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Patented Nov. 14, 1899.

G. & R. SCHWARZ.
CALCULATING MACHINE.

(Application filed Feb. 18, 1899.)

(No Model.)

2 Sheets—Sheet 1.

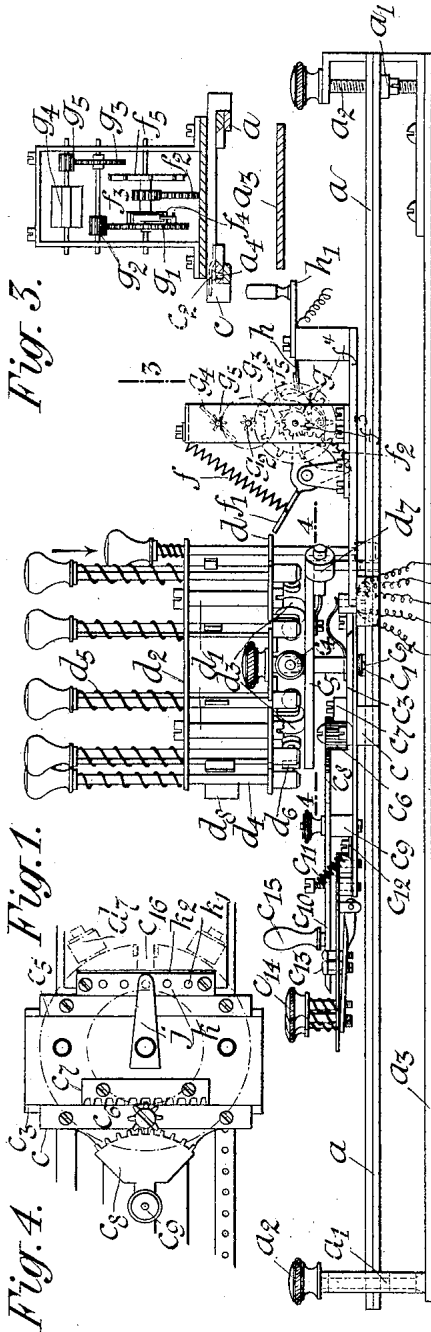


Fig. 1.

Fig. 3.

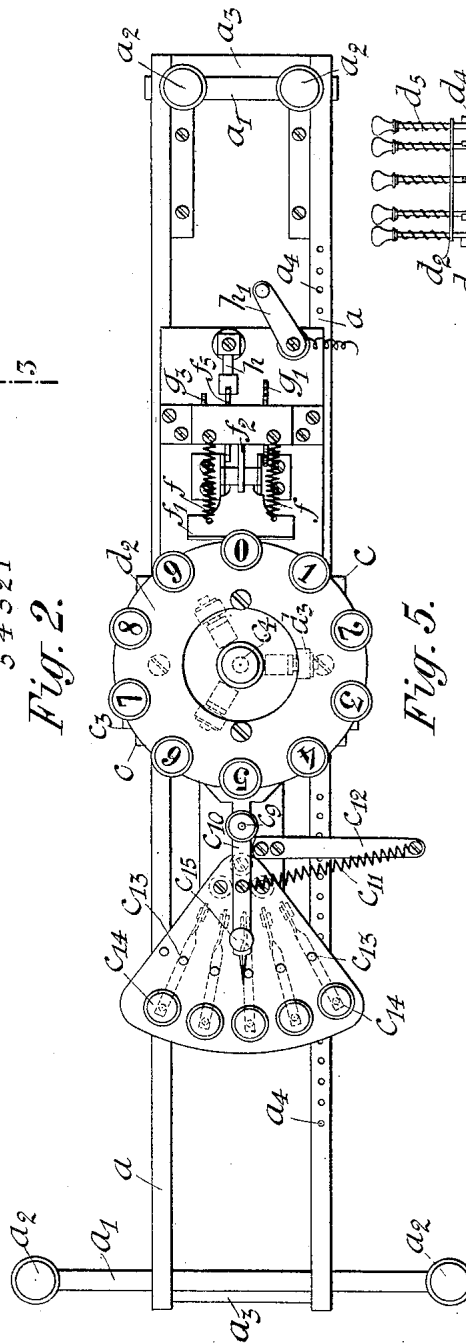
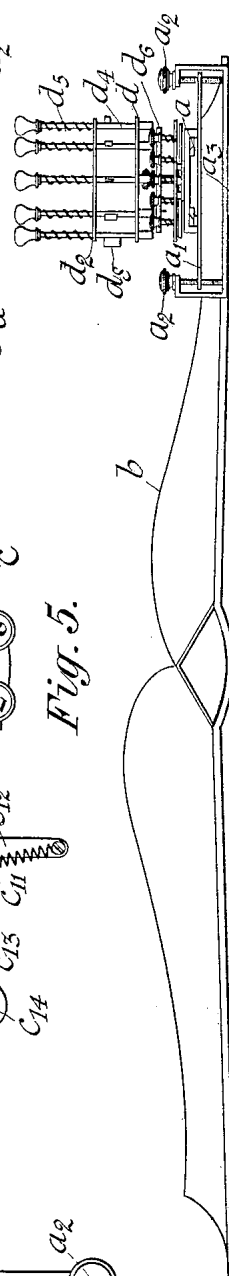


Fig. 2.

Fig. 5.



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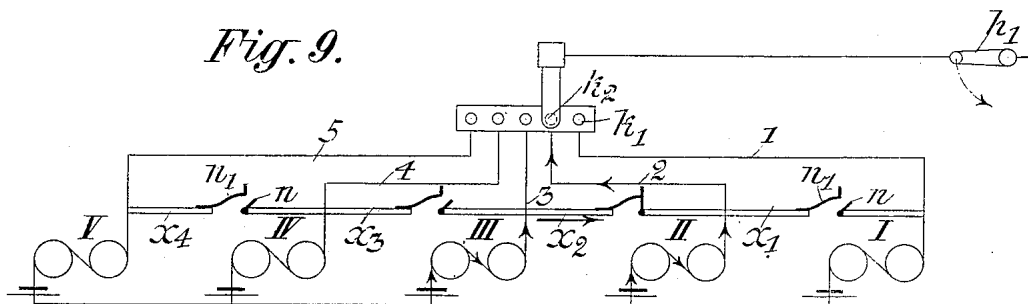
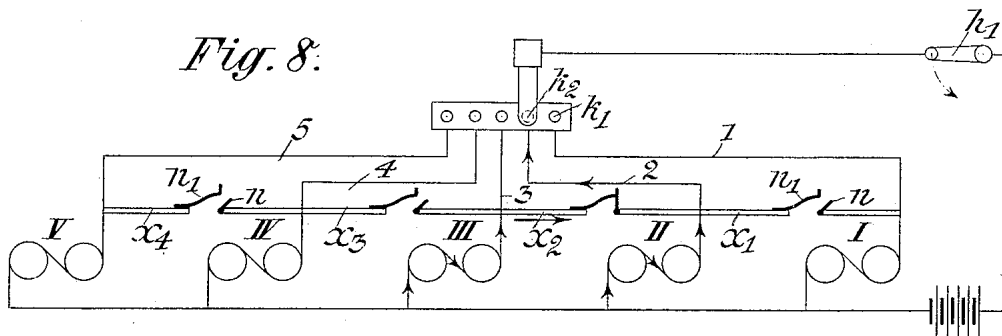
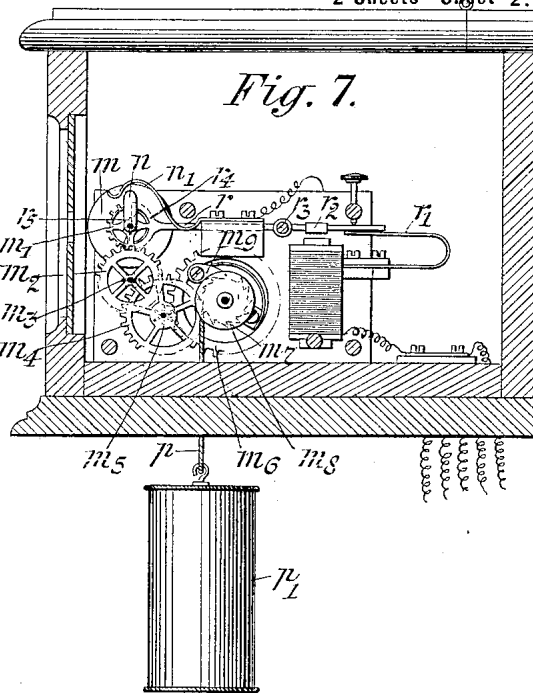
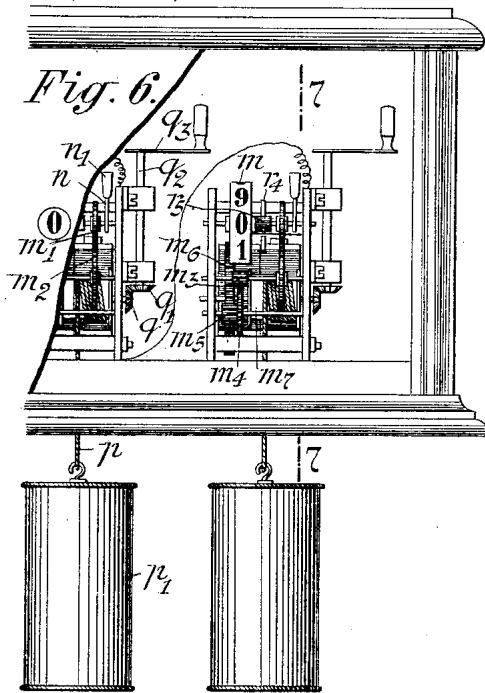
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2 Sheets—Sheet 2.



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UNITED STATES PATENT OFFICE.

GUSTAV SCHWARZ AND RUDOLF SCHWARZ, OF VIENNA, AUSTRIA-HUNGARY.

CALCULATING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 637,167, dated November 14, 1899.

Application filed February 13, 1899. Serial No. 706,041. (No model.)

To all whom it may concern:

Be it known that we, GUSTAV SCHWARZ and RUDOLF SCHWARZ, subjects of the Emperor of Austria-Hungary, residing at Vienna, in the Province of Lower Austria and Empire of Austria-Hungary, have invented a new and useful Calculating-Machine with Distant Total or Difference Indicator, of which the following is a specification.

Our invention relates to that class of machines for adding numbers together or for subtracting one number from another in which a type-writer adapted to print the numbers is combined with a computing-machine or subtracting-machine, the succession of the figures "1 2 * * * * * 8 9 0" being reversed upon the registering-disks of this latter.

The invention has for its object to provide means for the total or difference to be indicated on a place distant from that where the type-writer is operated.

According to our invention the adding or subtracting machine is so constructed and arranged that on a key of the type-writer, which comprises ten keys, corresponding to the numerals 0 1 2 * * * * * 8 9, being operated as many successive closings and openings of an electric circuit take place as there are units contained in the number corresponding to the key. The said electric circuit contains, besides the source of electric current, as many electromagnets, arranged in multiple arc, as the sum is to comprise places, the said electromagnets being arranged in the locality where the sum or difference is to be indicated and provisions being made for completing the electric circuit by the shunt containing the required electromagnet every time the type-writer is displaced, according to the local value of a figure, while the other shunts remain cut out.

The attraction of an armature has for its effect that a disk along the edge of which the figures "0" to "9" are marked is turned the rate corresponding to one figure. In order to cause, when a numeral-disk passes from the indication "9" to "0" the disk corresponding to the next higher place to be turned one numeral, a normally-interrupted electric connection runs from each shunt to the shunt containing the electromagnet which corre-

sponds to the next higher place, and while the numeral-disk corresponding to the lower place passes from "9" to "0" a revolving circuit-maker strikes a spring-terminal, and thereby closes the said electric connection.

In order to make our invention fully understood, we shall hereinafter describe the same in detail, with reference to the annexed two sheets of drawings, in which—

Figure 1 is a side elevation, and Fig. 2 a top view, of the type-writer and the device for displacing it, according to the local value of a figure to be printed. Fig. 3 is a sectional elevation on line 3 3, Fig. 1, showing the mechanism by which the circuit is closed while a numeral is being printed. Fig. 4 is a top view of the sliding contact-piece closing the shunt of the electromagnet concerned every time the type-writer is shifted. Fig. 5 illustrates how the frame carrying the type-writer is clamped upon a book for use. Fig. 6 is a front elevation, and Fig. 7 a sectional side elevation, on line 7 7, Fig. 6, respectively, of numeral-disks, the weight-motors adapted to drive them, and the electromagnets which by means of their armature-levers stop the said motors. Figs. 8 and 9 show diagrams of the circuit connections in the two cases of the battery being inserted as a whole into the main line or being inserted by portions into the shunts.

It will be seen from Fig. 5 that the rectangular frame $a a' a'$ can be clamped upon the book b , into which the numbers are to be entered. For this purpose screws a^2 , which are journaled in the base-plate a^3 , engage tapped holes of the cross-bars $a' a'$ of the frame. A carriage c is adapted to be slid along the longitudinal bars $a a$ of the frame, the said carriage having secured to one of its lateral slide-bars a spring c' , which carries a half-globular knob c^2 . The said knob takes into recesses a^4 , formed in the adjacent bar a , with intervals corresponding to the inter-linear spaces. Upon the said carriage c another carriage c^3 is movable in transverse direction, this carriage c^3 having secured to it the pivot c^4 and the circular rail c^5 for the circular type-writer. The carriage c^3 , supporting the type-writer, is made movable in the transverse direction in order to provide for

the displacement of the type-writer according to the local value of the figure to be printed. The displacements are performed by the pinion c^6 , mounted upon the longitudinally-movable carriage c and gearing with a rack c^7 , screwed to the transversely-movable carriage c^3 . The pinion c^6 is driven by the toothed sector c^8 , having its pivot c^9 secured to an extension of the longitudinally-sliding carriage c . Beyond the pivot c^9 a lever-arm c^{10} is rigidly connected with the toothed sector c^8 , and a coiled spring c^{11} has one end fixed to the said lever-arm c^{10} and the other end to a laterally-projecting arm c^{12} , screwed to the carriage c . The stop-pins c^{13} , which may be lowered by pressing down the corresponding keys c^{14} , keep the lever-arm c^{10} in its position against the pull of the spring c^{11} . When the cross-carriage c^3 , and consequently the lever-arm c^{10} too, are in their extreme left-hand positions, figures of the highest local value may be entered. As soon as the figure is printed the first of the keys c^{14} is pressed down, whereby the first stop-pin c^{13} is lowered, and the spring c^{11} is permitted to pull the arm c^{10} over the said stop-pin to the next stop-pin. The toothed sector c^8 and the pinion c^6 and rack c^7 transmit this movement to the cross-carriage c^3 , carrying the type-writer. When all parts have arrived in the positions corresponding to the entering of units, one may seize the knob or handle c^{15} of the arm c^{10} in order to push the said arm over the sloped ends of the stop-pins c^{13} into the position corresponding to the entering of the next numeral. In consequence of this displacement of the arm c^{10} the spring c^{11} is put in tension.

The annular type-writer is carried by the circular plate d , loosely mounted on the pivot c^4 and having secured to it, by means of the standards d' , a ring d^2 , in which guide-holes for the plungers carrying the types are formed. To the lower surface of the plate d are secured brackets for the rollers d^3 , running upon the rail c^5 . The type-plungers d^4 are guided in square holes of the base-plate d and of the ring d^2 , the coiled springs d^5 keeping the said plungers raised and stop-rollers d^6 being pivoted to the inner faces of the plungers. On a plunger being pressed down, its stop-roller d^6 comes to bear upon the outer marginal portion of the rail c^5 , and when the whole type-writer is then by means of the lowered plunger turned to the left or to the right the type first passes over either of two inking-rollers d^7 , fastened to the rail c^5 by means of springs. Afterward the stop-roller d^6 drops into the recess c^{16} of the rail c^5 , whereby the inked type is pressed upon the paper.

It has been stated hereinbefore that the plunger d^4 while being lowered must cause as many successive closings and breakings of an electric circuit as there are units in the numeral printed by the said plunger. To this effect all plungers except that carrying the cipher-type are provided with outwardly-projecting ribs d^8 of different heights. The said

projecting ribs or tappets carry along, against the pull of springs $f f$, the one plate-shaped arm f' of an angular lever, the other arm of which is formed by a toothed sector f^2 . According to the height of the rib or tappet d^8 , the lever-arm f' is moved downward a greater or smaller distance. During this movement the toothed sector f^2 rotates the pinion f^3 , loosely mounted to its shaft and carrying upon its boss the ratchet-wheel f^4 at one side, and the star-shaped contact-wheel f^5 , provided with nine points, at the other side. While this rotary movement takes place, the springs $f f$ are put in tension, and the ratchet-wheel f^4 freely passes below the pawl g , pivoted to the toothed wheel g' , which is mounted by the side of the ratchet-wheel. At the same time a given number of the points of the contact-wheel f^5 slide over the upper surface of a contact-spring h , which upper surface is coated with insulating material. Afterward the toothed sector f^2 and the pinion f^3 turn in the opposite direction under the action of the springs $f f$, formerly put in tension, and the ratchet-wheel f^4 carries along the pawl g , pivoted to the toothed wheel g' , whereby this latter is rotated. It transmits the movement to the pinion g^2 , the shaft of which also carries the toothed wheel g^3 , and this latter is in gear with a pinion g^5 , mounted on the shaft of a revolving fan g^4 , checking the rate of speed. Owing to this arrangement the return movement takes place with a predetermined speed, moderated by the revolving fan g^4 , and during this return movement with moderated speed the same number of points of the contact-wheel f^5 rub along the conductive lower surface of the spring h , which may be connected by means of the switch-lever h' with one pole of a source of electricity, by preference of a battery. From the teeth of the contact-wheel f^5 the current flows into the carriage c and cross-carriage c^3 , to which a contact-spring j is secured. This latter bears against and rubs over a block k , of insulating material, inserted into the carriage c and having as many conductive contact-pieces $k' k^2$, embedded into it as the members to be added may contain places. When the type-writer is displaced according to the local value of the figure to be entered, the contact-spring j also passes from one of the contact-blocks $k' k^2$ to another. From the contact blocks or terminals $k' k^2$, run as many shunts 1 2 as there are contact-blocks, and at the place where the sum or difference for the time being is to be indicated an electromagnet I II III is inserted into every shunt. Beyond the electromagnets the shunts may unite again and the conducting-wire may lead to the other pole of the source of current, as shown in Fig. 8. However, there may also be separate sources of electric current inserted into every shunt, as illustrated in the diagram Fig. 9.

In front of each electromagnet there is mounted upon a shaft a numeral-disk m , having its cylindric face divided into ten squares,

(marked with the figures "1 2 * * * * 9 0.")

By the train of wheels m' m^2 m^3 m^4 m^5 m^6 the shaft of the numeral-disk m is transmittingly connected with the shaft of the cord-drum m^7 .

5 The said cord-drum is loosely mounted upon its shaft, and one of its end sheaves has secured to it a ratchet-wheel m^8 , to which corresponds a pawl m^9 , pivoted to the toothed wheel m^6 . For the purpose of winding the cord p , from which the weight p' is suspended, up the hollow trunnion of the drum m^7 has secured to it a bevel-wheel q , in gear with a bevel-wheel q' , secured to a vertical shaft q^2 , which is provided with a crank and handle q^3 .

15 The armature-lever r , upon which the spring r' exerts its pressure in such a direction as to tend to keep the armature r^2 raised while the electromagnet is not excited, is movable around the pivot-pin r^3 . The other arm of the armature-lever has its free end made up into an escapement-anchor r^4 , similar to that used in the escapements of clocks. The said escapement-anchor r^4 takes into a ten-toothed pinion r^5 , fixed to the shaft of the numeral-disk m , and thereby keeps the train of wheels of the weight-motor locked while the armature r^2 is not attracted. When the armature is attracted, the one tooth of the escapement-anchor r^4 is withdrawn from the pinion r^5 , and at the same time the other tooth takes into the next interstice between two teeth of the pinion, whereby the shaft of the numeral-disk is allowed to make one-tenth of a revolution.

Every time a numeral-disk m passes to the indication "0" or beyond this indication it is necessary that also the numeral-disk corresponding to the next higher place should be turned to the next higher figure. In cases when the indicated sum passes from "99" to "100" or from "999" to "1,000" three or four numeral-disks must be turned simultaneously. To this effect every one of the shunts 1 2 3 is provided with a conductive connection x' x^2 x^3 , respectively, to the shunt comprising the electromagnet which corresponds to the next higher place, the said conductive connections being interrupted at one point. For closing the interruption of any of the conductive connections x' x^2 x^3 in the moment 50 when a numeral-disk indicates "0" the shaft of the numeral-disk m also carries a contact-arm n , to which corresponds a contact-spring n' . The said arm n and contact-spring n' are inserted into the electrical connections x' x^2 x^3 55 in the manner shown by Figs. 8 and 9.

It will be readily understood that it depends on the succession in which the numerals are caused to appear behind the holes of the box containing the disks—i. e., on the fact whether this succession is "1 2 3 * * * * 9 0" or "9 8 * * * 3 2 1"—whether the machine will act as an adding or subtracting machine. In order to enable one and the same machine to be used for both purposes, we provide two sets of numeral-disks. When the sum or difference indicated is also to be entered into the book by

means of the type-writer, the circuit is first broken by means of the switch-lever h' .

The operation of the machine is as follows: First, the frame a' a^2 a^3 is clamped upon the book into which the numbers are to be entered in such a position that the circular type-writer when brought into its extreme right-hand position has its recess c^{16} placed over the units-column of the book. As already 75 explained, the type-writer is shifted from the left to the right by operating the keys c^{14} , by which the corresponding stop-pins c^{13} are lowered, and so the lever c^{10} is permitted to be drawn to the right by the coiled spring c^{11} , 80 the movement of the lever c^{10} being transmitted, by means of the toothed sector c^8 , pinion c^6 , and rack c^7 , to the sliding carriage c^3 , upon which the type-writer is mounted. By seizing the carriage c with both hands and pushing it forward or pulling it backward along the bars a a the type-writer is also adjusted over the line where the first number is to be printed. The knob c^2 of the spring c' , shooting into one of the holes a^4 , sufficiently locks 85 the carriage c in its position. As soon as the type-writer is thus adjusted upon the book the lever h' is turned to the left to close the gap of the electric circuit, and thereby the machine is made ready for operation. 95 Then the contact-spring j bears upon the contact-block h' , which is the terminal of the shunt-line containing the electromagnet I, adapted to actuate the units-computer, and consequently this electromagnet will be energized when the electric circuit is completed by means of the type-writer, as already explained. Let it now be assumed that the adding-disks are mounted to the computers, that these latter indicate the number "5,736," 100 and that the amount "8,715" is to be added. The operator seizes the plunger marked "5," presses it downward till its roller d^6 bears upon the circular rail c^5 , and by means of the seized plunger turns the type-writer to the right or to the left till the roller d^6 drops 110 into the recess c^{16} . Thereby the type at the bottom end of the plunger which has been carried over either of the inking-rollers d^7 is pressed against the paper of the book and the figure "5" is printed in the units-column. While the "5" plunger is lowering, its rib d^8 carries along the plate-shaped arm f' of the lever $f' f^2$ a distance corresponding to the height of the said rib d^8 , thereby putting the coiled springs f in tension. The other arm f^2 of the lever $f' f^2$, in the shape of a toothed sector, causes the loose pinion f^3 , with which it meshes, to turn one hundred and eighty degrees, whereby five teeth or points of 125 the ten-pointed contact-wheel f^5 , secured to the nave of the loose pinion, are caused successively to strike the layer of insulating material upon the upper surface of the contact-spring h . At the same time the ratchet-wheel f^4 , likewise secured to the nave of the loose pinion f^3 , glides freely under the pawl g . 130

As soon as the plunger is released its coiled spring d^5 throws it upward, whereby the springs $f f$ are allowed to return the lever f' f^2 into its former position. The returning toothed sector f^2 again drives the loose pinion f^3 one hundred and eighty degrees, but in the opposite direction, whereby the five points of the ten-pointed contact-wheel f^5 are caused to strike the metallic lower surface of the spring h , and the electric circuit is closed and broken five times. At the same time the ratchet-wheel f^4 drives, by means of the pawl f^5 , the wheel g' , to which the pawl is pivoted, and the wheel g' transmits the movement, by means of the wheels $g^2 g^3 g^5$, to the fan g^4 , which moderates the rapidity of succession of the makings and breakings of the electric circuit. Every time the circuit is closed the electromagnet I attracts its armature r^2 , and as soon as the circuit is broken again the spring r' moves the armature-lever r in the opposite direction. At each such double oscillation of the armature-lever r the escapement-anchor r^4 , integral with the said lever, permits the ten-toothed wheel r^5 to turn, under the action of the weight p' , one tooth—that is to say, a tenth of a revolution—so that the numeral-disk m , fixed to the shaft of the ten-toothed wheel r^5 , which originally presented the numeral “6” behind the window of the box, will successively present “7,” “8,” “9,” “0,” and “1.” While the numeral-disk passes from the position “9” to the position “0,” the contact-arm n , which is secured to the shaft of the numeral-disk and conductively connected with the shunt 1, strikes the contact-spring n' , which is in electric connection with the shunt 2. Thereby the electromagnet II is energized and the tens-disk is caused to turn one figure—viz., from “3” to “4.” The units having thus been added the operator seizes the thumb-piece c^{15} of the lever c^{10} and pushes the lever to the left, over the second one of the chamfered pins c^{13} . Thereby the carriage c^3 , carrying the type-writer, is also moved to the left such an extent that the recess c^{16} is placed over the tens-column of the book and that the spring j is caused to bear upon the contact-block k^2 , corresponding to the shunt 2. Now as there is one ten to be added the operator seizes the plunger marked “1”, depresses it, and pushes it forward, when it will print the figure “1” into the tens-column of the book and by its rib d^8 cause one completion of the circuit comprising the shunt 2. Thus the tens-computer disk m is advanced from “4” to “5” by the electromagnet II, controlling the escapement of the computer’s weight-motor. In an analogous manner the type-writer is afterward shifted over the hundreds-column of the book, and the plunger marked “7” is pressed down and pushed forward in order to add seven hundreds to the seven hundreds already indicated. While the numeral-disk of the hundreds-computer passes from the indication “9” to “0,” the contact-arm n , carried by the shaft of the disk, rubs over its

corresponding contact-spring n' , and thereby closes and breaks the shunt containing the electromagnet IV, this having for its effect that the thousands numeral-disk advances from “5” to “6.” From what has been said the procedure for adding the eight thousands will be obvious.

It will be readily understood that one is not bound first to add units, afterward tens, &c., but may at pleasure begin adding at any place.

For subtracting the numeral-disks provided for this purpose are inserted, and by entering the subtrahend into the book in the manner described the minuend indicated by the numeral-disks is diminished by that amount.

What we claim, and desire to secure by Letters Patent of the United States, is—

1. In an adding and subtracting machine with distant total or difference indicator, the combination with a circular revoluble type-writer comprising ten spring-plungers, adapted to print the types “0, 1 * * * * * 8, 9,” of a source of electricity, a contact-spring connected to one pole of the current-generator and having its upper surface covered with insulating material, a ten-pointed contact-wheel connected to the other pole of the generator and adapted to strike the contact-spring with its points, a longitudinal rib formed on each type-plunger except the “cipher” one, the ribs being of lengths which are to one another as 1: 2: * * * * *: 8: 9, according to the numerals to be printed by the plungers, a lever adapted to be pressed downward by the rib of a lowering type-plunger, a transmitting connection between the lever and the ten-pointed contact-wheel, springs adapted to be put in tension by the lowering-lever, a fan for checking motion, and a ratchet mechanism adapted to drive the fan while the lever is returned by the reaction of the springs, substantially as and for the purpose described.

2. In an adding and subtracting machine with distant total or difference indicator, the combination with a frame, adapted to be clamped upon a book, of a carriage adapted to slide along the said frame, a carriage adapted to slide upon the former carriage in transverse direction, a circular rail mounted upon the upper carriage, the said rail having a recess in its marginal portion in front of the carriage, a pivot arranged in the center of the rail, a plate adapted to turn around this pivot, ten spring-plungers movable in holes of the plate and carrying the types “0, 1, * * * * * 8, 9,” and rollers pivoted to the plungers and adapted to roll on the rail and drop through the recess of the same, substantially as and for the purpose described.

In witness whereof we have signed this specification in presence of two witnesses.

GUSTAV SCHWARZ.
RUDOLF SCHWARZ.

Witnesses:

ALVESTO S. HOGUE,
VINSON KERPL.