No. 735,291. PATENTED AUG. 4, 1903.

C. F. PIDGIN.

CALCULATING MACHINE.

APPLICATION FILED JUNE 22, 1899.

NO MODEL. 5 SHEETS—SHEET 1.

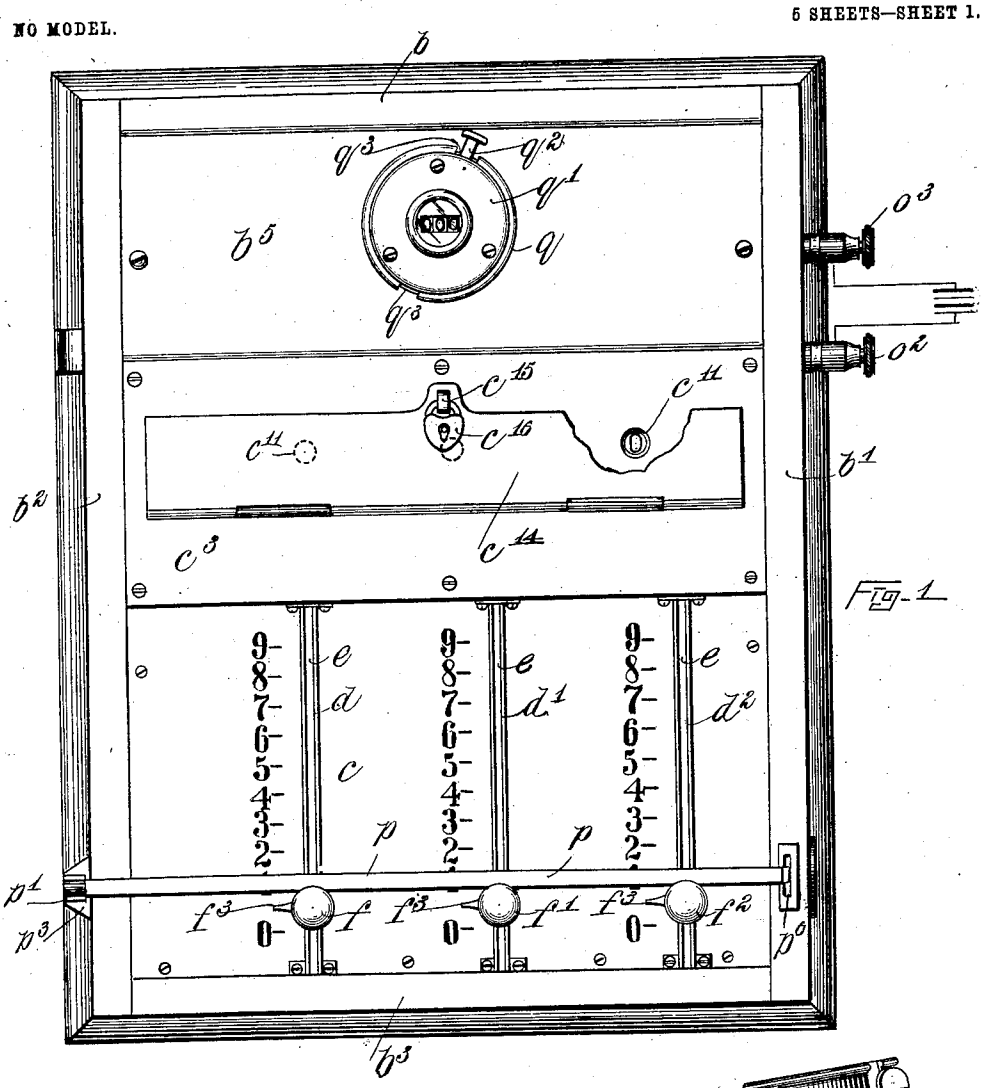

Fig. 1.

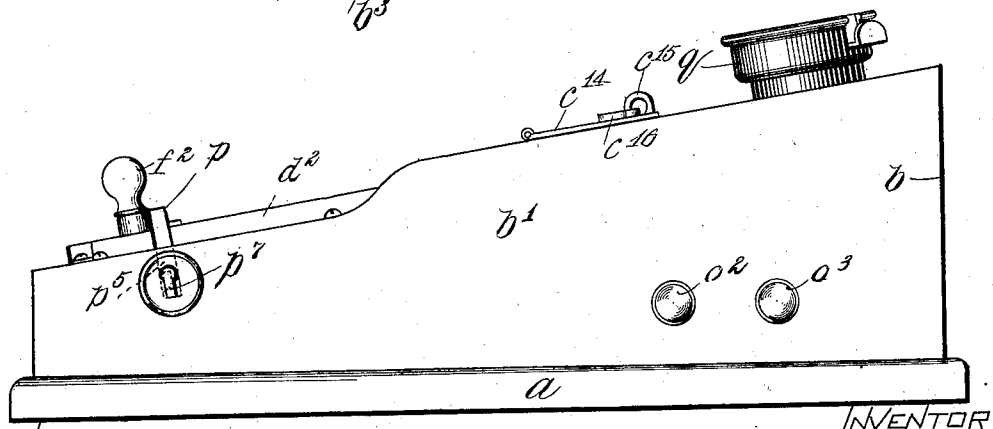

Fig. 2.

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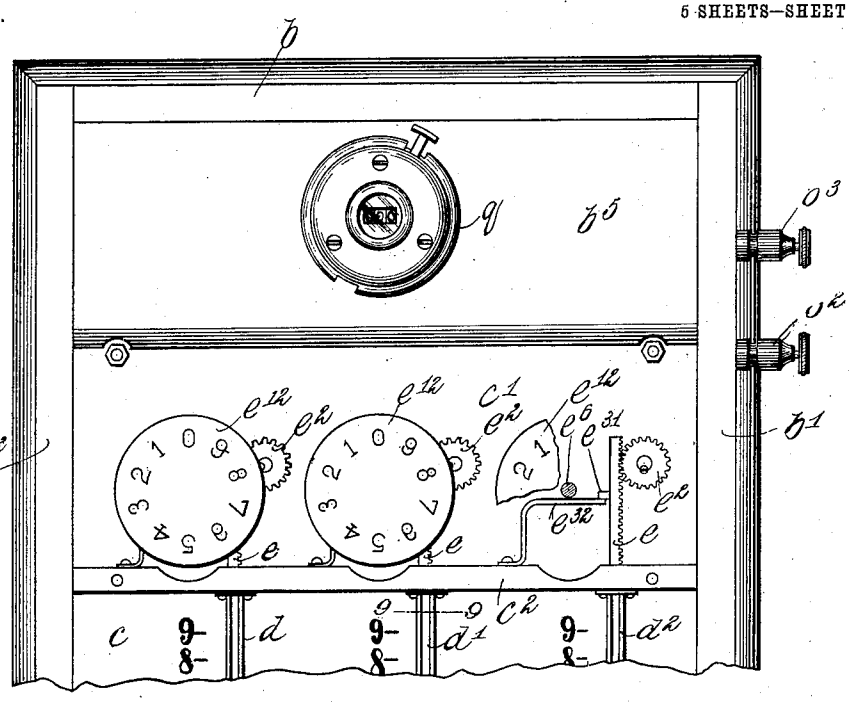
NO MODEL. 5 SHEETS—SHEET 2.

Fig. 3.



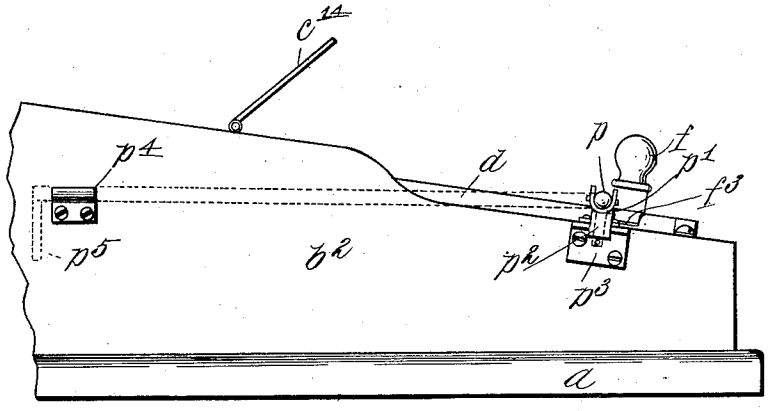


Fig. 4.

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NO MODEL. 5 SHEETS—SHEET 3.

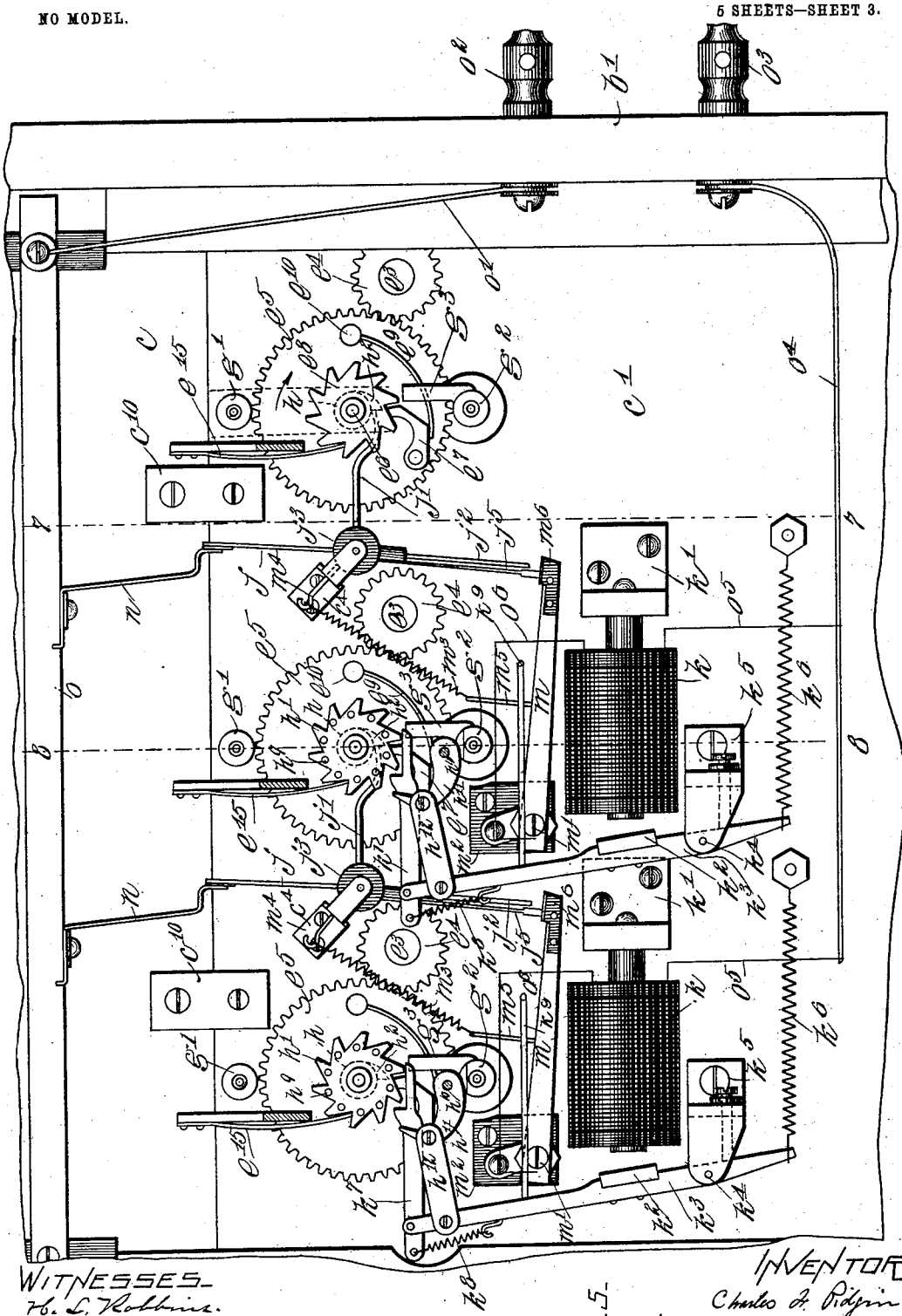

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FIG. 5.

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CALCULATING MACHINE.

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NO MODEL. 5 SHEETS—SHEET 4.

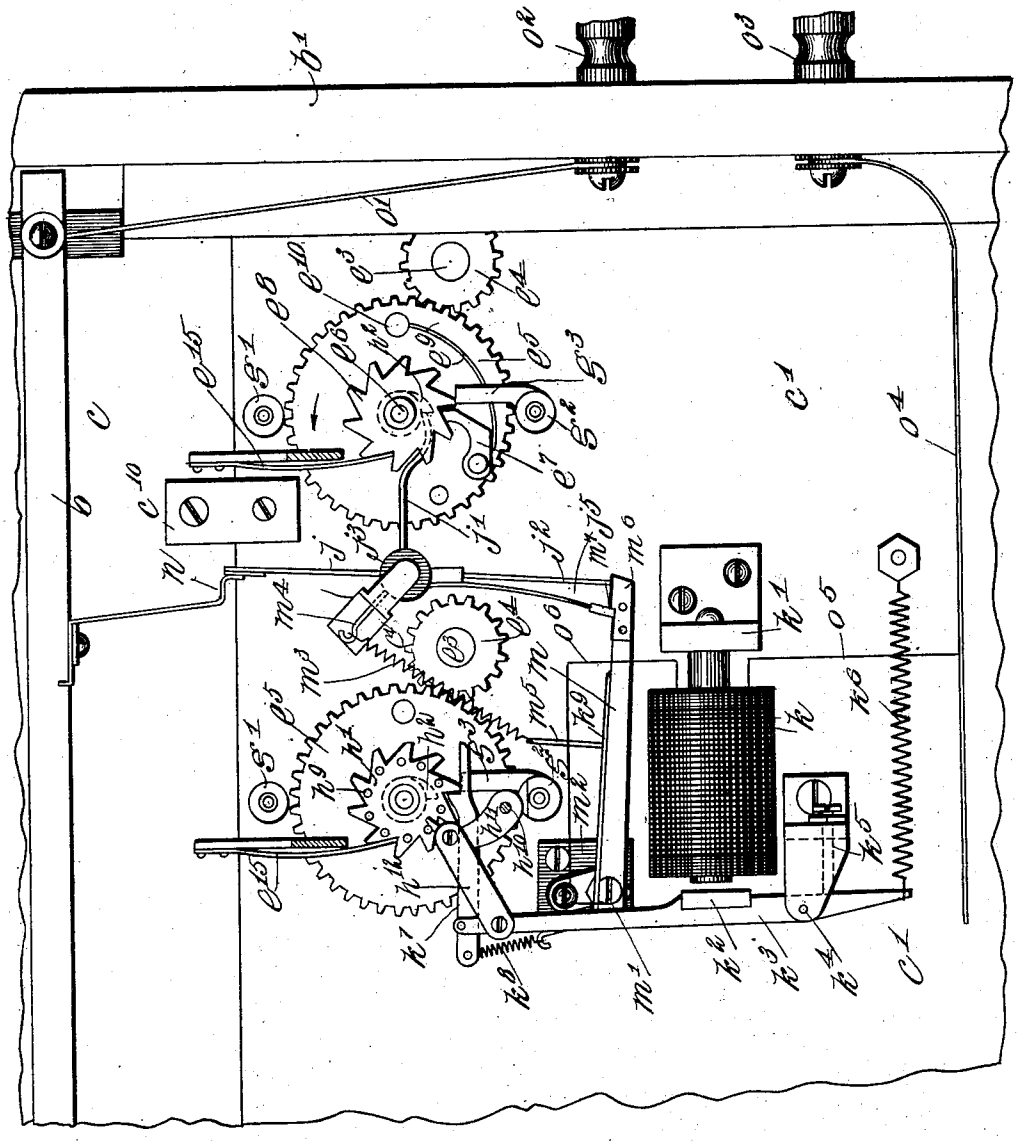

FIG. 6.

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APPLICATION FILED JUNE 22, 1899.

NO MODEL. 5 SHEETS—SHEET 5.

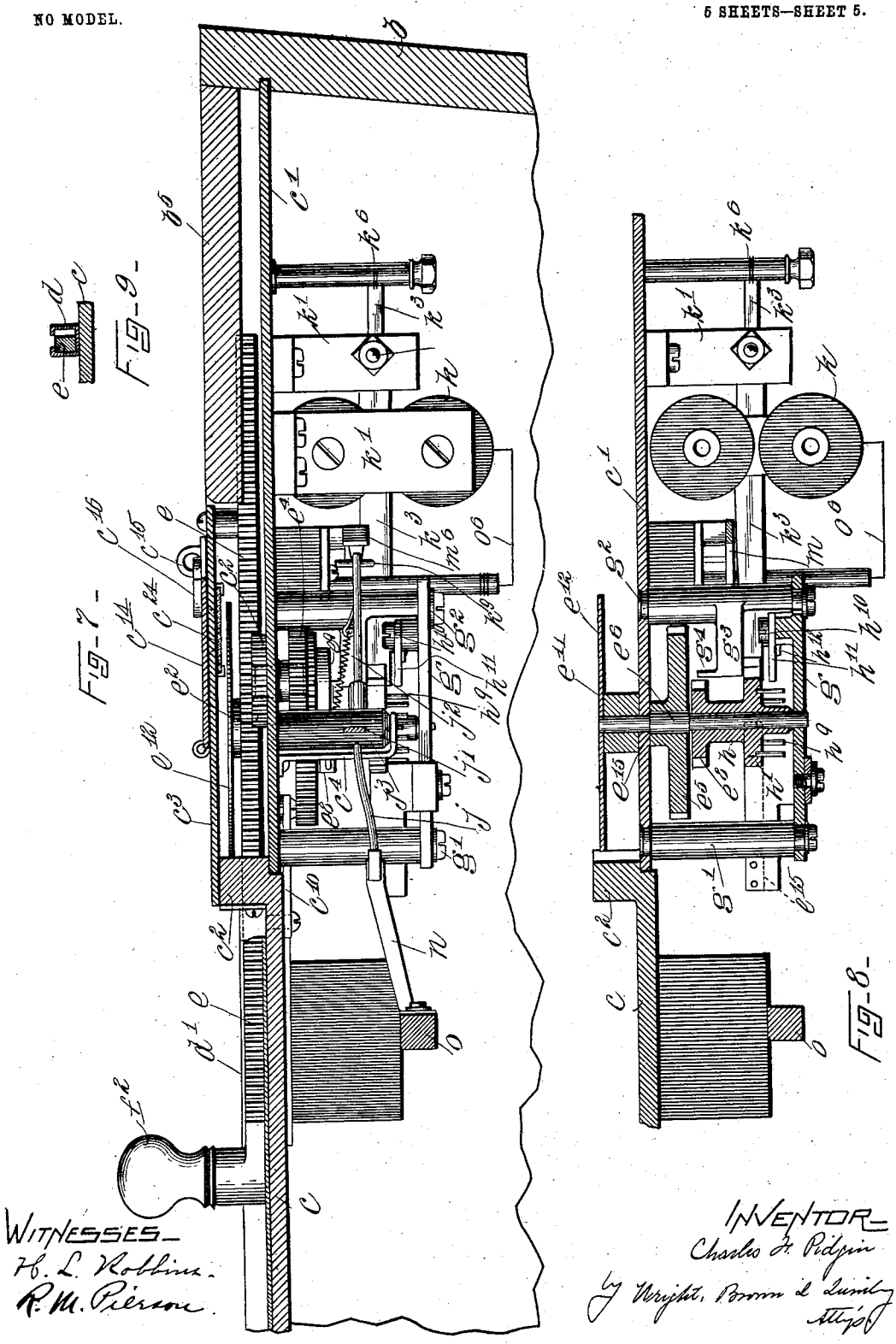

Fig. 9.

Fig. 7.

Fig. 8.

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No. 735,291. Patented August 4, 1903.

UNITED STATES PATENT OFFICE.

CHARLES F. PIDGIN, OF BOSTON, MASSACHUSETTS.

CALCULATING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 735,291, dated August 4, 1903.

Application filed June 22, 1899. Serial No. 721,483. (No model.)

To all whom it may concern:

Be it known that I, CHARLES F. PIDGIN, of Boston, in the county of Suffolk and State of Massachusetts, have invented certain new and useful Improvements in Calculating-Machines, of which the following is a specification.

This invention has for its object to provide a machine by means of which mathematical calculations may be made accurately and rapidly without a corresponding exercise of the reasoning faculties beyond that necessary to transfer by mechanical manipulations of the several keys the figures which are being added, multiplied, or otherwise computed, and while it is my design to provide a machine which may be used for computations by officials in banking and other institutions, yet it is more especially my object to render it particularly applicable in adding and recapitulating statistical items in census and other similar work.

To these ends the invention consists of a machine having certain features of construction and relative arrangement of parts, all as I have illustrated upon the drawings, shall now proceed to describe in detail in the following specification, and particularize in the appended claims.

Referring to the said drawings, on which similar reference characters indicate similar parts or features, as the case may be, wherever they occur, Figure 1 represents in plan view a machine embodying my invention. Fig. 2 represents an end elevation of the same. Fig. 3 represents a plan view with the plate which covers the numeral-bearing disks removed. Fig. 4 represents an elevation of the other end of the machine. Fig. 5 represents a view of the machine with the casing in vertical position, so as to expose the electrical adding mechanism. Fig. 6 represents a portion of the same with the parts in a different position. Fig. 7 represents a transverse section on the line 7 7 of Fig. 5. Fig. 8 represents a similar section on the line 8 8 of Fig. 5. Fig. 9 represents a transverse section on the line 9 9 of Fig. 3.

In my invention I employ a registering or indicating device for each numerical value from the unit-point and mechanism for indicating a value upon its proper device—that is to say, the units will be registered or indicated by one mechanism, the tens by another and separate one, the hundreds upon a third, and so on—and I further employ electrical devices whereby when the sum of the numbers of any standard of value exceeds the maximum of that standard the excess will be carried to the next higher order of value.

Referring to the drawings, which illustrate one embodiment of the invention, I have shown a casing which includes the base a, the end walls b' b^2, the rear wall b, and front wall b^3, together with a top which consists of several parts. The top or table of the casing is inclined, as shown in Fig. 2, the lower half of the table being formed of a plate c and the upper portion consisting of a thin flat plate c', secured to the plate c by small strips of metal c^{10}, as shown in Figs. 5 and 7. Above the plate c at the rear portion of the casing is a strip b^5, of wood, and between the latter and a flange c^2, formed along the rear edge of the plate c, is placed a metallic strip c^3. These parts, as described, support and cover all of the various operative parts of the machine. The trains of registering or indicating mechanism are placed side by side under the rear portion of the table, and they are governed by keys, which may be slid over the front portion of the same. Except for the electrical carrying devices the mechanisms are all independent, and they may be operated in any desired order without affecting the result of the computation. On the said plate c are placed a plurality of parallel guides d d' d^2, each of which is **U**-shaped in cross-section with the upper edges bent inward, and in each of said guides is placed a rack-bar e. The lower ends of said rack-bars are provided with knobs or keys f f' f^2, each of which carries an index or pointer f^3. On the upper face of the plate beside each guide is a graduated scale having beside it a column of figures in sequence commencing with "0" and ending with "9," and the first column, commencing with the right-hand end, represents a certain order of numerical value, as units, the second another or higher order, as tens,

and the third hundreds. It will be understood that although I have shown the three columns of figures as representing three orders of values and shall describe the three sets of calculating mechanism corresponding thereto other similar trains of mechanism may be added, so that the machine will count up into the hundreds of millions.

Each of the rack-bars e projects through an aperture in the flange c^2 into a space formed between the plate c' and the wooden strip b^5. In the plate c^3 is an aperture c^{11}, corresponding to each column of figures, and below said plate are a plurality of numeral-disks corresponding in number to the number of columns of figures and each adapted to have one of its figures visible through one of the apertures c^{11}. These apertures are protected by a strip c^{24} of glass and are normally closed by a hinged cover c^{14}, which is locked by a suitable device, such as a staple c^{15} and padlock c^{16}.

The trains of indicating or registering mechanism are similar, so I shall describe only one of them in detail.

The numeral-disk is indicated at e^{12} and is suitably connected with the rack-bar e by a mechanism which I shall describe, whereby assuming that the disk is at zero position when the key is moved rearwardly to a certain number—as, for instance, "7"—and then is returned to normal or zero position the numeral "7" immediately appears in the aperture c^{11} corresponding to the said key.

The numeral-disk e^{12} is secured to the end of an arbor e^6, which is journaled in the plate c' and in a narrow support or strip g, secured to the plate c' by posts g' g^2, riveted or otherwise secured at their ends. The arbor e^6 is provided with a shoulder e^{15}, which bears against the under face of the plate c', and on said arbor directly below the said plate there is loosely mounted a large gear-wheel intermeshing with a pinion e^4. The last-mentioned pinion is secured to a small shaft e^3, which projects upwardly from the plate c' and is equipped on its end with a pinion c^2, intermeshing with the rack-bar e. Hence each time the rack-bar is reciprocated the gear-wheel e^5 is rotated first in one direction and then in the other.

By examining Fig. 6 it will be seen that the gear-wheel is provided with a pawl e^7, held in engagement with a ratchet e^8, rigidly secured to the arbor e^6 by a spring e^9, attached to a stud e^{10} on said wheel, so that while the gear-wheel e^5 is adapted to rotate freely in the direction of the arrow in Fig. 5 without affecting the arbor e^6 when rotated in the opposite direction or in the direction of the arrow in Fig. 6 the arbor will be rotated with it. A spring-pawl e^{15} holds the ratchet against reverse movement, and in order to prevent the latter and said gear-wheel e^5 from moving too far the post g^2 is formed with an arm g^3, having a finger g^4, (see Fig. 8,) which engages the pawl e^7. When the rack-bar is returned to zero position, it carries the gear-wheel e^5 in the direction of the arrow in Fig. 6 until the pawl e^7 strikes against the stop g^3, and if the parts were allowed to remain in this position they would be locked, and hence said rack-bar is formed with a lug e^{31}, (see Fig. 3,) which engages a spring e^{32}, secured to said flange c^2, so as to carry said bar slightly rearward after it has been returned to zero position, so as to carry back the pawl e^7 from the tooth previously engaged by it and from the stop g^3, as shown in Fig. 6.

As thus far described, it is plain that when either one of the knobs or keys is carried backward to any numeral in its column of figures and is then returned to normal or zero position the numeral-wheel corresponding thereto is rotated a corresponding number of steps—that is to say, assuming that in the units mechanism the figure "5" appears through the aperture c^{11} and the key f^2 is carried to the numeral "3" and then returned the numeral "8" will then appear in said aperture.

Whenever the sum of the numerals in any train of mechanism appertaining to any one of the standards of value exceeds nine, (the maximum of that standard,) one is added or carried onto the next higher order of numerical value—that is to say, when the units-key has been moved so that the summation of numbers of that standard is ten (10) or above one (1) is added or carried over to the tens mechanism, this being accomplished by electromagnetic devices, which I shall now proceed to describe.

Each ratchet e^8 (with the exception of that in the units mechanism) is formed on a sleeve h, having at its lower end a second ratchet-wheel h', and between said wheels is a cam h^2, as shown in dotted lines in Figs. 5 and 6. A lever having three arms j j' j^2 and a hub j^3 is fulcrumed underneath the plate c' in a bracket c^4, and the arm j' rests against the sleeve h, so as to be engaged by the cam h^2 once for each rotation of the ratchet. When the cam has made a complete rotation, the three-armed lever is actuated to close the circuit through an electromagnet to impart a single step to the ratchet of the other next higher train of mechanism. The electromagnets are one less in number than the trains of registering or indicating mechanism, for it is evident that they are unnecessary with the units mechanism, since that represents the lowest order or standard of value. The magnet is indicated at k and is supported by a bracket k'. The armature k^2 is secured to a lever k^3, which is fulcrumed at k^4 in a bracket k^5, secured to the plate c'. The armature is normally held away from the magnet when the circuit through the latter is broken by a spring k^6. On the free end of the lever is pivotally supported a pawl k^7, held in operative relation to the ratchet h' by a spring k^8, and hence each time the circuit is closed through the magnet and the armature is

drawn toward its core the pawl k^7 engages the ratchet h' and moves the latter a single step. The make-and-break devices or switch mechanism for the circuit include the three-armed lever, previously referred to, and a second lever m, which is fulcrumed at m' in an insulated plate m^2, secured to the plate c'. A spring m^3, connected to a hook m^4 on the bracket c^4 and to a hook m^5 on the lever m, raises the latter and holds it against the end of the arm j^2 or against the end of a spring member j^5, carried by the three-armed lever. The arm m is formed of metal which is a good conductor of electricity, and on its end it has a strip m^6 of insulating material. Connected to the arm j^2 of the three-armed lever is said spring member j^5, whose end is adapted to engage the metallic portion of the lever m or else the insulator-strip m^6, and when it engages the metallic portion it is temporarily held against movement by a shoulder m^7, as shown in Fig. 6. The arm j of the three-armed lever is held against a spring-contact n by the spring m^3, before referred to. The contact n is in electrical connection with a conductor o, extending lengthwise of the plate c, the latter being connected by the wire o' with the binding-post o^2, and a second binding-post o^3 is electrically connected with a wire o^4, which is connected in multiple with the electromagnets, as shown in Fig. 5, by wires o^5. Said electromagnet is further connected by a wire o^6 with the lever m, so that when the spring member is in engagement with said lever m the circuit is closed through the electromagnet, it being understood, of course, that the binding-posts are connected with an electrical generator of any kind.

Under normal conditions the arm j rests against the spring-contact n and the end of the spring member j^5 rests against the insulation m^7 on the lever m; but when the arm j' is forced downward by the cam h^2, just as the numeral-bearing disk completes one rotation to bring the figure "0" into the aperture c^{11}, the arm j is moved away from the spring-contact, so as to break the electrical connection therewith, and the spring member j^5 is moved into the position shown in Fig. 6, whereby it electrically connects with the lever m, and as the cam h^2 continues to rotate the end of the arm j' finally drops off from it and the spring m^3 carries the arm j back into contact with the spring-contact n, the spring member j^5 remaining in electrical connection with the lever n. This immediately closes the circuit through the electromagnet k and the latter actuates the armature k^2 to move the ratchet k' of the registering mechanism of the next order of values a single step, whereby the numeral-bearing disk is also rotated one step.

In order to immediately break the circuit the instant that the electromagnet is energized, I mount an arm k^9 on the lever k^3 and bend its end so that it projects over or across the lever m, as shown in Fig. 5, and hence when the lever k^3 is actuated the said arm k^9 presses the lever m and permits the spring member j^5 to spring into parallelism with the arm n^2, whereby its end rests against the insulated strip on the said lever m. Now it will be seen from this explanation that each time the summation of certain values on any one train of mechanism exceeds nine the train of mechanism corresponding with the next value is immediately actuated to advance the numeral-bearing disk therein, so that such summation is immediately indicated in the next train of mechanism.

I have found sometimes that it is difficult to check the momentum of the gearing when actuated by the electromagnet, and hence I provide a stop mechanism to prevent the ratchets from being moved more than one step at a time.

The ratchet h' is provided with a plurality of pins h^9, one for each tooth, and pivoted on a pin h^{10}, projecting from the plate g, is a dog h^{11}, having an end which may be moved into engagement with any one of the pins, as shown in Fig. 6. A link h^{12} connects the said pawl with the lever k^3. These parts are so constructed and arranged that the end of the pawl lies normally out of the path of motion of the pins h^9; but when the lever k^3 is actuated to cause the pawl k^7 to engage and advance a tooth upon the ratchet h' the end of the dog h^{11} is immediately thrust into the path of the next adjacent pin, as shown in Fig. 6, to stop it from moving beyond a single step.

In the operation of the machine, assuming that the numerals indicating "3 8 4" appear in the apertures c^{11} and that it be desired to add sixty-seven thereto, the following steps are taken: The units-key is moved backward to the numeral "7" in the column and is then returned to zero position. As it moves forward the rack causes the rotation of the train of gearing and the disk e^{12} and the numeral "1" appears in place of the "7." During the rotation of the ratchet e^8 just as the disk e^{12} reaches zero position the cam h^2 operates the three-armed lever to close the circuit through the magnet, and thereby cause the pawl k^7 to advance the ratchet h' of the tens mechanism, whereby the disk e^{12} of said mechanism is turned to present the numeral "9" instead of "8." Then the tens-key is moved back to "6," and as it is being returned it causes the closing of the circuit through the magnet of the hundreds-train of mechanism to cause the disk e^{12} of that mechanism to be advanced to present the numeral "4" at the third aperture c^{11}. The tens-key on reaching zero position has rotated the disk e^{12} of the tens mechanism six steps, whereby it presents the numeral "5." Hence the total "451" appears as the summation of the two sets of figures.

It is not necessary that the units-key should be operated first, as either of the others may be manipulated first, if desired, without changing the result. As a matter of fact the

computor usually begins with the left-hand key and works toward the right in the way that figures are usually read.

In order to prevent the manipulation of the keys by others in case the computor leaves the machine, I provide a lock which consists of a bar p, as shown in Figs. 1, 2, and 4. At its left end the bar is pivoted between the ears of a stud p', which is swiveled in a bearing p^2, forming a part of a bracket p^3, secured to the wall b^2, and said bar may be therefore swung across the machine, as shown in Fig. 1, or else be laid in a bracket or rest p^4, secured to the wall b^2, as shown in dotted lines in Fig. 4, where it is out of the way when the machine is in use. The right end of the bar is formed with a hook p^5 to enter a spring-lock p^6 in the wall b', as shown in Fig. 2, said lock being similar to those employed in roll-top desks. The locking member may be disengaged by a key inserted in the keyhole p^7. To lock the keys $f f' f^2$, they are moved to the lower or forward ends of the guides and the bar p is engaged with the lock, after which they cannot be moved backward, and are held at zero position.

Where the machine is employed for making a series of computations, it is desirable that the operator should be provided with a simple tallying device for noting the completion of each one of them, and hence on the top of the strip or plate b^5 I secure a cup q, in which is placed a simple tallying-machine capable of registering nine hundred and ninety-nine. Said machine comprises a casing q', having suitable numeral-disks with actuating mechanism therefor, (not shown,) and an actuator q^2, which may be pressed inward to move the units-disk one step. The cup q has apertures or slots q^3 to receive the actuator, as shown.

Each time a computation is complete the actuator is thrust inward to tally one and the registering or indicating mechanisms of the machine are returned to zero by adding to each numeral in the aperture beginning at the right c^{11} the difference between it and ten.

The machine, as hereinbefore set forth, is well adapted for statistical and computational work of all kinds. The main part of the mechanism is operated mechanically, and in that respect it is an improvement over those machines in which the trains of mechanism are actuated electromagnetically through the closing of a plurality of circuits in succession by means of a contact on each key, since the latter is wasteful of electricity and is therefore costly, and besides that the contacts constantly become covered with dust and dirt, and thereby fail to make proper electrical connection.

In the present machine the electrical carrying mechanism is inclosed in a tight casing, which is substantially dust-proof, whereby they retain their efficiency without cleaning or repair for years. The plate or table c is imperforate, and the guides are placed on top of it, so that there is no opportunity for dust to sift through slots or openings into the interior of the casing.

In addition to the advantages which I have briefly enumerated it will also be noted that the stop devices for preventing the numeral-disks from moving more than one step at a time, the positive actuation of the trains of registering or indicating mechanism, &c., possess many points of advantage.

Having thus explained the nature of the invention and described a way of constructing and using the same, although without attempting to set forth all of the forms in which it may be made or all of the modes of its use, I declare that what I claim is—

1. A calculating-machine comprising a plurality of mechanical registering mechanisms for different orders of value, electromagnetic devices for carrying from one mechanism to that of the next higher order, said devices each consisting in part of an automatic circuit-closer, and a supplemental circuit-breaker arranged to automatically actuate said circuit-closer, whereby the circuit is broken, and independent devices arranged to have mechanical engagement with said registering mechanisms for the purpose of actuating the same.

2. A calculating-machine comprising a plurality of mechanical registering mechanisms for different orders of value, electromagnetic devices for carrying from one mechanism to that for the next higher order, said devices each consisting in part of an automatic circuit-closer, and a supplemental circuit-breaker arranged to automatically actuate said circuit-closer, whereby the circuit is broken.

3. A calculating-machine comprising a plurality of mechanical registering mechanisms for different orders of value, electromagnetic devices for carrying from one mechanism to that for the next higher order, said devices each consisting in part of a cam-actuated circuit-closer, and a circuit-breaker arranged to automatically actuate said circuit-closer, whereby the circuit is broken.

4. A calculating-machine comprising a plurality of mechanical registering mechanisms for different orders of value, electromagnetic devices for carrying from one mechanism to that for the next higher order, said devices each consisting in part of an automatic circuit-closer, an electromagnet, and a movable member controlled by said magnet and arranged to actuate said circuit-closer, whereby the circuit is broken.

5. A calculating-machine comprising a plurality of registering mechanisms for different orders of value, electromagnetic devices for carrying from one mechanism to that for the next higher order, said devices each consisting in part of a switch adapted to close a circuit, an arm with which said switch is adapted to make electrical connection, an electromagnet in circuit with said arm, and a device

arranged to automatically actuate said arm, whereby the circuit is broken.

6. A calculating-machine comprising a plurality of registering mechanisms for different orders of value, electromagnetic devices for carrying from one mechanism to that for the next higher order, said devices each consisting in part of two contacts in the same circuit, one of said contacts having a stop, a switch-lever having an arm for each contact, one of said arms being resilient and adapted to engage the stop, and means for operating said switch-lever, whereby one arm leaves its contact until the other engages the stop, and then returns, to close the circuit between said contacts.

7. In a registering-machine, registering mechanism including an arbor, actuating means therefor including a wheel carrying a pawl, and a ratchet, a stop located in the path of said pawl, and a spring to move said pawl back from said stop.

8. In a registering-machine, registering mechanism including an arbor, a pinion mounted on said arbor and carrying a pawl, a ratchet, a pinion meshing with said former pinion, a stop located in the path of said pawl, a reciprocating member arranged to actuate said second pinion, a stop-lug on said reciprocating member, and a spring lying in the path of said stop-lug.

9. The combination with a plurality of registering mechanisms for different orders of value comprising a series of arbors, actuating means for each arbor including a wheel carrying a pawl, and a pair of ratchets, one of which is engaged by said pawl, of electromagnetic devices for carrying from one mechanism to that of the next higher order, said devices each comprising an automatic circuit-closer, an electromagnet, a pivoted armature, and an actuating-pawl mounted in the end of said armature and adapted to engage the second ratchet.

10. The combination with a plurality of registering mechanisms for different orders of value comprising a series of arbors, actuating means for each arbor including a wheel carrying a pawl and a pair of ratchets, one of which is engaged by said pawl, of electromagnetic devices for carrying from one mechanism to that of the next higher order, said devices comprising an automatic circuit-closer, an electromagnet, a pivoted armature, an actuating-pawl mounted on said armature and adapted to engage the other ratchet, and a stop-dog carried by said armature and adapted to engage said latter ratchet.

11. The combination with a plurality of registering mechanisms for different orders of value comprising a series of arbors, actuating means for each arbor including a wheel carrying a pawl, a ratchet engaged by said pawl, a second ratchet having pins projecting therefrom, of electromagnetic devices for carrying from one mechanism to that of the next higher order, said devices each comprising an automatic circuit-closer, an electromagnet, an armature pivoted at its lower end, an actuating-pawl mounted in its upper end and adapted to engage said second ratchet, and a stop-dog also mounted in the upper end of said armature and adapted to engage said pins.

In testimony whereof I have affixed my signature in presence of two witnesses.

CHARLES F. PIDGIN.

Witnesses:

MARCUS B. MAY,

C. C. STECHER.