H. E. GOLDBERG.

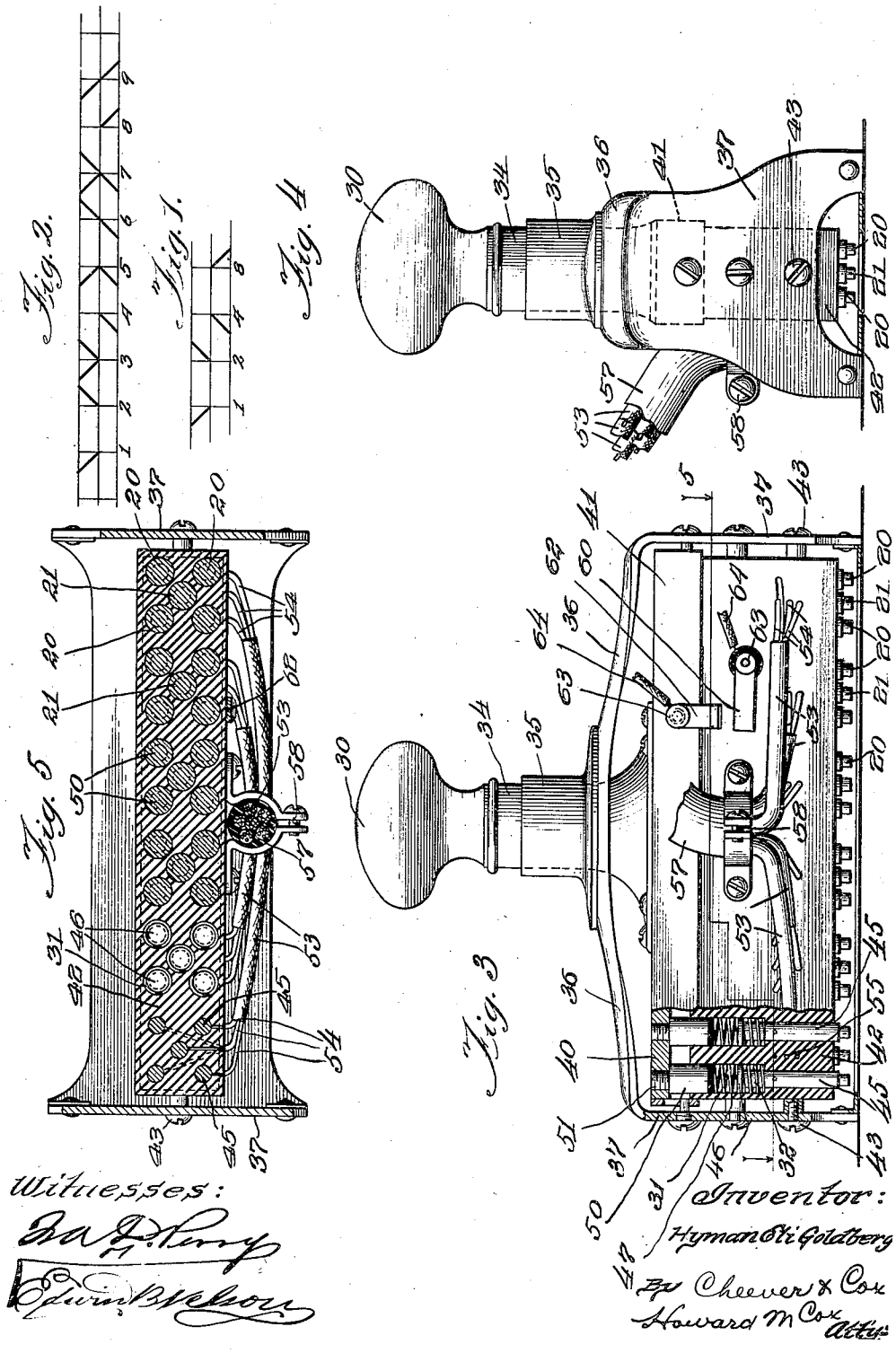
CONTROLLER.

APPLICATION FILED NOV. 23, 1910.

1,117,184.

Patented Nov. 17, 1914.

3 SHEETS—SHEET 1.



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3 SHEETS—SHEET 2.

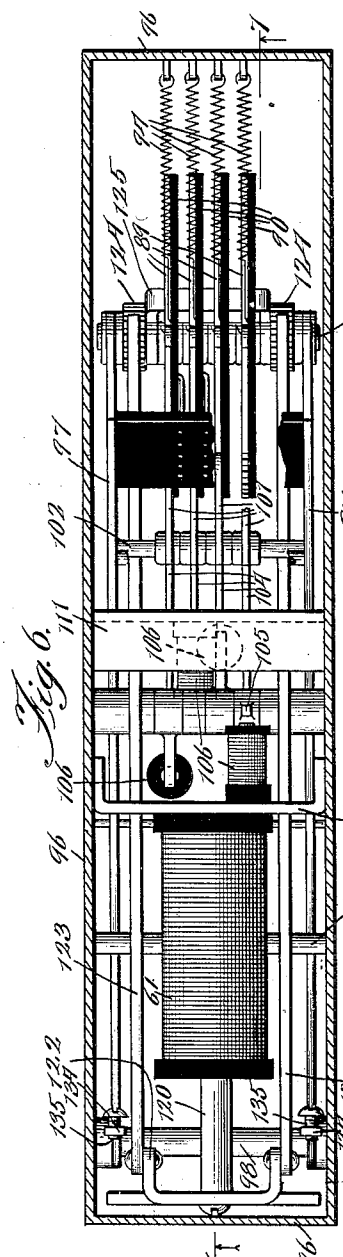

Fig. 6.

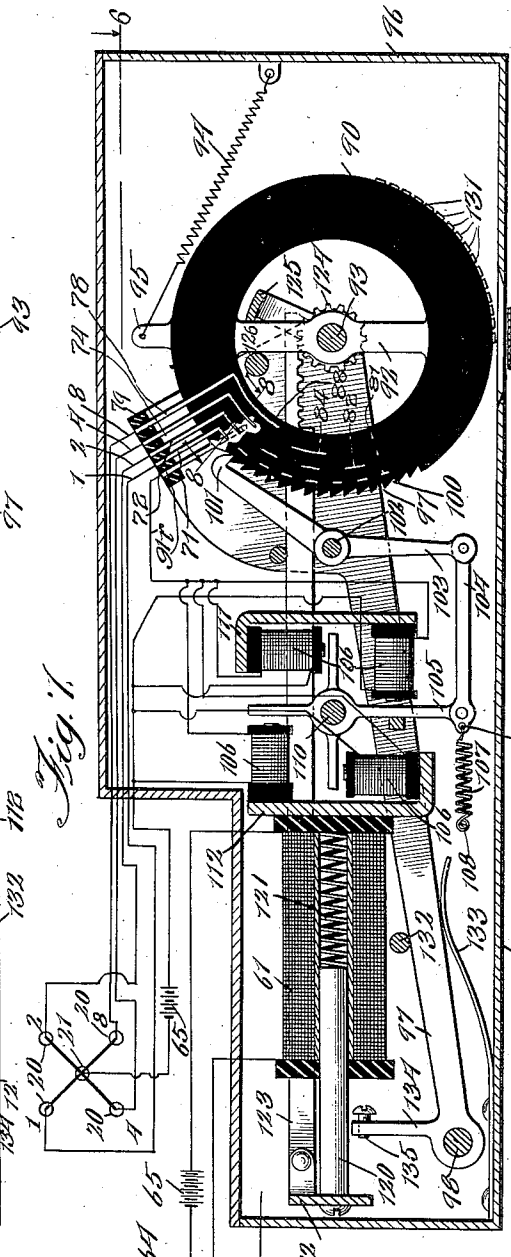

Fig. 7.

Fig. 8.

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3 SHEETS—SHEET 3.

Fig. 11.

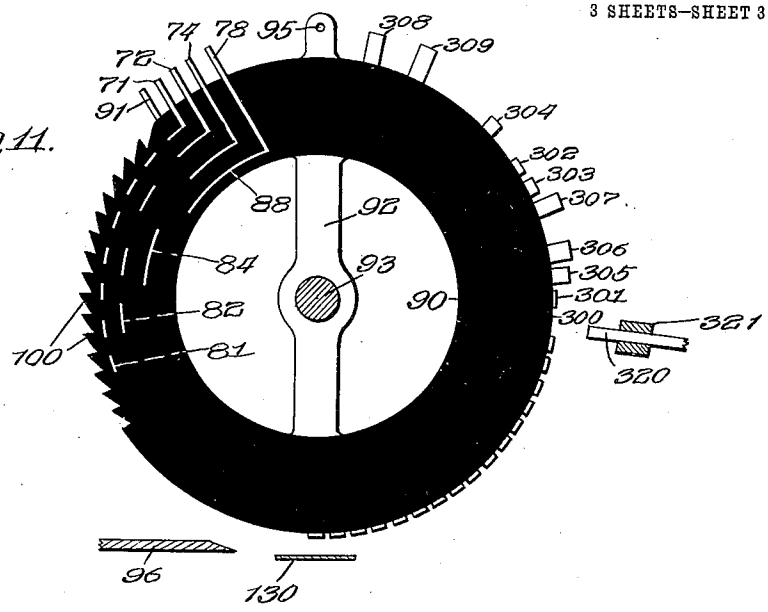


Fig. 9.

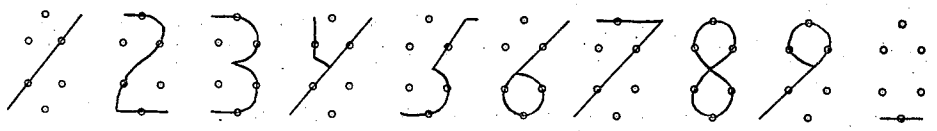
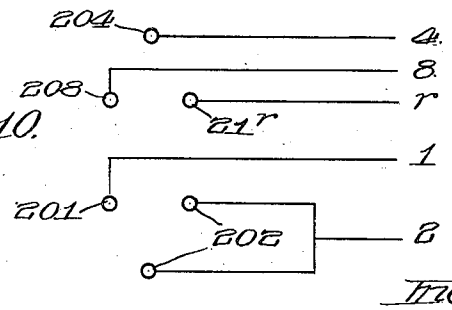


Fig. 10.



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UNITED STATES PATENT OFFICE.

HYMAN ELI GOLDBERG, OF CHICAGO, ILLINOIS, ASSIGNOR OF ONE-HALF TO ROBERT P. LAMONT, OF CHICAGO, ILLINOIS.

CONTROLLER.

1,117,184. Specification of Letters Patent. Patented Nov. 17, 1914.

Application filed November 23, 1910. Serial No. 593,866.

To all whom it may concern:

Be it known that I, HYMAN ELI GOLDBERG, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Controllers, of which the following is a specification.

My invention relates to controllers operating in part, at least, electrically, and the object of the invention is to provide apparatus such that the movement of the controlled body may be controlled through the medium of conducting ink drawn or impressed upon a non-conducting body such, for example, as a sheet of paper.

My invention may be applied to many kinds of machines, for instance, copying, typesetting, sorting machines, etc.

In order to illustrate the invention I have chosen to describe it as embodied in a copying machine adapted to print upon a receiving sheet numerals corresponding to characters which have been previously drawn or imprinted upon a transmitting sheet.

In the mechanism selected and shown in the accompanying drawings, Figure 1 shows the basis of a numerical scheme by means of which the numerical digits are represented. Fig. 2 shows the method of representing the digits 1, 2, 3, 4, 5, 6, 7, 8, 9, the same being a combination of the character elements shown in Fig. 1. Figs. 3 and 4 are front and end elevations respectively of the contactor which forms the transmitting mechanism. Fig. 5 is a plan section taken on the line 5—5 Fig. 3. Fig. 6 is a plan section of the receiving mechanism taken on the line 6—6 Fig. 7. Fig. 7 is a view partly mechanical and partly diagrammatic showing the receiving mechanism and the wiring diagram thereof. The mechanical portion is a plan section taken on the line 7—7 Fig. 6. Fig. 8 is a fragmentary section of the movable switch element taken on the line 8—8 Fig. 7. Figs. 9, 10 and 11 show modifications of the apparatus for using the Arabic numerals as the transmitting characters.

Similar numerals refer to similar parts throughout the several views.

The form of the transmitting characters may be varied, but to facilitate explanation the simpler ones shown in Figs. 1 and 2, and the apparatus operating in connection therewith, will first be described.

For the purpose of permitting accurate and easier writing of the figures, the transmitting sheet, as for instance, a ledger sheet, is indicated in Figs. 1 and 2 as having been ruled with faint horizontal and vertical lines. The basic characters assumed consists of radii all diverging in different directions. Fig. 1 shows the characters 1, 2, 4 and 8 which are all inclined at 45° and radiate from a common center which is always at the intersection of the vertical and middle horizontal line. These characters 1, 2, 4 and 8 are combined as shown in Fig. 2 to produce the digits 1, 2, 3, 4, 5, 6, 7, 8, 9. 3 equals 2 plus 1; 5 equals 4 plus 1; 6 equals 4 plus 2; 7 equals 4 plus 2 plus 1; 9 equals 8 plus 1. The transmitting characters are ordinarily written by hand with an ordinary pen, using electrically conductive ink such for example, as the ink which forms a basis for my copending application filed October 28, 1910, Serial No. 589,565.

Figs. 3, 4 and 5 show the transmitting mechanism or contactor which is applied to the ink written characters and contains terminals electrically connected to conductors forming part of the circuits of the apparatus. Electric connection is established between these terminals by means of the ink which forms the transmitting characters, the ink thus constituting a switch which connects various of the terminals with each other. The contactor here shown has six groups of five terminals, one group for each decimal place in a six figure number. Each group is made up of a central terminal 21, and four corner terminals 20, arranged at the corners of an imaginary square about said central terminal. In applying the contactor to the paper ruled and written upon as shown in Figs. 1 and 2, the terminals 21 should be placed above the common center of the character, and the terminals 20 above the four corners. Upon pressing the plunger handle 30, springs 31 are compressed thus depressing the terminals against the force of the lighter springs 32. Said terminals are therefore pressed into contact with the ink written character, thus establishing connections between the various terminals 20 and the terminal 21 in case any ink written character is present to make such connec-

tions, and leaving the circuit open if no ink line joins the terminal 20 and its terminal 21. Terminal 21 is at one end of the conductor r which forms a common return for the four parallel branch conductors 1, 2, 4 and 8 which end at the terminal 20. This is illustrated diagrammatically in Fig. 7. On the lower end of handle 30, heretofore referred to, is a plunger 34 slidable in collar 35 supported by the top yoke 36 extending between end frames 37. On the lower end of plunger 34 is a horizontal plate 40 and cover 41. Below this plate, and at a distance therefrom, is a block 42 secured by screws 43 to the end frame 37. All the terminals 20 and 21 are on the ends of small plungers 45 vertically slidable within the block 42, as shown at the left of Fig. 3. The enlarged head 46 of each plunger 45 is movable vertically within chamber 47 in block 42. The light springs 32, are located in the bottom of each chamber 47, bearing against the bottom of the chamber and the under side of head 46, thus serving to keep plungers 45 and consequently terminals 20 and 21 clear of the paper. Above each and within the same chamber 47 is a stronger spring 31, bearing at its upper end upon the under side of piston 50, secured, as shown at 51, into plate 40, movable with plunger 34 and head 30. On the outside of the contactor are a plurality of small electric cables 53, each of which contains five strands of wire 54, one of these small cables 53 being intended for and connected to each group of five terminals 20 and 21, heretofore described. The wires 54 for each one of these groups pass into the sides of block 42 through holes 55 provided for the purpose and constantly contact with the adjacent plunger 45 so that electricity entering any of the terminals 20 and 21 passes up through its plunger and thence out through its particular wire 54 into its particular cable 53. All the cables 53 illustrated in Fig. 5 are grouped in a common cable 57 attached for convenience by means of the clamp 58 on the side of the device. All of the wires 54 heretofore described are insulated from each other and the cables 53 are also insulated from each other as clearly appears in Fig. 5. In a circuit separate from the ones heretofore mentioned is a solenoid 61 which is connected by means of wires 64 to two contacts 60 and 62. Contact 60 is fastened to the stationary block 42 and is in position to be engaged by the contact 62 when the plate 41, to which it is fastened, is depressed. The connection between the contacts 60 and 62 and their wires 64 is made preferably by means of the binding posts 63. The parts are so proportioned that the contacts 60 and 62 will not come into engagement and close the circuit through solenoid 61 until after the terminals 20 and 21 have reached the surface of the paper upon which the ink switch is drawn or printed. In each circuit there is a suitable source of electric motive force such as the batteries 65 shown in Fig. 7.

I will now describe the receiving mechanism which prints the numerals or other characters to be copied. The wires 1, 2, 4 and 8 are connected to brushes 71, 72, 74 and 78 respectively, which are mounted in any suitable insulating support 79, see Figs. 6 and 7. These brushes engage contacts 81, 82, 84 and 88 respectively, forming part of the rotary disk 89 which constitutes a movable switch element. This disk is made of conductive material and the contacts are integral with it and penetrate the insulation 90 fastened to the face of the disk as shown in detail in Fig. 8. The return wire r is connected to a brush 91 which makes sliding contact with the back of disk 89. In the present machine there are four of these rotary switch elements shown, although the number will vary with the capacity of the machine. The receiving mechanism shown has a capacity of four places, while the contactor has a capacity of six places, two of which will remain idle with a receiving mechanism of the capacity shown.

It will be understood that the wiring above described and illustrated in Fig. 7 is duplicated for each place in the capacity of the machine, except the wiring connected to solenoid 61 which is common to the entire machine.

Each rotary switch element is independently rotatable, being supported by spokes 92 upon shaft 93. Each disk is constantly urged in a forward direction by means of a tension spring 94 attached at one end to a lug 95 and at the other end to the casing 96. Shaft 93 is supported in two side plates 97 which form a rocking frame pivoted upon the shaft 98 supported in the casing 96. Each rotary switch element is provided with a ratchet 100 adapted to be engaged by a pawl 101 adapted to prevent the forward rotation of said disk. Said pawls are pivotally supported upon a shaft 102 carried by the side plates 97 and are provided with arms 103 connected by means of links 104 to arms 105 which form armatures coöperating with the magnets 106. Tension springs 107 are fastened at one end to the stationary bar 108 supported in the casing 96 and at the other ends to the eyes 109 integral with the links 104. The parts are so constructed and arranged that said springs normally urge the armatures 105 away from the magnets and the pawls 101 into engagement with their coöperating ratchets 100. The armatures in the present case are four in number, one for each place in the capacity of the machine, and these armatures are independently mounted upon the shaft

110 supported in the casing 96. In the drawings these magnets 106 are arranged around the shaft 110 at an angle of 90° apart. The reason for this construction is merely to gain room, thus permitting the employment of larger magnets than if they were placed side by side. Magnets 106 are rigidly supported in walls 111 and 112 which form part of the stationary casing. Each magnet is in series with the return wire r and will therefore be energized when there is current in any one of the four wires 1, 2, 4, and 8. Solenoid 61 is supported at one end by the cross wall 112 before mentioned and is adapted to attract its core 120 against the force of the spring 121 contained within said solenoid. Core 120 is articulately connected by means of a cross plate 122 to two rack bars 123 provided at their forward ends with teeth adapted to engage the pinions 124. Said pinions are integral with the keeper 125 which is mounted so as to rotate upon shaft 93 and engage the spokes 92 and hold the latter in engagement with the stationary stop bar 126. This is the initial position of the parts, wherein they are normally kept by reason of the fact that spring 121 is strong enough to overcome the force of the springs 94.

The operation of the parts heretofore described is as follows: The depression of the plunger 30 of the contactor causes the terminals 20 and 21 to be connected by the ink switch formed by the figures or characters upon the transmitting sheet. Should there be no ink character present under any particular set of terminals 20 and 21, then there will be no connection formed between said terminals; but if there are ink characters present, some of said terminals 20 will be electrically connected with their associated terminal 21 and the particular magnet 106 in series with that particular terminal 21 will be energized by means of its wire r and thus attract its armature 105 against the force of its spring 107, and withdrawing the pawl 101 from its ratchet 100, thus releasing the rotary switch element 89, 90. The further continued depression of plunger 30 now causes the contact 62 to engage the contact 60 which immediately energizes the solenoid 61, attracting the core 120 against the force of the spring 121 and moving the connected racks 123, thus rotating the pinions 124 and the keeper 125. Such of the switch elements 89, 90 as have been released by their coöperating pawl 101 will now move forward under the force of the springs 94. The various brushes 71, 72, 74 and 78 will thus engage and make and break contact with their coöperating sets of contacts 81, 82, 84 and 88 respectively. This will continue until the disk 89, 90 has moved, under the force of its spring, far enough to completely leave the contacts and thus completely deënergize the electric circuit therewith connected, whereupon the coöperating magnet 106 will immediately release its coöperating armature 105, and the pawl 101 will be brought by spring 107 to engage the ratchet 100 at the particular tooth beneath it. The disk 89, 90 will thus have moved a number of steps dependent upon and equal to the numerical value of the ink character engaged by the terminals 20 and 21, as will now be explained in detail.

Contacts 81, 82, 84 and 88 are of different lengths and are arranged according to a definite plan upon the rotary switch element 89, 90. There are eight contacts in the set 81, four contacts in the set 82, two contacts in the set 84, while there is only one contact 88. The contacts forming the set 81 are each one angular step in length and one angular step apart. Contacts 82 are each two angular steps in length and two angular steps apart. Contacts 84 are each four angular steps in length and four angular steps apart, while contact 88 is eight angular steps in length. It will thus be seen that a different combination of contacts will be freed and connection with them broken at each angular step of the disk, 89, 90. Thus in the normal position represented in Fig. 7 brushes 71, 72, 74 and 78 are in engagement with contacts 81, 82, 84 and 88 respectively. Should the disk now move forward one angular step, the brushes 72, 74 and 78 will still remain in engagement with their contacts, but the contact with brush 71 will be broken. In a similar manner at the end of the second step contact will be broken with brush 71. At the end of the third step with brushes 71 and 72. At the end of the fourth step with brush 74. At the end of the fifth step with brushes 74 and 71. At the end of the sixth step with brushes 74 and 72. At the end of the seventh step with brushes 71, 72 and 74. At the end of the eighth step with brush 78. At the end of the ninth step with brushes 71 and 78. At the end of the tenth step with brushes 72 and 78. At the end of the eleventh step with brushes 71, 72 and 78. At the end of the twelfth step with brushes 74 and 78. At the end of the thirteenth step with brushes 71, 74 and 78. At the end of the fourteenth step with brushes 72, 74 and 78. At the end of the fifteenth step, which is the last step within the capacity of this particular form illustrated, contact will be broken with brushes 71, 72, 74 and 78. It will thus be noticed that contact is broken with the different combinations of brushes at each differential step of the disk or movable switch element. Now considering that connection is broken with a different combination of brushes at each differential step of the rotary switch element, and considering that at the other ends of the respective conductors the terminals 20 and 21 are

joined by a selective ink switch, it will be seen that only certain of said brushes are in circuit relation, namely only those which connect their particular terminals 20 with the common return 21 by means of the ink switch. Suppose the ink switch contacted by the terminals 20 and 21 is the numerical number 7. This will establish the connection between the common return r and the brushes 71, 72, and 74, the brush 88 not being connected and therefore not entering into the circuit. Now by examining the different combinations of brushes whereby contact was broken at each differential step, it will be seen that the first time when contact was broken was when all of brushes 1, 2 and 4 were at the end of the seventh differential step. Then and only then does the magnet 106 become demagnetized, releasing its pawl to arrest the movable switch element.

I have now explained how, by writing or printing any character on the transmitting sheet, and pressing the handle of the contactor, a differential motion will be imparted to the rotary switch elements corresponding to the value of the numerical character thus written or printed. I will now describe means whereby the rotary switch elements are made to print the corresponding numeral figures upon the receiving sheet 130 shown in Fig. 7. Numeral type 131 are formed upon the periphery of each of the rotary switch elements, these forming the series of digits 0, 1, 2, 3, 4, 5, 6, 7, 8, 9. The "0" is located at printing position when the parts are in the initial position shown in Fig. 7. The side plates 97 which form the rocking frame are normally held in elevated position against the stationary stop bar 132 by the springs 133. Said side plates have an integral standing arm 134 carrying an adjustable strike screw 135 in position to be engaged by the cross bar 122 secured to core 120. The arrangement is such that screw 135 will not be reached by bar 122 until the latter has traveled some distance, to wit—a distance sufficient for the differential movement previously described to have completely taken place. It is possible to depend for the necessary slowness of action upon the natural inertia of the parts, although an ordinary dash pot may be used to produce a retarding effect if desirable. As soon as bar 122 comes into contact with screw 135 it commences to rotate arm 134 in a direction to lower the rocking frame and cause the rotary switch elements carried thereby to produce an impression upon the receiving sheet.

I will now describe the apparatus adapted to operate in connection with Arabic numerals instead of the symbols above described and shown in Figs. 1 and 2. The appearance of the numerals is shown in Fig. 9, as also are shown the points where the terminals of the contactor will make contact with the transmitting sheet. In this case the arrangement of the terminals is modified as shown in detail in Fig. 10. The terminal 204 is connected to conductor 4; terminal 208 is connected to conductor 8; terminal 201 to conductor 1, the two terminals 202 to the conductor 2 and the conductor 21^r to the conductor r. These conductors lead to the brushes 71, 72, 74, 78 and 91 respectively as shown in Fig. 7.

It will be seen by comparing Figs. 9, 10 and 11 that when the contactor is depressed the ink numeral upon the transmitting sheet will connect with terminal 21^r with the following terminals and produce the following amounts of rotation in the movable switch element 89, 90.

Numeral.	*Terminals.*	*Motion.*
1	201	1
2	204, 201, 202	7
3	204, 202	6
4	208, 201	9
5	202	2
6	201, 202	3
7	204, 201	5
8	208, 202, 201, 204	15
9	208, 204, 201	13

It will be noted that the ink numerals do not produce an amount of rotation proportional to their value, but the amount of rotation is nevertheless definite and no two of them produce the same amount of rotation. Therefore the movable element or type wheel will always bring the same part of the wheel to printing position when any given ink numeral is contacted. Consequently I put the type corresponding to the numeral at the place to which that numeral brings the wheel and the proper numeral will thus be printed. The locations of the type upon the wheel is indicated in Fig. 11.

Should it be desired to use the Arabic numerals and nevertheless obtain a motion equal to the value of the transmitting Arabic numeral, it may be accomplished by providing the element 89, 90 with a series of radially projecting posts, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, as shown in Fig. 11. These posts may serve as stops for plunger 320 supported by the stationary bearing 321. The arrangement of the posts is such as to bring the post corresponding to the Arabic numeral ink character opposite to the plunger whenever said ink character is contacted; and the height of said post above the zero level is equal to the numerical value of said numeral ink character. The plunger may thus receive a differential motion equal in value to the numeral character contacted.

To more fully explain the function of plunger 320 and the stop pins 300 to 309 inclusive, let it be assumed that it is desired that the mechanism should print the Arabic numerals and that the printing element should have a movement proportional to the

value of the numeral printed. These numerals or printing types will be formed on the plunger 320 or a part moving in directly proportional accordance with the movements thereof. As no means are shown for moving said plunger automatically it may be assumed that it is moved by hand. As the posts 301 to 309 are graduated as to height from 1 to 9 units, seriatim they will stop the plunger when moved leftward (Fig. 11) in nine different positions depending upon the post temporarily in line with the plunger. Consequently if the plunger be constituted a printing element, the type numerals thereon can be arranged successively, one next to the other in normal order. Moreover mechanism connected thereto would thus be given an amount of movement corresponding to the numerical value of the numerical character.

A portion of the mechanism shown in this application is also shown in my copending application filed January 10th, 1911, Serial No. 601,837, and also in my copending application filed January 12th, 1911, Serial No. 602,228.

Having thus described my invention what I claim as new and desire to secure by Letters Patent, is:

1. In combination, a differentially movable element and means for controlling the motion thereof, said means comprising a motor element normally tending to impart motion to said movable element, means for resisting said motion, releasing means for rendering said resisting means non-active, and arresting means for arresting said element at differential steps of the motion thereof, said arresting means comprising a plurality of electric conductors capable of being energized both singly and in combination, the energizing of any one of said conductors causing a definite amount of motion in said movable element, which motion is independent of the strength of the energy in said conductor, and the energizing of the combination of said conductors producing in said movable element a motion whose amount is equal to the sum of the amounts belonging to said conductors individually.

2. In combination, a movable element which is electrically conductive, and means for controlling the motion thereof, said means comprising an electric conductor placed in series with said movable element and divided into a plurality of parallel branches, said branches being capable of being energized both singly and in combination, the energizing of any one of said branches causing a definite amount of motion in said movable element, which motion is independent of the strength of the electric energy in said branch, and the energizing of a combination of said branches producing in said element a motion whose amount is equal to the sum of the amounts belonging to said conductors individually.

3. In combination, a movable element which is electrically conductive and means for controlling the motion thereof, said means comprising an electric conductor placed in series with said movable element, and divided into a plurality of branches, each of said branches being capable of being energized by being switched in to form part of the circuit of which the said movable element and said conductor form parts, and means whereby the energizing of any one of said branches causing a definite amount of motion in said movable element, which motion is independent of the strength of the electric energy in said branch, and the energizing of the combination of said branches producing in said element a motion whose amount is equal to the sum of the amounts belonging to said conductors individually.

4. A movable electric switch element, and means for controlling the motion thereof, said controlling means comprising a main conductor, a plurality of branch conductors, a selective switch operative upon one end of each of said branch conductors and capable of throwing said branch conductors, both singly and in combination, into series with said main conductor, said movable switch element being in series with said main conductor, and a plurality of terminals upon said movable switch element, said terminals being brought into series with the other ends of said branches by the motion of said movable switch element.

5. A movable electric switch element, and means for controlling the motion thereof, said controlling means comprising a main conductor, a plurality of branch conductors, a selective switch operative upon one end of said branch conductors and capable of throwing said branch conductors, both singly and in combination, into series with said main conductor, said movable switch element being in series with said main conductor, and a plurality of terminals upon said switch element, said terminals being brought into series with the other ends of said branches by the motion of said switch element, said terminals being arranged upon said movable switch element in a plurality of groups, one group for each branch conductor.

6. In combination, a movable switch element, and operating means for imparting differential motion thereto, said operating means comprising driving mechanism, a contact of definite length upon said switch element, a conductor adapted to make electric connection with said contact during the motion of said switch element, and means controlled by the current in said conductor for arresting said switch element.

7. In combination, a movable switch ele-

ment and operating means for imparting differential motion thereto, said operating means comprising driving mechanism, a contact of definite length upon said switch element, a conductor adapted to make electric connection with said contact during the motion of said switch element, and means brought into operation upon the breaking of the connection between said contact and conductor for arresting said switch element.

8. In combination, a movable switch element and operating means for imparting differential motion thereto, said operating means comprising driving mechanism, a plurality of contacts of definite lengths upon said switch element, a plurality of conductors adapted to make electric connection with said contacts, and arresting means for arresting said switch element, said arresting means being held in non-acting condition by the current in any one of said conductors.

9. In combination, a movable switch element and operating means for imparting differential motion thereto, said operating means comprising driving mechanism, a plurality of conductors, a plurality of contacts of definite lengths upon said switch element, said contacts being arranged in sets, one set for each conductor, and arresting means for arresting said switch element, said arresting means being held in non-acting condition by the current in any one of said conductors.

10. In combination, a movable switch element and operating means for imparting differential motion thereto, said operating means comprising driving mechanism, a plurality of conductors connected in parallel and thus forming branches of an electric circuit, a plurality of contacts of definite lengths upon said switch element, said contacts being arranged in sets, one set for each branch conductor, and arresting means for arresting said switch element, said arresting means being held in non-acting condition by the current in said circuit.

11. In combination, a movable switch element and operating means for imparting differential motion thereto, said operating means comprising driving mechanism, a plurality of conductors connected in parallel and thus forming branches of an electric circuit, a plurality of contacts of definite lengths upon said switch element, said contacts being arranged in sets, one set for each branch conductor, arresting means normally preventing the motion of said switch element and electromagnetic means responsive to current in said circuit for rendering said arresting means non-active.

12. In combination, a movable switch element capable of being brought successively into a number of differential positions, a plurality of contacts arranged thereon in sets, an electric conductor for each set adapted to successively engage the contacts of its particular set, said contacts being of definite lengths and so arranged with relation to the conductors that contact is broken with some one or more of said conductors at each differential position of said movable switch element, driving mechanism for said movable switch, arresting means normally preventing the motion of said switch element, and electro responsive means responsive to the current in any of said conductors for rendering said arresting means non-active.

13. In combination, a movable switch element capable of having a differential motion imparted thereto, a plurality of contacts arranged in sets upon said switch element, a conductor for each set of contacts and capable of touching same during the motion of said movable switch element, the contacts in the several sets being so arranged upon the switch element that at each differential step contact is broken with a different combination of conductors, and means for governing the motion of switch element by current in said conductors.

14. A plurality of circuits, each having two normally-open breaks, a selective switch capable of closing the first break in each of said circuits individually, or a plurality of them in combination, a movable switch element, operating means for imparting differential motion to said switch element, arresting means normally preventing the motion of said switch element, a plurality of contacts of definite lengths upon said switch element, said contacts being arranged in sets, each set being capable of closing the other break of one of said circuits, said contacts being of definite lengths and so arranged with reference to the circuits that contact is broken with some one or more of the circuit conductors at each differential movement of said movable switch element, and electromagnetic means responsive to current in any of said circuits for rendering said arresting means non-active, thus arresting said movable switch element at a differential position dependent upon the combination of circuits closed by said selective switch.

15. In combination, a plurality of circuits each having two normally-open breaks, a selective switch capable of closing the first break in each of said circuits individually or a plurality of them in combination, a movable switch element capable of having a differential motion imparted thereto, a plurality of contacts arranged in sets upon said switch element, each set being capable of closing the other break of one of said circuits, the contacts in the several sets being so arranged upon the switch element that at each differential step contact is broken in a different combination of said circuits, and

means for governing the motion of the switch element by current in any of said circuits whereby the amount of motion in said switch element is dependent upon the combination of circuits closed at the first break by said selective switch.

16. In combination, a movable switch element adapted to receive a differential movement, contacts arranged thereon so as to travel in parallel paths, a plurality of conductors having terminals adapted to be engaged by said contacts as the latter travel past them, there being a plurality of contacts in each path, the length of the various contacts being such that engagement is broken with a different combination of conductors at each differential step, and means for governing the motion of said switch element by current in any of said circuits whereby the amount of motion in said switch element is dependent upon the combination of circuits closed at the first break by said selective switch.

17. Electric apparatus comprising a plurality of conductors arranged in parallel and each provided with a terminal at one end, a selective switch composed of dry conductive ink, means for bringing each of said terminals and ink switch into contact whereby each conductor may be switched in at said terminals to form a parallel branch of the same electric circuit, a terminal at the other end of each of said conductors, a movable switch element, means capable of imparting a differential motion thereto, a plurality of contacts arranged in sets upon said movable switch element, the contacts in each set, because of said motion, coming successively into contact with one of the last mentioned terminals to thereby bring that terminal also into circuit, the contacts in said sets also being so arranged upon the movable switch element that at each differential step thereof contact is broken between it and a different combination of its contacting terminals, and means for governing the motion of the movable switch element by current in said circuit whereby the amount of motion of said movable switch element is dependent upon the particular combination of terminals contacted by said selective ink switch.

18. Electric apparatus comprising a plurality of conductors arranged in parallel and each provided with a terminal at one end, a selective switch composed of dry conductive ink, means for bringing each of said terminals and ink switch into contact whereby each conductor may be switched in at said terminals to form a parallel branch of the same electric circuit, a terminal at the other end of each of said conductors, a movable switch element, means capable of imparting a differential motion thereto, a plurality of contacts arranged in sets upon said movable switch element, the contacts in each set, because of said motion, coming successively into contact with one of the last mentioned terminals, to thereby bring that terminal also into circuit, the contacts in the said sets also being so arranged upon the movable switch element that at each differential step thereof contact is broken between it and a different combination of its contacting terminals, and eletcro magnetic means responsive to current in said circuit for governing the motion of said movable switch element.

19. Electric apparatus comprising a plurality of conductors arranged in parallel and each provided with a terminal at one end, a selective switch composed of dry conductive ink, means for bringing each of said terminals and ink switch into contact whereby each conductor may be switched in at said terminals to form a parallel branch of the same electric circuit, a terminal at the other end of each of said conductors, a movable switch element, means capable of imparting a differential motion thereto, a plurality of contacts arranged in sets upon said movable switch element, the contacts in each set, because of said motion, coming successively into contact with one of the last mentioned terminals, to thereby bring that terminal also into circuit, the contacts in the said sets also being so arranged upon the movable switch element that at each differential step thereof contact is broken between it and a different combination of its contacting terminals, a pawl for arresting said movable switch element and an electromagnet in said circuit for rendering said pawl nonactive.

20. Electric apparatus comprising a plurality of conductors arranged in parallel and each provided with a terminal at one end, a selective switch composed of dry conductive ink, means for bringing said terminal and ink switch into contact whereby each conductor may be switched in at said terminal to form a parallel branch of the same electric circuit, a terminal at the other end of each of said conductors, a movable switch element capable of having a differential motion imparted thereto, a plurality of contacts arranged in sets upon said movable switch element, the contacts in each set, because of said motion, coming successively into contact with one of the last mentioned terminals, to thereby bring that terminal also into circuit, the contacts in the said sets also being so arranged upon the movable switch element that at each differential step thereof contact is broken between it and a different combination of its contacting terminals, a pawl for arresting said switch element, a spring for rendering said pawl active and an electromagnetic means in said circuit for rendering said pawl non-active.

21. Electric apparatus comprising a plurality of conductors arranged in parallel and each provided with a terminal at one end, a selective switch composed of dry conductive ink, means for bringing said terminal and ink switch into contact whereby each conductor may be switched in at said terminal to form a parallel branch of the same electric circuit, a terminal at the other end of each of said conductors, a movable switch element capable of having a differential motion imparted thereto, a plurality of contacts arranged in sets upon said movable switch element, the contacts in each set, because of said motion, coming successively into contact with one of the last mentioned terminals, to thereby bring that terminal also into circuit, the contacts in the said sets also being so arranged upon the movable switch element that at each differential step thereof contact is broken between it and a different combination of its contacting terminals, a ratchet upon said switch element, a normally active pawl coöperating with said ratchet to arrest said movable switch element, and electromagnetic means in said circuit for rendering said pawl non-acting.

22. Electric apparatus comprising a plurality of conductors arranged in parallel and each provided with a terminal at one end, a selective switch composed of dry conductive ink, means for bringing said terminal and ink switch into contact whereby each conductor may be switched in at said terminal to form a parallel branch of the same electric circuit, a terminal at the other end of each of said conductors, a movable switch element capable of having a differential motion imparted thereto, a plurality of contacts arranged in sets upon said movable switch element, the contacts in each set, because of said motion, coming successively into contact with one of the last mentioned terminals, to thereby bring that terminal also into circuit, the contacts in the said sets also being so arranged upon the movable switch element that at each differential step thereof contact is broken between it and a different combination of its contacting terminals, a motor element normally tending to impart motion to said movable switch element, means for resisting said motion, releasing means for rendering said resisting means non-active, and arresting means operated by current in said circuit for arresting said movable switch element at any differential step thereof.

23. In combination, a differentially movable element normally tending to move forward, an electromagnetic keeper normally holding it in initial position, an electromagnetic detent adapted to terminate the forward movement of said movable element at various differential positions thereof and means common to the keeper circuit and detent circuit for controlling them.

24. In combination, a differentially movable element tending to move forward, an electromagnetically operable keeper normally holding it in initial position, an electromagnetic detent adapted to terminate the forward movement of said movable element at various differential positions thereof, a switch in the keeper circuit, another switch in the detent circuit, and means common to the two switches for controlling them.

25. In combination, a differentially movable element normally tending to move forward, an electromagnetically operable keeper normally holding it in initial position, a switch for the keeper circuit which, when closed causes said keeper to be retracted, an electromagnetic detent adapted to terminate the forward movement of said movable element at various differential positions thereof, a switch in the detent circuit, and means common to the two switches for controlling them.

26. In combination, a differentially movable element normally tending to move forward, an electromagnetically operable keeper normally holding it in initial position, a switch for the keeper circuit which, when closed causes said keeper to be retracted, a detent normally tending to terminate the forward motion of said movable element at the various differential positions thereof, said detent being electromagnetically retractable from said movable element, a switch in the detent circuit, means common to the keeper circuit switch and detent circuit switch for closing them, thereby retracting both keeper and detent from said movable element, releasing it and permitting it to move forward, and another switch in the detent circuit adapted to be opened by said movable element in its forward motion, whereby said detent is released and consequently terminates the forward motion of said movable element.

27. Apparatus comprising a differentially movable element adapted to move forward differentially and means for operating the same, said operating means comprising a transmitting sheet bearing an electrically conductive Arabic numeral character, and electromagnetic mechanism controlled by the different portions of said numeral character for operating said movable element.

28. Apparatus comprising a movable element adapted to move differentially and means for operating the same, said operating means comprising a transmitting sheet bearing an electrically conductive Arabic numeral character, a motive device for actuating said movable element, and a controller for said motive device having a plurality of

parts each adapted to be operated electromagnetically by a different definite portion of said numeral character.

29. Apparatus comprising a movable element adapted to move differentially and means for operating the same, said operating means comprising a transmitting sheet bearing an electrically conductive Arabic numeral character, a motive device for actuating said movable element, and an electromagnetically operated controller for said motive device having a plurality of parts adapted to be operated simultaneously by different portions of said numeral character.

30. The combination, with a record sheet having electrically conductive Arabic numeral characters thereon of a differentially movable element, and electromagnetically operated numeral-controlled apparatus having parts adapted to coöperate with different definite portions of said numeral characters for controlling said movable element.

31. Apparatus comprising a differentially movable element, a transmitting sheet, an electrically conductive ink character forming an Arabic numeral upon said sheet, and electromagnetic transmitting mechanism controlled by the different portions of said ink character for operating said movable element.

32. Apparatus of the class described comprising a differentially movable element, a transmitting sheet, a character on said sheet formed of conductive ink, and electrically controlled operating mechanism for said movable element, said operating mechanism including a plurality of electric circuits arranged in parallel, and a plurality of terminals adapted to contact different portions of said character for closing the circuit through a plurality of said circuits for controlling said differentially movable element.

In witness whereof, I have hereunto subscribed my name in the presence of two witnesses.

HYMAN ELI GOLDBERG.

Witnesses:
HOWARD M. COX,
MAX S. ROSEWZWEIG.