co-operating with said wheels, reciprocating controlling mechanism for moving said racks, a rotary handle, a disk rotated thereby links reciprocated by said disk and connected to said controlling mechanism, a shaft carrying a helically-arranged series of cams for operating said carrying mechanisms successively when said wheels and racks are disengaged, and mechanism operated by said handle for bringing said racks and wheels into the same plane during a portion of the movement of said racks.

93. In a calculator, the combination of a series of registering gear-wheels, carrying mechanisms interposed between said wheels and settable thereby, with a series of racks co-operating with said wheels, reciprocating controlling mechanism for moving said racks, a rotary handle, a disk rotated thereby, links reciprocated by said disk and connected to said controlling mechanism, a shaft carrying a helically-arranged series of cams for oper-

ating said carrying mechanisms successively when said racks and wheels are disengaged, and a cam on said handle-shaft for bringing said racks and wheels into the same plane during a portion of the movement of said racks.

94. In a calculator, the combination of the series of registering gear-wheels, carrying mechanisms interposed between said wheels, with a series of racks co-operating therewith, plural series of projections varying in height, one series for each rack, means for determining which projection of each series shall co-operate with its rack, means for reciprocating the projections, means for bringing said racks and wheels into the same plane during a portion of the movement of said racks, and means for operating said carrying mechanisms successively when said racks and wheels are in different planes.

95. In a calculator, the combination of a series of registering gear-wheels, carrying mechanisms interposed between said wheels and settable thereby, with a series of racks co-operating therewith, plural series of projections varying in height, one series for each rack, means for determining which projection of each series shall co-operate with its rack, means for reciprocating said projections and bringing said racks and wheels into the same plane during a portion of the movement of said racks, and means for operating said carrying mechanisms successively when said racks and wheels are in different planes.

96. In a calculator, the combination of a series of registering gear-wheels, carrying mechanisms interposed between said wheels and settable thereby, with a series of racks co-operating therewith, plural series of projections varying in height, one series for each rack, means for determining which projection of each series shall co-operate with its rack, means for bringing said wheels and racks into the same plane during a portion of the movement of said racks, and means for reciprocating said projections and for operating said carrying mechanisms successively when said wheels and racks are not in the same plane.

97. In a calculator, the combination of a series of registering gear-wheels, carrying mechanisms interposed between said wheels and settable thereby, with a series of racks co-operating therewith, plural series of projections varying in height, one series for each rack, means for determining which projection of each series shall co-operate with its rack, means for reciprocating said projections, and means for bringing said wheels and racks into the same plane during a portion of the movement of said racks, and for operating said carrying mechanisms successively when said racks and wheels are not in the same plane.

98. In a calculator, the combination of a series of registering gear-wheels, carrying mechanisms interposed between said wheels and settable thereby, with a series of racks co-operating therewith, plural series of projections varying in height, one series for each rack, means for determining which projection of each series shall co-operate with its rack, and means for reciprocating said projections and for bringing said racks and wheels into the same plane during a portion of the movement of said racks, and for operating said carrying mechanisms successively when said racks and wheels are in different planes.

99. In a calculator, the combination of a series of registering gear-wheels, carrying mechanisms interposed between said wheels and settable thereby, with a series of racks co-operating therewith, plural series of projections varying in height, one series for each rack, means for determining which projection of each series shall co-operate with its rack, an operating-handle, a link connecting said handle and a frame for reciprocating said projections, and connections with said handle for bringing said racks and wheels into the same plane during a portion of the movement of said racks, and for operating said carrying mechanisms successively when said wheels and racks are in different planes.

100. In a calculator, the combination of a series of registering gear-wheels, carrying mechanisms interposed between said wheels and settable thereby, with a series of racks co-operating therewith, plural series of projections varying in height, one series for each rack, means for determining which projection of each series shall co-operate with its rack, a rotary disk, a frame, connections between said disk and frame for reciprocating said projections, a cam for bringing said racks and wheels into the same plane during a portion of the movement of said racks, and means for rotating said disk, operating said cam, and said carrying mechanisms successively when said wheels and racks are not in the same plane.

101. In a calculator, the combination of a series of registering gear-wheels, carrying mechanisms interposed between said wheels and settable thereby, with a series of racks co-operating therewith, plural series of projections varying in height, one series for each rack, means for determining which projection of each series shall co-operate with its rack, a rotary handle, a disk rotated thereby, a link connecting said disk and a frame for reciprocating said projections, cams operated by said handle for bringing said racks and wheels into the same plane during a portion of the movement of said racks, and for operating said carrying mechanisms successively when said wheels and racks are not in the same plane.

102. In a calculator, the combination of a series of registering gear-wheels, carrying mechanisms interposed between said wheels and settable thereby, with a series of racks co-operating therewith, plural series of projections varying in height, one series for each rack, setting means for determining which

projection of each series shall co-operate with its rack, an operating-handle, a disk rotated thereby, a link connecting said disk and a frame for rotating said projections, cams on said handle-shaft for bringing said racks and wheels into the same plane during a portion of the movement of said racks, and a shaft operated by said handle and carrying a helically-arranged series of cams for operating said carrying mechanisms successively when said wheels and racks are in different planes.

In witness whereof I have set my hand, this 28th day of October, 1895, in the presence of two witnesses.

LÉON BOLLÉE.

Witnesses:
CORDIER,
A. BARNABÉ.