Dec. 4, 1934. M. L. ZIMMER 1,982,722

COMPUTING MACHINE

Filed Oct. 23, 1930 2 Sheets-Sheet 1

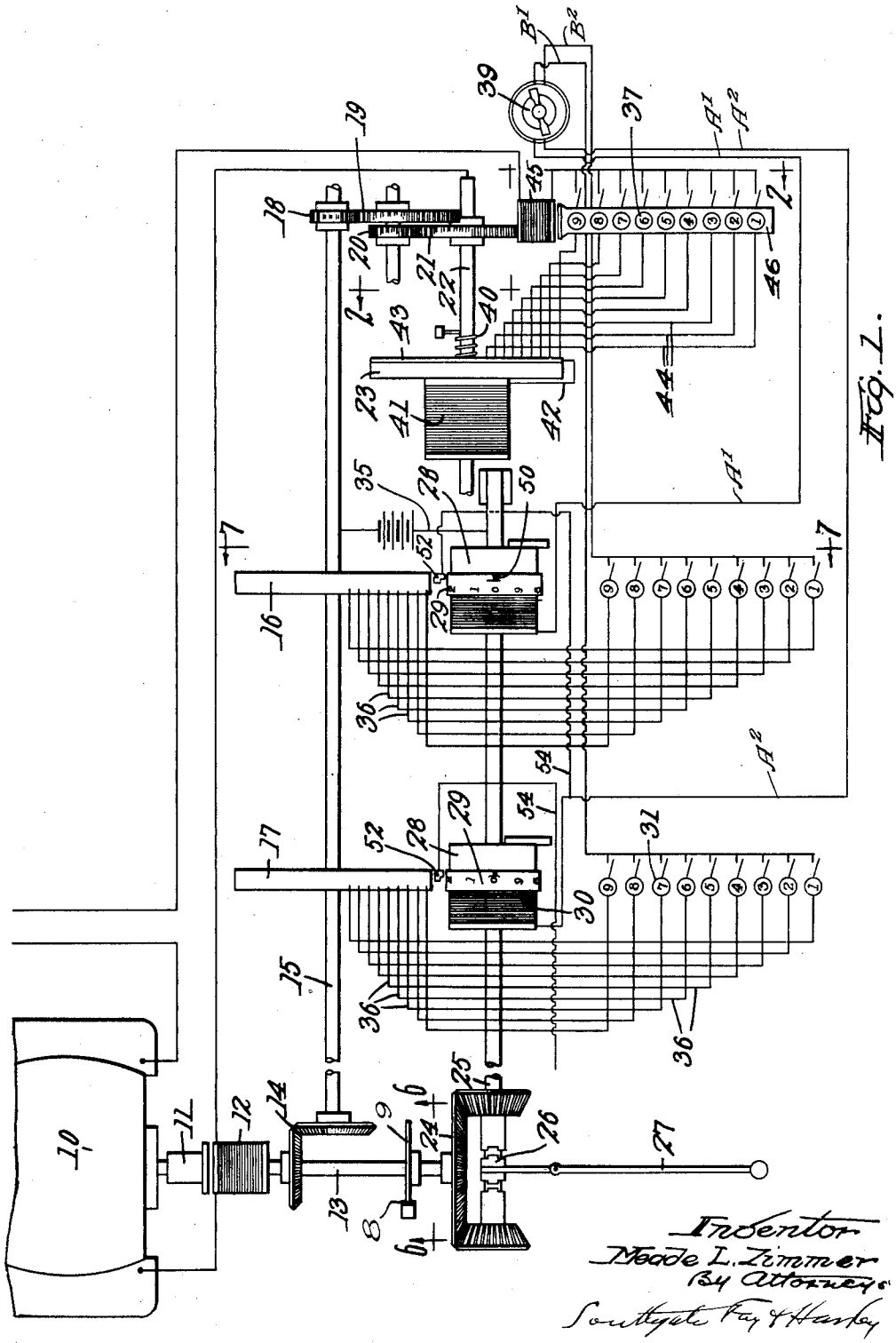


Fig. 1.

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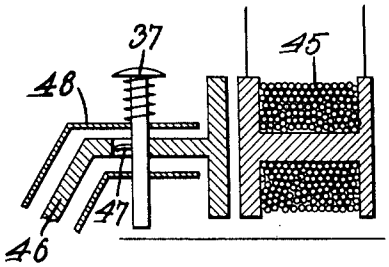


Fig. 3.

Fig. 2.

Fig. 4.

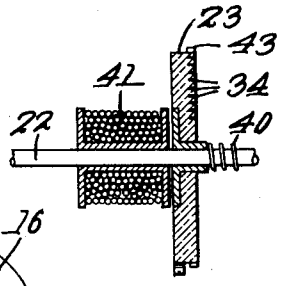


Fig. 5.

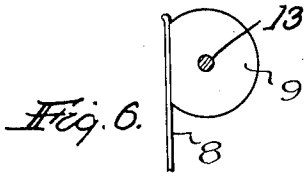


Fig. 6.

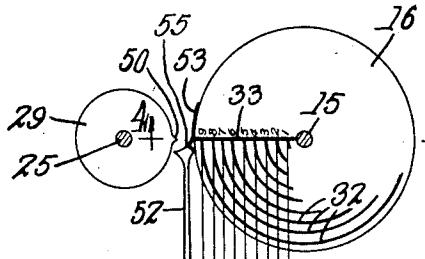
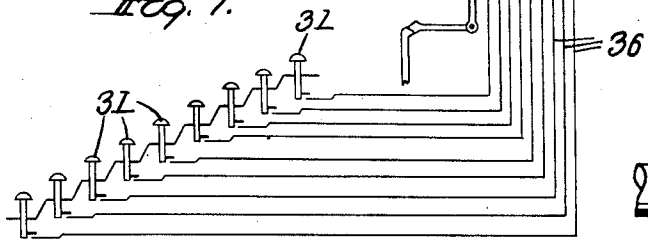


Fig. 7.



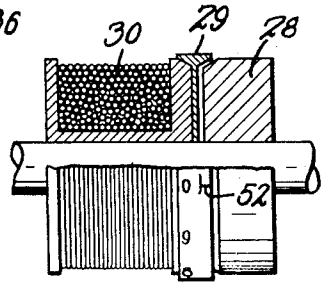


Fig. 8.

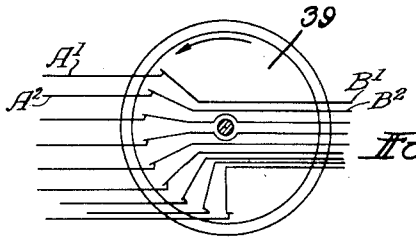


Fig. 9.

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UNITED STATES PATENT OFFICE

1,982,722

COMPUTING MACHINE

Meade L. Zimmer, Cordoba, Argentina

Application October 23, 1930, Serial No. 490,693

18 Claims. (Cl. 235—61)

The principal objects of this invention are to provide a computing machine in which the usual mechanical features for operating the computing wheels will be eliminated and in which no moving carriage will be necessary; to provide a machine for this purpose in which the noise of operation will be entirely avoided, which will be capable of operation as fast as human fingers can work and therefore will present no limitation as to speed and in which what moving parts there are will all move smoothly and noiselessly with a minimum amount of wear and tear; to provide an automatic electric computing machine, and to provide a machine which will be adapted for control of electrical impulses of differential duration.

Other objects and advantages of the invention will appear hereinafter.

Reference is to be had to the accompanying drawings, in which

Fig. 1 is a plan of a machine constructed in accordance with this invention showing the construction including only the units and tens columns and the wiring diagram somewhat diagrammatically;

Fig. 2 is a sectional view on the line 2—2 of Fig. 1 showing a set of keys, for use in multiplying, in side elevation;

Fig. 3 is a sectional view on enlarged scale and in greater detail showing the top key of this set;

Fig. 4 is a sectional view on the line 4—4 of Fig. 7;

Fig. 5 is a sectional view of the multiplying wheel and connected parts;

Fig. 6 is a sectional view on the line 6—6 of Fig. 1;

Fig. 7 is a sectional view on the line 7—7 of Fig. 1 showing one of the ordinary sets of keys, for setting up a number, in side elevation;

Fig. 8 is a side view of one of the number displaying wheels connected with this set of keys, and showing it partly in radial section, and

Fig. 9 is a diagrammatic view of the distributor showing its wiring.

I have shown in the drawings a machine illustrating only two sets of keys and wheels and also illustrating the multiplying mechanism, it being understood that the dividing mechanism is substantially the same with the usual necessary changes.

In general it may be stated that preferably nine rows of ordinary keys are employed for use in addition or subtraction. The units and tens columns only are shown to illustrate the principle and there is another row of keys used for multiplying and also for dividing.

The mechanical features are very few. The machine is operated by a motor 10 which is connected with a line to provide a source of power adapted to be connected up with the motor under certain conditions when certain keys are pressed. The motor is provided with an ordinary magnetic friction clutch section 11 which, through an electro-magnet 12, always connected in series with the motor circuit, connects this motor with the main shaft 13 when the current is on. The magnetic clutch is a friction clutch having two flat soft iron plates covered with a thin layer of leather or some other substance that gives rise to considerable friction, so that when they are drawn together by the magnet the shaft 13 is turned by the friction produced between the plates. There is no very good reason for rotating the magnet, but if it is rotated the circuit is established exactly as in the case of the magnet 30 on the shaft 25. When the circuit is broken the motor will stop and the magnet will be deenergized. On the shaft 13 is a segmental disc 9 and a spring 8 always presses against it to bring the shaft to exactly the same position every time it stops after a complete revolution. This shaft through gears 14 drives a first shaft 15 at its own speed on which are arranged computing wheels 16, 17, etc. only two of which are shown, the wheel 16 representing the unit column. These wheels are of "Bakelite", fibre or other insulating material and are fixed on the shaft. On the shaft 15 is a gear or pinion 18 operating through a gear 19 and pinion 20 fixed with respect to it, a gear 21 at the ratio of 1 to 20. This gear 21 is fixed on a shaft 22 on which is an insulating wheel 23 similar to the wheel 16 but for a different purpose. The gears 18 and 21 are insulated from their shafts.

On the shaft 13 is a gear 24 which will drive a second shaft 25 at the ratio of 2 to 1 either forwardly or backwardly for multiplication and addition or division and subtraction in accordance with the position of a clutch section 26 operated by handle 27. Loose on this shaft 25 are a plurality of magnetic iron collars 28 constituting permanent magnets, one for each column and of course one for each wheel 16 or 17. These permanent magnets 28 are not rotatable but are fixed positively in position. This shaft has a soft iron numbered wheel 29 loose on it which is clutched to the shaft by an electro-magnet 30 as will appear. When this magnet is deenergized the permanent magnet 28 holds the wheel 29 against

rotation. The magnet 30 is fixed on the shaft 25 and is always connected with its line by brush and metallic disc contacts.

The several sets of setting up keys associated with the wheels 16, 17, etc., are arranged as shown in Fig. 7. Each of the setting up keys 31 is numbered, of course, from 1 to 9. These are ordinary keys held up by springs which restore them when the fingers are removed from the keys. When a key is depressed a projection upon it forms a contact with an electric circuit. Each of these electric circuits is also made or broken at the wheel 16 or 17. This insulating wheel is provided with a series of inlaid graduated arcuate metallic contacts 32. These contacts are arranged concentric with the shaft 15 and each one is longer than the one next to it toward the center by a certain definite distance, for a purpose to be described.

Associated with this wheel is a stationary radial brush 33 having a number of spring contacts equal to the number of inlaid arcuate contacts 32 located in their paths of movement and electrically connected to the shaft 15. The No. 9 arcuate contact extends through an arc of 162° and the difference between each two adjacent arcuate contacts is 18° as shown. When the wheel is in zero position as indicated in Fig. 4 these brush contacts engage the upper ends of all of these inlaid contacts.

The clutch 26 being moved in either direction by the handle 27 to turn the shaft 25 either forward or back for addition and multiplication on one hand or division and subtraction on the other, the operator sets up the number in the usual way by pressing the key in each column on the part of the machine that has been described. Assume that a key is pressed in the units column, a circuit is established from the shaft 15, radial brush 33 which is electrically connected with the shaft 15, one of the contacts 32, all of which the brush engages, one wire 36, each of which has a terminal spring-brush in the path of one of the rotating contacts 32, key, any type of distributor 39, magnet 30, shaft 25, to which one pole of the magnet is connected and through wire 35 and source of power back to the shaft 15. The distributor 39 is connected with as many lines as there are columns of figures, but only two, B_1 and B_2 are shown in Fig. 1. It is connected on the other side with the respective magnets 30 through wires A_1, A_2, etc.

The effect of this circuit is to attract the wheel 29 by the electro-magnet 30 which is stronger than the permanent magnet 28 and then this disc will rotate with the shaft 25 to which this magnet 30 is fixed, if that shaft is rotating. Such rotation would continue as long as this circuit is complete through one of the inlay contacts 32. It will be clear that these contacts are arranged so that whatever the key operated, the corresponding arcuate contact will be put in action and will remain connected long enough so that the number wheel will rotate that number of steps or tenths of a revolution if connected up to rotate. This will bring the proper numeral to the top or registering position where it will be seen through a window, not shown. When that inlay contact has passed beyond the brush 33 there will no longer be any current as that is the only circuit through which the current can flow. Then everything stops in that position leaving the numeral displayed.

I have not shown any means to return the parts back to zero, as this device, as so far described, merely selects the number that is to be added or multiplied. A zero setting device can be added or it can be set to zero by manipulating the keys.

If something is to be added to the number the same process is gone through with, as will appear later, and the addition will be applied directly. If, however, it is to be multiplied or the number actually set up so that it will show through the window, the keys 31 are kept down and the mechanism at the right of Fig. 1 is employed. To set up and display the number, the No. 1 key in the key bank 37 is pressed. To multiply, the properly numbered key in the same series is pressed. Here as stated the disc or wheel 23, which is of insulating material and which is provided with the arcuate contacts the same as on the other wheels, is slidably and rotatably mounted on the shaft 22 and the spring 40 operates it to bring it back to zero position.

The electro-magnet 41 fixed on that shaft 22 is connected by a wire and brush 42 to a metal ring 43 on the wheel 23. The electro-magnet is always connected with the wire at one terminal and the other terminal of the magnet is connected with the shaft 22. The inlay contacts 34 are employed in connection with a brush as in the other case and they are connected with the multiplying keys 37 by wires 44, terminating in spring brushes, each located in the path of one of the inlays 34. When one of these keys 37 is depressed it completes the circuit to the other side of the line through a solenoid 45. This solenoid pulls the contact bar 46 to the right as shown in Figs. 2 and 3. The multiplying keys 37 are mounted on the frame 48. The bar 46 is held in its position by the solenoid 45 and a latch 47 to hold this particular key down until the shaft 15 has made the required number of rotations, when it is returned to normal position by a coil spring 38.

This operation also starts the motor and energizes the solenoid 12 so that the shafts will all commence to rotate at once. The wheel 23 will rotate until the inlay contact connected with the button depressed runs off the radial brush and then the circuit is broken and everything stops. This action, through the gearing 18, 19, 20 and 21 and the gears 24 allows the shaft 15 to be rotated by the motor as many complete revolutions as the key 37 calls for and then stops it as previously described. The gear ratio is 1 to 20 as stated so that if the key 5 on the bar 46 is depressed, the shaft 15 will rotate five times and the shaft 22 90°.

It will be remembered that the depression of the keys in the two series shown at the left in Fig. 1 (units and tens columns) merely gets things ready to operate and does not operate anything except to attract the wheels 29 to the magnets 30. Of course, when a key in the row at the extreme right is depressed and the motor started and the magnet 12 energized the shafts will turn as stated.

In order to register the result on the counters suppose we depress key 5 in the units key row. This closes wire 36 connected to key 5 through wire B_2 which connects B^2 to A^2 when commutator is properly set so that we have a circuit established through magnet 30, out through shaft 25 to source of current, or battery in Fig. 1, to shaft 15 on the contact strip 5 out through brush point 5, back to key 5. This of course energizes magnet 30 so that counter 29 is drawn to it and by friction carried with it when shaft 25 is turning. The machine is made to make one turn by pressing key 1 row 46.

One turn of the shaft 15 thus keeps the circuit closed until the contact runs past the brush point

which is just long enough to carry the counter five divisions which is what is wanted. As soon as the contact is broken magnet 30 is deenergized and counter 29 is caught and stopped by fixed magnet 28. Then the clutch 11 is released, the shafts stop and the number 15 is set up and visible through the windows. This has to be done for addition or subtraction.

In multiplying, the second complete turn of the shaft 15 will turn the units wheel 29 five more spaces and the tens wheel 29 one space. One will be carried as will be explained below.

The carrying device is shown in Fig. 7. As soon as any wheel 29 makes a complete turn, bringing the zero under the window of the machine, a small tooth 50 on the wheel 29 kicks a lever 52 over against the contact wheel 17 of the next higher order. This wheel has a contact 53 on its periphery of less than one-tenth of the circumference of that wheel which establishes contact through line 54 and the magnet of the next higher order. Thus it is again energized long enough to carry the wheel 29 in the next column through one space. The arc of the contact 53 is the same as the shortest contact 32 on the same wheel. The lever 52 is restored to its original position by the tooth 55 which, just after leaving the contact on the periphery of the disc 16 for effecting the carrying process, kicks it back to its original position. This of course makes the wheel in the next column read one more than it did before.

The shifting from one wheel to another is brought about by simply shifting the distributor one notch at a time by means of the handle or contactor shown on it. This registers the first key row on the second wheel, thus accomplishing the same result as is done by the shifting of the carriage on the present type of mechanically operated machine.

Although I have illustrated and described only one form of the invention I am aware of the fact that modifications can be made therein by any person skilled in the art without departing from the scope of the invention as expressed in the claims. Therefore I do not wish to be limited in this respect but what I do claim is:—

1. In a computing machine, the combination with a set of keys each having an electrical contact adapted to be closed by the depression of the key, parallel circuits which said contacts are arranged to complete, a main line connected with the contacts on one side, a rotary wheel having contact strips of different lengths each connected with one of said contacts on the other side, and a brush contacting with said strips when the wheel is in certain positions and connected with the other side of said main line, of means whereby whenever the circuit is completed said wheel will be caused to rotate until the strip in circuit passes beyond the brush.

2. In a computing machine, the combination with a wheel and an electro-magnet connected to rotate at the same time on their own axes, of a set of keys, contacts adapted to be closed by the keys, a set of branch circuits closed by said contacts, unequal means on the wheel for opening each branch circuit after the wheel has rotated part of a revolution, said magnet being connected with a source of power in series with all of said branch circuits, and a number displaying wheel free to turn arranged to be attracted and turned by the electro-magnet when it is energized.

3. In a computing machine, the combination with a rotary insulating wheel having graduated concentric contacts thereon and a stationary brush engaging said contacts, of a series of keys each in circuit with one of said contacts and adapted to close another contact in the circuit, a rotary electro-magnet in said circuit, a fixed permanent magnet adjacent thereto, a rotary soft iron wheel between said magnets having numerals thereon, and means for connecting said electro-magnet with said circuit and with a source of power when any key is depressed and as long as the corresponding concentric contact is closed, whereby the soft iron wheel will rotate with the electro-magnet until the concentric contact passes beyond the brush.

4. In a computing machine, the combination with a motor, a motor circuit, an electro-magnetic clutch in the motor circuit for connecting the motor with the main shaft of the machine, a shaft geared to the main shaft, a numbered wheel loosely mounted on the second shaft, a permanent magnet loose on the second shaft but in fixed position adjacent to the numbered wheel, an electro-magnet keyed to the second shaft and located in a second circuit, a set of keys, means operated by the keys for completing the second circuit so that the numbered wheel will rotate with the second shaft, when the current is cut off the numbered wheels will be instantaneously released by the electro-magnets and held in fixed position by the permanent magnets, and means connected with said motor circuit for causing the motor to turn the main shaft through a desired number of complete revolutions for multiplying.

5. In a computing machine, the combination of a set of keys, a separate circuit for each key adapted to be closed by the depression of the key, an electromagnetic means connected with all of said circuits and adapted to be energized by the closing of any one circuit, a rotating shaft having said electromagnetic means fixed thereon, a numbered wheel mounted to rotate freely, said electromagnetic means constituting means for transmitting the rotation of said shaft to the numbered wheel until the circuit of that electromagnetic means is interrupted, and means for interrupting said circuit when the numbered wheel has rotated far enough to set up thereon the numeral of the key which has been depressed.

6. In a computing machine, the combination of a set of keys, a wheel freely rotatable and having numerals thereon to display the numbers set up in the machine, a shaft, means for rotating said shaft while the machine is running, said shaft having an electromagnet fixed thereon for transmitting the rotation of said shaft to the wheel, a series of circuits, one connected with each key and all connected with said electromagnetic means and adapted to be closed by the depression of a key to energize said electromagnetic means and turn the numbered wheel to set up on that wheel the number of the key depressed, means for interrupting said circuit when the numbered wheel is rotated far enough to set up thereon the numeral of the key which has been depressed.

7. In a computing machine, the combination of a set of keys, an independently rotatable wheel having numerals thereon, an electric motor, a main shaft operated by the electric motor, a second shaft connected with the first shaft to be rotated thereby, an electromagnet constituting means for connecting the wheel so as to be operated by the second shaft, a series of circuits each adapted to be closed by the depression of one of the keys for energizing the electromagnet and thereby controlling the operation of the wheel and

means rotating with said wheel for cutting off the circuit from said electro-magnet after the wheel has rotated through part of a revolution to set up the numeral thereon of the key which has been depressed.

8. In a computing machine, the combination of a set of keys, a separate circuit for each key adapted to be closed by the depression of the key, an electromagnetic means common to all of said circuits adapted to be energized by the closing of any of said circuits, a shaft on which said electromagnetic means is fixed, a wheel mounted to rotate freely, said electromagnetic means constituting means for transmitting the rotation of the rotating shaft to the wheel, an electric motor, a power circuit in which said motor is located, a driving shaft having means for driving the first named shaft, an electromagnet in the motor circuit for connecting the motor with the driving shaft when the motor circuit is closed, whereby whenever the motor circuit is closed the motor will rotate and the driving shaft will rotate with it, driving the first named shaft and means rotating with said wheel for cutting off the circuit from said electro-magnet after the wheel has rotated through part of a revolution to set up the numeral thereon of the key which has been depressed.

9. In a computing machine, the combination of a set of keys, a separate circuit for each key adapted to be closed by the depression of the key, an electromagnetic means connected with all of said circuits adapted to be energized by the closing of any of said circuits, a shaft, a numbered wheel mounted to rotate freely, said electromagnetic means constituting means for transmitting the rotation of the shaft to the wheel, and contact making and breaking means in said key circuits, rotating constantly while said shaft is operating, for cutting off the magnet circuit when the wheel has rotated far enough to set up the numeral of the key which has been depressed.

10. In a computing machine, the combination of a set of keys, an independently rotatable wheel having numerals thereon, an electric motor, a main shaft operated by the electric motor, a second shaft connected with the first shaft to be rotated thereby, an electromagnet connected with said second shaft for rotating said wheel with the rotation of the second shaft, a series of circuits each adapted to be closed by the depression of one of the keys for energizing the electromagnet and thereby controlling the operation of the wheel, and contact making and breaking means in said key circuits, rotated constantly by the main shaft while it is operating, for cutting off the magnet circuit when the wheel has rotated far enough to set up the numeral of the key which has been depressed.

11. In a computing machine, the combination of a set of keys, a separate circuit for each key, each adapted to be closed by the depression of a key, an electromagnetic means connected with all of said circuits and adapted to be energized by the closing of any of said circuits, a shaft, a numbered wheel mounted to rotate freely, said electromagnetic means constituting means for transmitting the rotation of said shaft to the wheel, a set of multiplier keys, a series of circuits each arranged to be closed by the depression of the corresponding multiplier key, and means whereby the closing of any one of such multiplier circuits will cause the shaft to rotate.

12. In a computing machine, the combination of a set of keys, a separate circuit for each key adapted to be closed by that depression of the key, an electromagnetic means connected with all of said circuits and adapted to be energized by the closing of any of said circuits, a shaft, means for rotating the shaft, a wheel mounted to rotate freely on said shaft, said electromagnetic means constituting means for transmitting the rotation of said shaft to the wheel on the rotating shaft, a set of multiplier keys, a separate circuit adapted to be closed by the depression of each of said multiplier keys, a second shaft connected with the first named shaft to rotate therewith, a computing wheel fixed on the last named shaft, a plurality of contacts on said computing wheel, each connected with one of said first-named circuits and each adapted to complete its circuit, said contacts being of different lengths so as to go out of contact one after the other as the computing wheel rotates and break the magnetic circuit when the computing wheel rotates the number of steps denoted by the key depressed, and means controlled by the multiplier keys for operating the first-named wheels to perform the multiplying operation.

13. An adding device for an electric counting machine comprising a series of keys, a corresponding series of circuits, each adapted to be completed by the depression of one of said keys, a rotary shaft, means for rotating said shaft, a numbered wheel freely mounted on the shaft, an electromagnet fixed to the shaft, a computing wheel, a series of arcuate metallic contacts on said computing wheel, each one being of a different length from the others to correspond with the different keys, and a brush adapted to engage all of said contacts on the computing wheel, said brush being connected with said circuits and with the electromagnet, whereby when one of the keys is depressed the numbered wheel will be attracted by the electromagnet and be rotated therewith and the current will be on so long as the contact in that circuit on the computing wheel is in contact with the brush and then the current will stop and release the numbered wheel from the magnet.

14. In a computing machine, the combination of a set of keys, a separate circuit for each key adapted to be closed by the depression of its respective key, a shaft, means for rotating the shaft, a rotatable numbered wheel, electromagnetic means connected with all of said circuits and adapted to be energized by the closing of any circuit, and a movable computing control device having a plurality of means proportional in arcuate length to the numerals on said keys for controlling the duration of an electric current in one of said circuits, said electromagnetic means constituting means for transmitting motion from said shaft to said wheel for operating it.

15. In a computing machine, the combination with a set of operating keys numbered from 1 to 9 continuously, each having an electrical contact, circuits which said contacts are arranged to complete individually, a computing control device having contact strips proportional in length to the numbers on said keys, each electrically connected with its corresponding key when in certain positions, and means whereby whenever the proper circuit is completed through said computing control device and the machine is in motion, electrical currents will be produced corresponding in duration to the numbered key depressed.

16. In a computing machine, the combination with a wheel, and an electro-magnet connected to rotate at the same time on their own axes, of

a motor adapted to rotate said wheel, a set of keys, contacts adapted to be closed by the keys, a set of branch circuits adapted to be completed by said contacts individually, unequal means on the wheel for disconnecting each branch circuit from a source of power after the wheel has rotated part of a revolution, said magnet being connected with said source of power, a number displaying wheel free to turn arranged to be attracted and turned by the electro-magnet, another set of keys, and means controlled by the second set of keys for connecting the motor with a source of power to rotate the first-named wheel thereby and to disconnect it after said first-named wheel has rotated one revolution.

17. In a computing machine, the combination with a motor, a motor circuit, a main shaft, means in the motor circuit and on the main shaft comprising a clutch for connecting the motor with the main shaft of the machine to operate it, of a first shaft and a second shaft, both geared to the main shaft, permanent magnets mounted in fixed position, a corresponding number of electro-magnets keyed to the second shaft, one for each permanent magnet, circuits with one of which each electro-magnet is connected, numbered wheels loosely mounted on the second shaft, one between each permanent magnet and a corresponding electro-magnet and adapted to be rotated with the second shaft when the electro-magnet is energized, sets of numbered keys, sets of branch circuits in said electro-magnet circuits, each adapted to be closed by one of said keys, each set connecting up one electro-magnet circuit so that said circuit is closed when any key of that set is depressed, means cooperating with the branch circuits to provide for differential control of said electro-magnets whereby when all the keys of one set are open, the numbered wheel corresponding therewith will then be instantaneously released from its electro-magnet and held in fixed position by the corresponding permanent magnet, and means for opening the motor circuit when the first shaft has completed a part of one revolution for the purpose of addition.

18. In a computing machine, the combination of a motor, a motor circuit, a main driving shaft, an electro-magnetic clutch between the motor and the driving shaft, said clutch being connected in series in the motor circuit, a shaft connected to be driven by the main shaft, a computing wheel of insulating material on the last named shaft, a series of metallic contacts carried by said wheel, said contacts being of graduated arcuate lengths, a brush connected with the motor circuit and adapted to be engaged by the metallic contacts, a series of keys, a series of circuits, each one in series with one of said contacts and in parallel with each other, and means whereby when any one of the keys is depressed it will complete one of the last named circuits, whereby the last named shaft will rotate until the contact on the wheel passes out of contact which will cause the motor circuit to open.

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