F. E. CASE.

ELECTRIC CONTROLLER.

APPLICATION FILED JUNE 29, 1908.

915,016.

Patented Mar. 9, 1909.

4 SHEETS—SHEET 1.

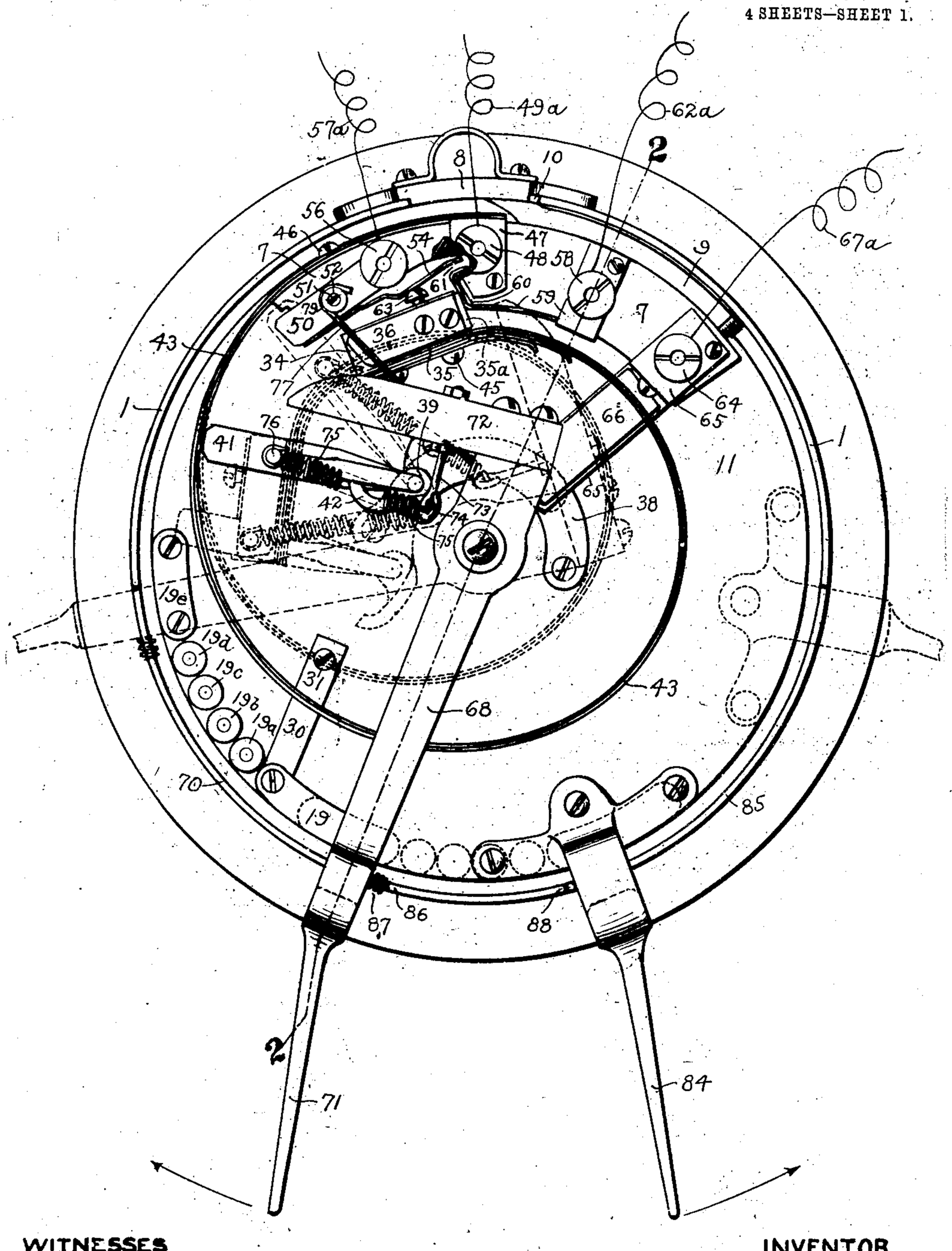


Fig. 1.

WITNESSES

Jos. J. Hosler.

Ruth A. Miller

INVENTOR

Frank E. Case,

BY

Harry Grease

ATTORNEY

F. E. CASE.

ELECTRIC CONTROLLER.

APPLICATION FILED JUNE 29, 1908.

915,016. **Patented Mar. 9, 1909.**

4 SHEETS—SHEET 2.

Fig. 2.

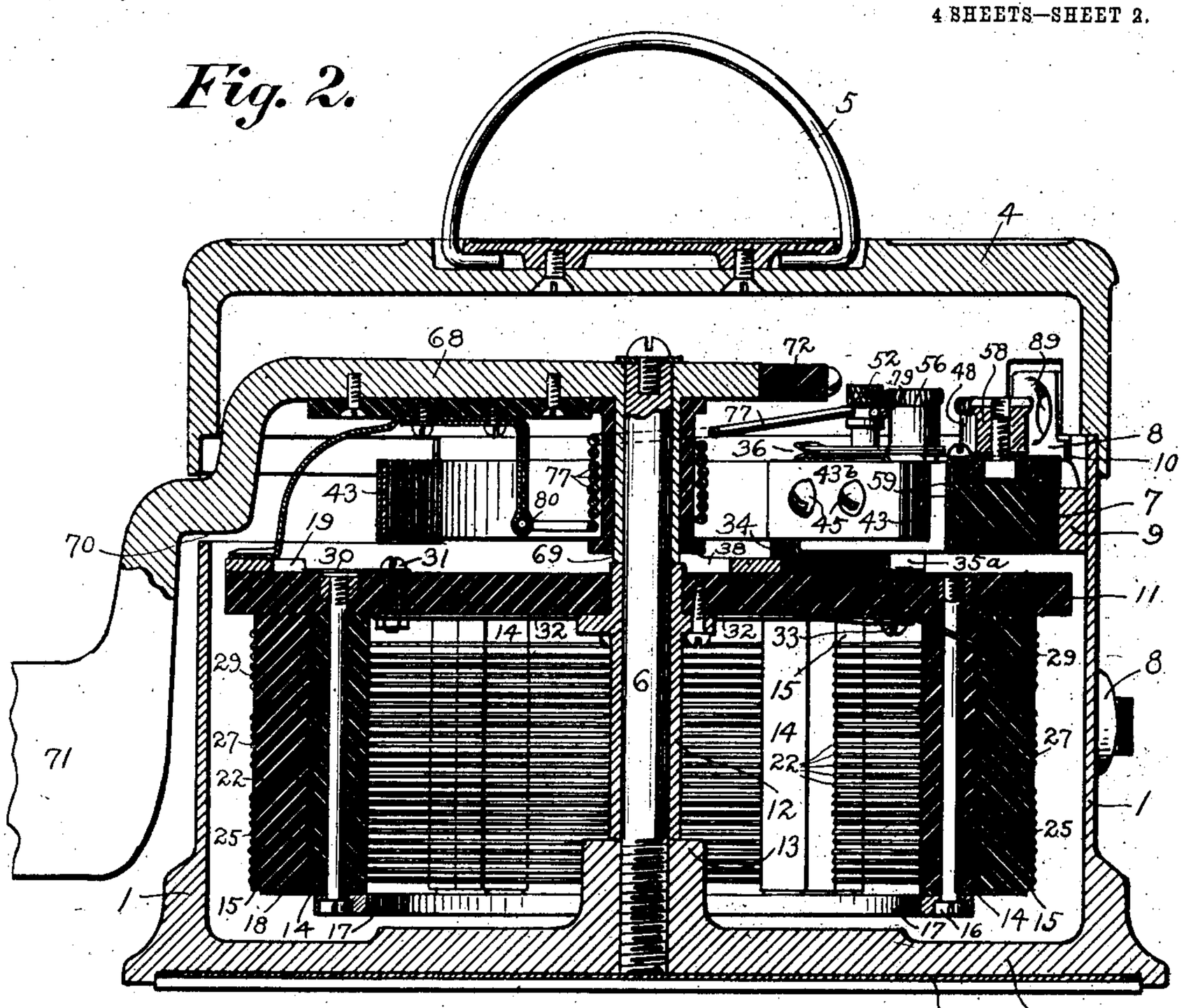
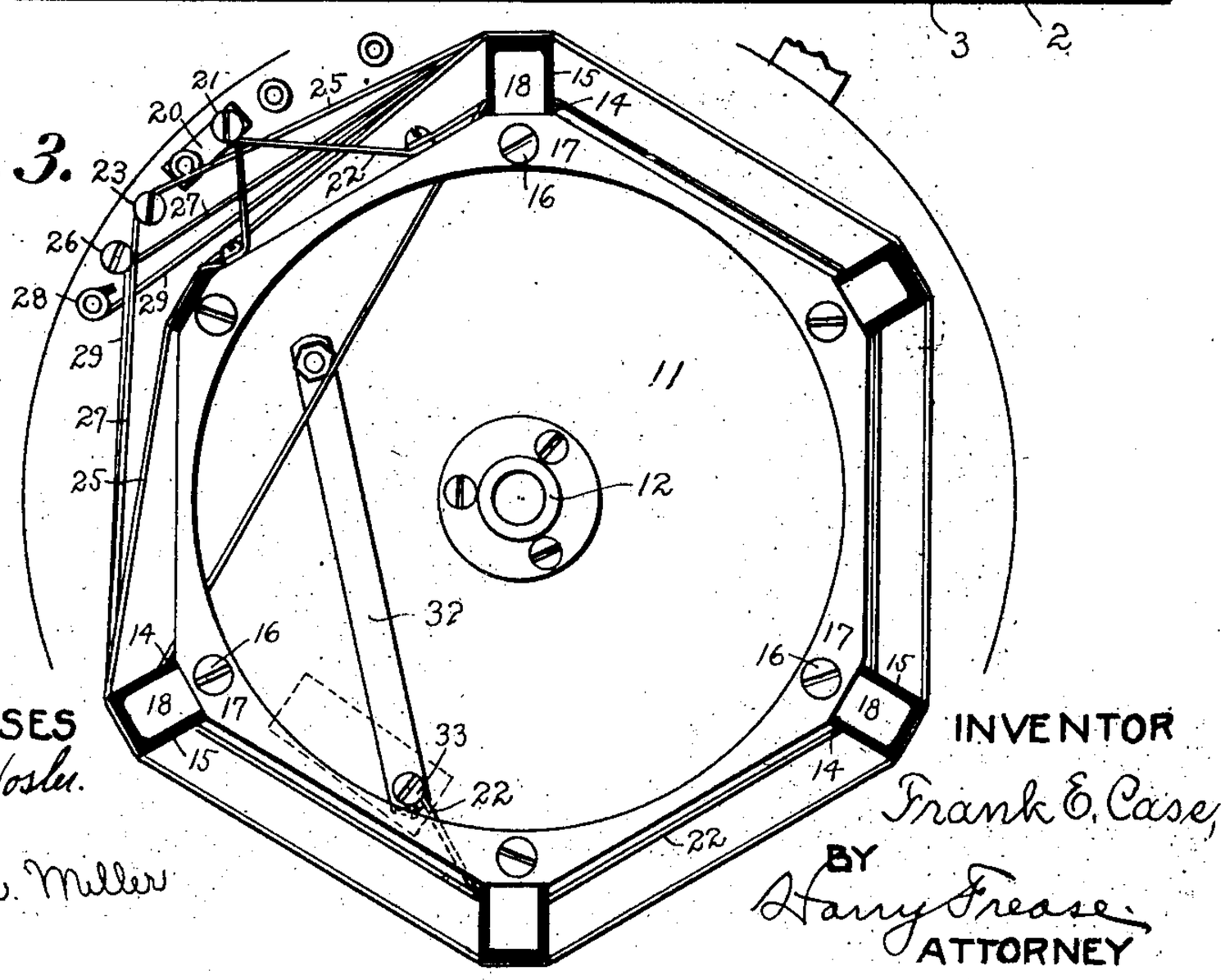


Fig. 3.



WITNESSES

Jos. J. Hosler.

Ruth A. Miller

INVENTOR

Frank E. Case,

BY

Harry Grease

ATTORNEY

F. E. CASE.

ELECTRIC CONTROLLER.

APPLICATION FILED JUNE 29, 1908.

915,016.

Patented Mar. 9, 1909.

4 SHEETS—SHEET 3.

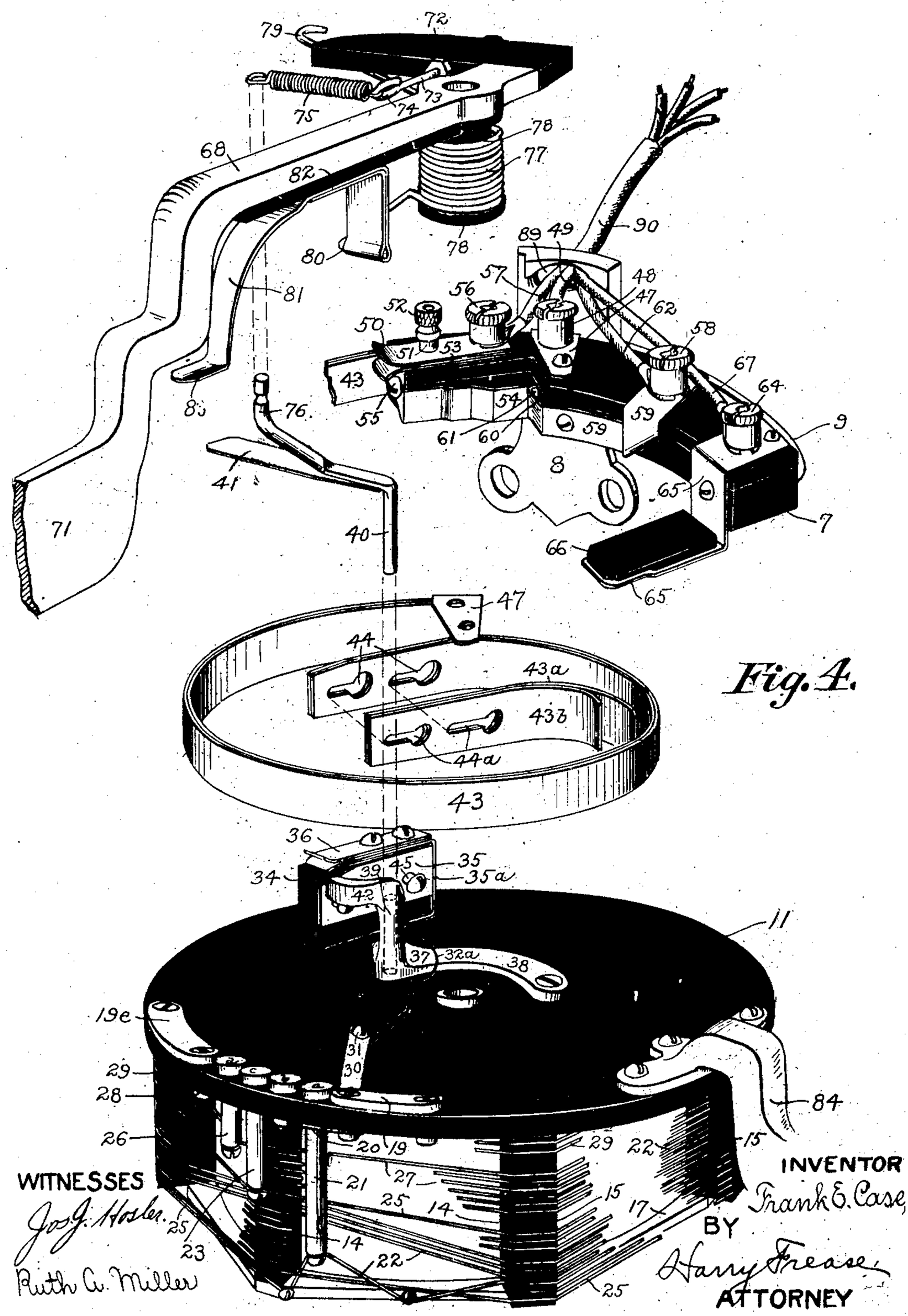


Fig. 4.

WITNESSES

Jos. J. Hosler.

Ruth A. Miller

INVENTOR

Frank E. Case,

BY

Harry Grease,

ATTORNEY

F. E. CASE.

ELECTRIC CONTROLLER.

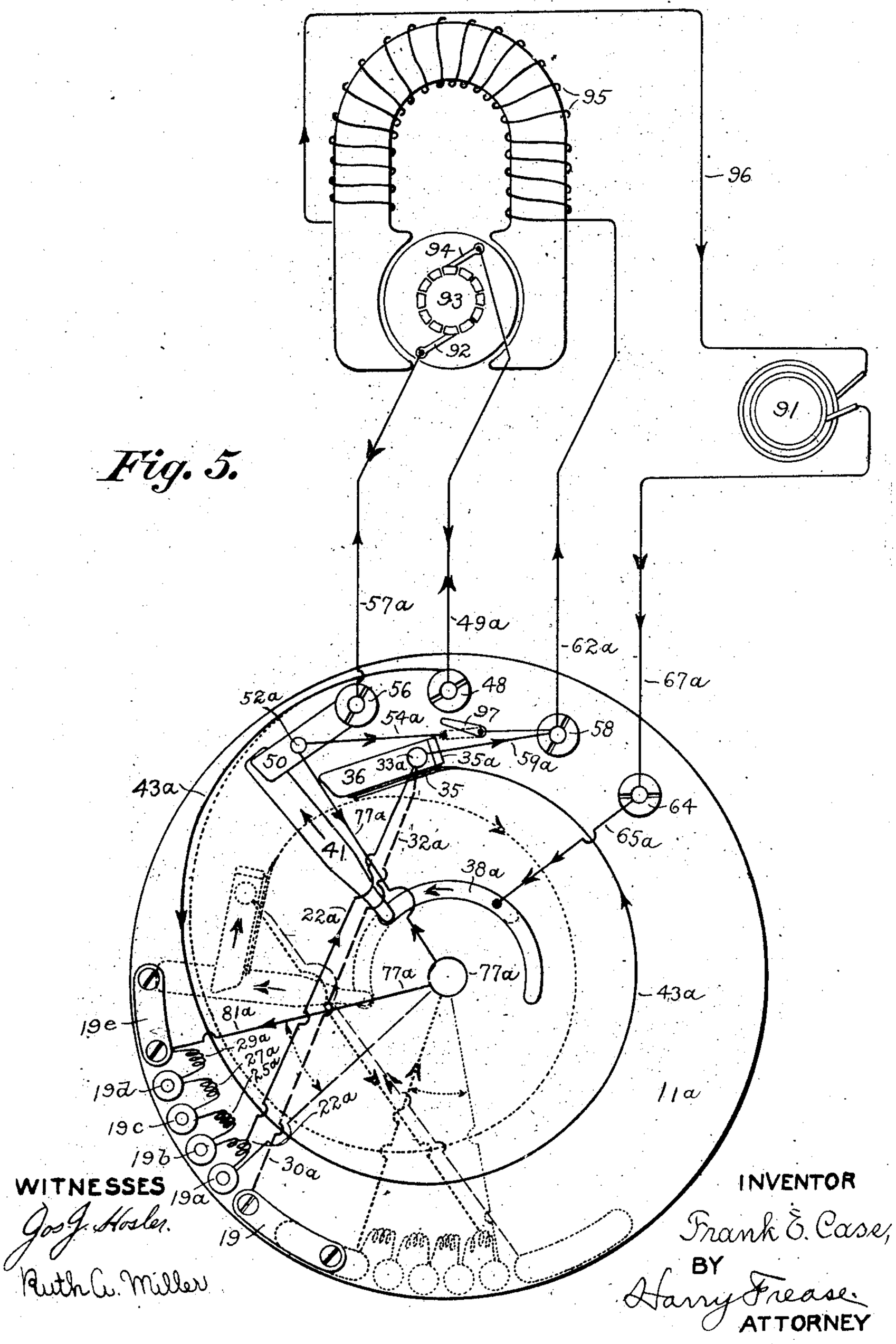
APPLICATION FILED JUNE 29, 1908.

915,016.

Patented Mar. 9, 1909.

4 SHEETS—SHEET 4.

Fig. 5.



WITNESSES

Jos. J. Hosler.

Ruth A. Miller

INVENTOR

Frank E. Case,

BY

Harry Frease.

ATTORNEY

UNITED STATES PATENT OFFICE.

FRANK E. CASE, OF CANTON, OHIO, ASSIGNOR TO THE HARVARD COMPANY, OF CANTON, OHIO, A CORPORATION OF OHIO.

ELECTRIC CONTROLLER.

No. 915,016. Specification of Letters Patent. Patented March 9, 1909.

Application filed June 29, 1908. Serial No. 440,800.

To all whom it may concern:

Be it known that I, FRANK E. CASE, a citizen of the United States, residing at Canton, in the county of Stark and State of Ohio, have invented a new and useful Electric Controller, of which the following is a specification.

The invention relates to a controller for electric motors, and in the embodiment of the invention herein described and illustrated, the controller is designed for use with motors for dental engines, and it is, therefore, arranged to be manipulated by the foot of the operator. It is not, however, intended to limit the scope of the invention to such particular use. Controllers of this character have usually been quite complicated, and the wiring connections very confusing, so that an unskilled operator might not conveniently or readily separate the parts and reassemble them for repairs or adjustments; and one object of the invention is to provide a controller which can be used and understood by an unskilled operator.

The armature and the field of the motor are connected in series, and the armature circuit is also connected in multiple-arc with a shunt circuit including a rheostat; and a further object of the invention is to use a single switch blade for closing the main circuit with the armature-rheostat derived circuit established in either direction, and, at the same time, to utilize a single rheostat for regulating the resistance in either direction. The controller can, therefore, be said to include a compound switch and compound rheostat.

These general objects and purposes are attained by pivoting a switch lever and a rheostat disk on the same axis, and by locating the contact-pieces of the rheostat on the disk so that they will have a sliding contact with a spring-arm located on the lever, by a rotation either of the lever or of the disk. One pair of switch jaws, for convenience herein called the forward-brush jaws, is located in a relatively fixed position adjacent to the side of the rheostat disk, and the other pair of switch jaws, for convenience herein called the reverse-brush jaws, is mounted on the rheostat disk. A common switch blade is pivoted on the disk and is provided with a suitable spring connection with the switch lever, so that when the lever is rotated in one direction, the switch blade is thrown into contact with the forward-brush jaws, and when the disk is rotated in the opposite direction, the blade is thrown into contact with the reverse-brush jaws. These general features of the controller, with the additional devices, springs, and wiring required to complete and connect the same for use, are illustrated in the accompanying drawings, forming part hereof, in which—

Figure 1 is a plan view of the controller with the cover removed, showing in full lines the position of the parts when the forward-brush circuit is closed, and in dotted lines the position of the parts when the reverse-brush circuit is closed, the position of the switch lever when rotated for the highest speed in the forward-brush circuit being shown in broken lines; Fig. 2, a vertical section of the controller on line 2—2, Fig. 1, showing the cover in place; Fig. 3, an underside view of the rheostat disk showing the arrangement and connections of the resistance wires; Fig. 4, a detached perspective view, showing in series, one above the other and in proper position for assembling, the rheostat disk with its attached parts, the main spring, the switch blade, the wire-block with its attached parts, and the switch lever with its attached parts; and Fig. 5, a diagrammatic view, showing the generator in symbol, the controller partly in plan and partly in symbol, and the motor partly in symbol and partly in outline, and illustrating the wiring connections and relative courses of the currents.

Similar numerals refer to similar parts throughout the drawings.

The case 1 is preferably cylindric in form, with a closed bottom or base 2, faced with a frictional cushion 3 for resting on a floor or table, and a removable cover 4 which is preferably provided with the handle 5, by means of which the controller can be conveniently carried from place to place. In the vertical axis of the case is formed or securely attached the pivot post 6, and in one side of the case, preferably to the side wall thereof, is securely attached the insulation wire-block 7 by means of the bracket 8 fastened on the out-

side of the case and having the arm 9 extending through the opening 10 in the wall of the case, and thence curving a short distance along the inside of the wall; to which arm the wire-block is fastened as by means of screws.

The rheostat disk 11, hereinafter referred to merely as the disk, is made of insulation, and is securely mounted on the sleeve 12, which sleeve is telescoped on the pivot post 6 and rests upon the step 13 in the bottom of the case, by means of which mounting the disk is adapted to rotate on the post. The resistance wires of the rheostat are wrapped in two coils, one within the other, around the two series of insulation posts 14 and 15, which posts are fastened to and depend from the under side of the disk, being secured thereto by suitable bolts as 16, the annular frame 17 and the radial plates 18. The contact-pieces 19, 19^a, 19^b, 19^c, 19^d and 19^e are fastened on the upper side of the disk along the edge thereof, and, except the first one, are connected with the resistance wires, as follows: The second and third pieces, 19^a and 19^b, are connected together, preferably by the conducting plate 20 located on the under side of the disk, and thence by the conducting rod 21, these two pieces are jointly connected to the resistance wire of the whole of the inner coil 22, which coil includes a sufficient length of wire to constitute the initial resistance; the fourth contact-piece 19^c, is connected by means of the conducting rod 23 to the wire of the lowest section 25 of the outside coil, which section includes sufficient wire for the first increase of resistance; the fifth contact-piece 19^d, is connected, by means of the conducting rod 26 to the wire of the intermediate section 27 of the outside coil, which section includes a sufficient length of wire for the next increase of resistance; and the sixth contact-piece 19^e, is preferably somewhat elongated and is connected by means of the conducting rod 28, to the wire of the upper section 29 of the outside coil, which section includes a sufficient increase of wire for the desired maximum resistance; it being understood that the various sections and coils of the resistance wire are connected in series, so that an increasing length of the same is utilized, and consequently an increasing amount of resistance is brought into play, by closing the circuit on each succeeding contact-piece in the order named. The first contact-piece, 19, is not connected with any portion of the resistance wire, but is connected by means of the conducting strip 30, the conducting screw 31 and the conducting strip 32, with the conducting screw 33 on the opposite side of the disk, to which latter screw the remote end of the wire of the inside or initial resistance coil 22 is also connected, being the end of the series of resistance coils, as the same are successively brought into use, so that the conducting screw 33 can be spoken of as being normally the terminal of the rheostat. The insulation block 34 is formed or attached on the upper side of the disk, and embracing one end, part of the inner side and parts of the upper and lower edges thereof, are the conducting plates 35 and 35^a, which plates are in contact with each other; and on the upper side of the block is securely fastened the reverse-brush jaws 36 which jaws are in conducting contact with the plate 35. The rheostat resistance, by its terminal, the screw 33, is in conducting connection with these plates and jaws, as is also the first contact plate 19 by means of the intervening strip 30, the screw 31 and strip 32, the latter of which connections is shown, diagrammatically, at 32^a, on the upper side of the disk in Fig. 4. The switch-bracket 37 is securely fastened on the upper side of the disk, and is composed of the foot-bar 38, curved concentric with the disk pivot, and the upright bearing 39 in which the depending shank 40 of the switch blade 41 is pivoted. The curved arm 42 is provided on the upper end of the bracket, which arm serves as a stop to limit the movement of the blade in one direction.

The main spring 43 is of conducting material and in the form of a plane spiral, and the inner end of this spring is connected with and in conducting contact to the plate 35 on the inner side of the small insulation block 34; this connection being preferably made by means of the pear-shaped slots 44 in the end of the spring, which slots are adapted to engage on the headed screws 45 extending through the side-block-plate 35, the spring plates 43^a and 43^b, with similar slots 44^a, being preferably provided to strengthen the spring at the point of divergence from the block connection. The outer end of the main spring is secured, as by the screw 46, to the outer periphery of the wire-block, near one end thereof, the extreme end of the spring being bent upward and inward to form the plate 47 on the top of the block, to or through which plate is connected the binding-post 48, to which post is connected the wire 49 leading to what is designated herein as the reverse-brush of the armature. The forward-brush jaws 50 are fastened to the upper side of the same end of the wire-block, as by means of the screw 51 which is provided with the annularly-grooved nut 52, and underneath these jaws and in conducting contact therewith, is fastened the upper end extension 53 of the conducting spring-plate 54, the free end of which plate is located on the inner side of the wire-block, whence the plate is bent outward and upward on the end of the block, to which it is fastened as by the screw 55. The forward-brush binding-post 56 is connected to the wire-block in conducting contact with and preferably through the upper end extension of the spring-plate 54 and the rear ends of

the forward-brush jaws, and to this binding post is connected the wire 57 leading to the forward-brush of the motor armature. The binding-post 58 is fastened to the wire-block in conducting contact with and preferably through the conducting-plate 59, one end of which plate extends across the upper side of the block, whence it is bent downward, thence along the inner side of the block, thence outward adjacent to the shoulder 60 formed on the inner side of the block and thence backward into the recess 61 formed in the block, in which recess the spring end of the plate 54 is adapted to operate. To the binding-post 58 is connected the wire 62 which leads to the field coil of the motor.

The normal relation of the parts is with the conducting-plate 35[a] on the end of the disk-block 34 in contact with the portion of the conducting plate 59 which extends across the shoulder 60 of the wire-block, and in this relation of the parts, the boss 63 on the outer side of the disk-block 34 is adapted to abut the spring-plate 54 and throw it away from and out of contact with the inturned end of the field-plate 59, as shown by full lines in Fig. 1; but when the disk is rotated to bring the disk-block 34 in the position shown by dotted lines in Fig. 1, the plate 54 springs inward to a contact with the inturned end of the field-plate 59, as shown in Fig. 4. The binding-post 64 is secured to the other end of the wire-block, in contact with and preferably through the main-conducting-plate 65, which plate extends across the top of the block, thence down the inside thereof and thence inward adjacent to the upper side of the disk, and has its free end resting in pressing and sliding contact on the foot-bar of the switch-bracket; the insulation plate 66 being preferably provided on the inward extension of the main-plate to insulate the same from the main spring. To the binding-post 64 is connected the wire 67 leading from the generator which supplies the electric current for the motor, which wire for convenience is herein called the main wire.

The switch lever 68, hereinafter called merely the lever, is pivoted by its sleeve-hub 69 on the upper end of the pivot post 6 of the case, the hub preferably resting on the upper end of the disk-sleeve. The lever extends outward through the annularly-elongated slot 70 in the side of the case, and terminates in the pedal 71 by means of which it is conveniently manipulated by the foot of the operator. On the inner end of the lever, which is extended beyond the pivot, is securely attached the insulation L-arm 72, and to this arm, at an interval from the side of the lever, is securely attached the rod 73 which is provided with the hook 74 on its end, to which hook is attached one end of the switch-spring 75, the other end of which spring is pivotally attached to the switch-blade at a point intermediate its ends, as by the pivot rod 76 thereon.

The minor spring 77 is coiled around the insulation sleeve 78 located around the hub of the lever, one end 79 of this spring being extended in the form of a hook and adapted to engage in the groove of the nut 52 on the screw 51, by which the forward-brush jaws are fastened, and the other end being extended to a connection at 80 with the inner end of the spring rheostat arm 81, which-arm is fastened intermediate its ends to the under side of the lever with the insulation strip 82 intervening. The foot 83 of the spring arm is arranged to forcefully abut the contact-piece 19, when the controller is in its normal inoperative position, as shown in Fig. 2 and indicated by full lines in Fig. 1. The reverse pedal 84 is fastened to the disk, and extends outward through the annularly-elongated slot 85 formed in the side of the case, by means of which the disk can be manipulated by the foot of the operator.

In the normal position of the controller, the lever 68 is held against the shoulder 86 at the end of the slot 70, by action of the minor spring 77, and the buffer spring 87 is preferably provided on the side of the lever to cushion this contact when the lever is thrown back to its normal position; and in the same relation of the parts, the disk pedal 84 does not come quite into contact with the shoulder 88 on the adjacent end of the slot 85, for the reason that the plate 35[a] on the end of the disk-block 34, is stopped against the action of the main spring by the portion of the plate 59 which is bent across the shoulder 60 of the wire-block. The bent portion of this plate is preferably adapted to form a cushion for the abutment of the disk-block plate.

The main wire 67, the field wire 62, the reverse-brush wire 49 and the forward-brush wire 57 are preferably insulated and carried together through the aperture 89 formed in the bracket 8, and are thence carried in the form of a cable 90, as shown in Fig. 4, to their respective connections, but these wires are more conveniently and clearly referred to as being extended directly from the respective controller binding-posts, as shown conventionally at 67[a], 62[a], 49[a] and 57[a] in Fig. 1, and, diagrammatically, in Fig. 5, which latter figure is especially referred to in connection with the description of the operation of the controller which follows.

In the diagrammatic Fig. 5, the respective parts, connections and wires are referred to by the same numerals employed in the other figures, but with the suffix "[a]" added thereto, where the parts are diagrammatically shown. In this figure, the course of the electric currents when the same are directed to enter the motor armature through the forward-brush and to leave by the reverse-

brush, is indicated by full arrows, and the reverse course is indicated by broken arrows; and, likewise, the connections for the so-called forward current are indicated by full lines, and where the connections for the reverse current are different from those of the forward current, the same are indicated by dotted lines.

The incoming electric current from the generator 91 is received over the main wire 67, through the binding-post 64, the main-plate 65, the switch-bracket 37, and the switch-blade 41. To send the current to the armature through the forward-brush 92, the lever is rotated to the left from its normal position toward the position shown by broken lines in Fig. 1. After the inner end of the switch-spring 75 has been rotated to cross the pivoted-axis of the switch blade, the tension of the spring acts to throw the free end of the blade into contact with the forward-jaws 50, thus closing the forward circuit, the same being continued to the forward-brush 92 through the binding-post 56 and the wire 57.

The parallel branches of the shunt circuit separate at the forward-jaws, whence the rheostat circuit passes through the screw 51, the nut 52 and the minor spring 77 to the rheostat-arm 81. The rheostat-arm normally rests on the contact-piece 19, and the parts are so located and arranged that the lever must be thrown to the left until the rheostat-arm has cleared the contact-piece 19 and rests on either or both of the contact-pieces 19^a and 19^b, before the switch-blade has been thrown into contact with the forward-jaws. This abutment of the rheostat-arm on the contact-pieces 19^a or 19^b, closes the shunt circuit through the initial inner coil of the resistance, so that before the main circuit has been closed, the shunt circuit has been closed with its initial resistance, the initial resistance being in this controller the least resistance. In this relation, the shunt circuit continues on through the wire 21 of the inner coil to the terminal screw 33 of the rheostat, which is in circuit connection with the plate 35^a on the end of the disk-block where the rheostat shunt circuit is joined to the parallel armature-circuit which has passed on from the forward-brush 92 through the armature 93, the reverse-brush 94, its connecting wire 49, the binding post 48, the main spring 43 and the plate 35 on the side of the disk-block, which plate is in conducting contact with the plate 35^a on the end thereof. The plate 35^a on the end of the disk-block being now in contact with the field-plate 59, as shown in Fig. 1, the rejoined parallel circuits continue on together through the field-plate 59, the binding-post 58 and the wire 63 to and through the field coil 95 of the motor and thence, by way of the return wire 96, to the generator, thus completing the entire circuit.

It is evident that the speed of the armature will be varied by the amount of resistance in the parallel or shunt rheostat circuit, and that by moving the lever to the left to bring the rheostat-arm 81 successively in abutment with the respective contact-pieces 19^c, 19^d and 19^e, the wires of the coil sections 25, 27 and 29 of the resistance wire will be brought successively into circuit connection, thus ultimately increasing the resistance to the maximum, and consequently increasing the speed to the maximum. For the purpose of stopping or reversing the armature, the lever is permitted to rotate to the right to its normal position, which it does by action of the minor spring, and the parts are so arranged that the rheostat arm clears the contact-piece 19^a and abuts solely on the contact-piece 19 before the switch has been withdrawn from contact with the forward-jaws, which withdrawal is positively accomplished by the abutment of the end of the L-arm 73 of the lever against the pivot-rod 76 of the switch-blade; as a result of which, the shunt circuit is established directly with the rheostat terminal 33, and thence on to the field circuit through the conducting plate 30^a, the screw 31^a and the conducting plate 32^a, thus cutting out all resistance, and in effect short-circuiting the armature and effecting what is known in controllers of this class as the sudden stop.

To send the current to the armature through the reverse-brush 94, the current is received from the main wire to the switch-blade 41 as before, and instead of rotating the lever, the rheostat disk is rotated by moving its pedal to the right from its normal position toward the position shown by dotted lines in Fig. 1. After the pivot-axis of the switch blade has been rotated to cross the line of the switch-spring, the tension of the spring acts to throw the free end of the blade into contact with the reverse-jaws 37, thus closing the reverse-circuit, which is continued on to the reverse-brush through the main spring 43, the binding post 48 and the connecting wire 49. The rheostat shunt circuit is separated from the derived armature circuit at the reverse-jaws through the plate 35^a, the rheostat-terminal screw 33 and thence reversely through the rheostat coils 22, 25, 27 and 29, as the case may be, to the respective contact-pieces. The rotation of the disk is arranged to clear the contact-piece 19 from abutment on the rheostat-arm, and to bring either or both of the contact-pieces 19^a and 19^b to abut thereon, before the switch-blade has been thrown into the contact with the reverse-jaws, so that, as before, the initial resistance circuit is closed before the main circuit is closed. The rheostat-cir-

cuit is completed as before, but in a reverse direction, through the rheostat-arm 81, the minor spring 77, the nut 52 and the screw 51, to the forward-jaws 50, where it is joined by the armature-circuit which passes from the reverse-brush through the armature 93, the forward-brush 92, the wire 57 and the binding-post 56; and as the forward-jaws are not now in contact with the switch-blade, the joined circuit passes on through the spring-plate 54, the field-plate 59, the binding-post 58 and the connecting wire 63, to and through the field-coil 95 and the return wire 96 to the generator 91, thus completing the main circuit as before.

It will be understood that when the disk is rotated to free the spring-plate 54 from the abutment of the post 62, the plate 54 automatically springs into conducting contact with the inturned end of the field-plate 59, which closing of the circuit is indicated by the switch symbol 96 in the diagrammatic Fig. 5. And it is evident that, as the disk is rotated by moving its pedal to the right, the successive rheostat contact-pieces will be brought to abut on the rheostat-arm, thus, as before, gradually increasing the resistance to the maximum; and that when it is desired to stop or reverse the armature, the disk is permitted to return to its normal position, which it does by action of the main spring, and in so doing, the contact-piece 19^a clears the rheostat-arm and the contact-piece 19 alone abuts on the rheostat-arm before the switch-blade is thrown from contact with the reverse-jaws, thus closing the circuit directly to the field, without any resistance, and in effect, as before, short-circuiting the armature before the switch-blade has been withdrawn from contact with the reverse-jaws, which withdrawal, as before, is positively accomplished by the abutment of the end of the L-arm of the lever with the pivot-rod of the switch-blade.

The resistance-coils which are illustrated and described herein, are adapted for the use of an alternating current, but it is evident that the use of this particular type of resistance is not essential for the proper and efficient operation of the other features of the improvement. And, it will be understood that the word "disk", in the description and claims herein, is used in a very general sense, to indicate a suitably shaped flattened plate or block on which the respective parts of the rheostat and other connections and devices are adapted to be mounted, and it is not intended to limit the word to indicate an exactly circular flat plate, although such a form is the one which is preferably embodied in the controller which is described and illustrated herein. And it is evident that the specific use of switch-jaws for the respective circuit-terminals, and the use of a blade form of switch, are not essential to the general features and functions of the invention.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. An electric motor controller including a case with a main-wire, a field-wire, and two brush-wire binding-posts and a pair of switch-jaws secured therein, one brush-post having a conducting-connection with the jaws; a lever and a disk co-axially pivoted in the case; a switch-blade and a pair of switch-jaws on the disk; a rheostat having its resistance-coils and contact-pieces on the disk, its arm on the lever and its terminal in conducting-connection with the disk-jaws; a conducting-spring connecting the disk-jaws with the other brush-post and acting to hold the disk in open position; a conducting-spring connecting the case-jaws with the rheostat-arm and acting to hold the lever in open position; a conducting-connection between the main-post and the switch-blade; a conducting-connection between the field-post and the disk-jaws adapted to be switched to the case-jaws when the disk is rotated from its open position; and a connection between the lever and the switch-blade adapted to throw the blade into the case-jaws when the lever is rotated to close the rheostat-circuit and into the disk-jaws when the disk is rotated to close the same circuit; with a generator, a motor and wire connections; whereby a parallel rheostat-armature circuit is established in one direction in series with the motor-field by rotating the lever, and a similar rheosta armature circuit is established in the reverse direction in series with the motor-field by rotating the disk.

2. An electric motor controller including a case with a block therein, a pair of switch-jaws having a conducting-connection with one motor-brush secured on the block, a lever and a disk co-axially pivoted in the case, a main-wire switch-blade and a pair of switch-jaws on the disk, a rheostat having its resistance-coils and contact-pieces on the disk, its arm on the lever and its terminal in conducting-connection with the disk-jaws, a conducting spring connecting the disk-jaws with the case-block and with the other motor-brush and acting to hold the disk in open position, a conducting-spring connecting the case-jaws with the rheostat-arm and acting to hold the lever in open position, a conducting-connection between the motor-field and the disk-jaws adapted to be switched to the case-jaws when the case is rotated from its open position, and a connection between the lever and the switch-blade adapted to throw the blade into the case-jaws when the disk is rotated to close the rheostat-circuit and into the disk-jaws when the disk is rotated to close the same circuit, whereby a parallel rheostat-armature circuit is established in

one direction in series with the motor-field by rotating the lever, and a similar rheostat-armature circuit is established in the reverse direction in series with the motor-field by rotating the disk.

3. An electric motor controller including a lever and a disk co-axially pivoted, switch-jaws fixed adjacent to the disk and having conducting-connection with one motor-brush, switch-jaws having conducting-connection with the other motor-brush and a main-wire switch-blade on the disk, a rheostat having its resistance-coils and contact-pieces on the disk, its arm on the lever and its terminal in conducting-connection with the disk-jaws, a conducting-connection between the rheostat-arm and the fixed jaws, means for normally holding the lever and the disk in open position, a conducting-connection between the motor-field and the disk-jaws adapted to be switched to the fixed-jaws when the disk is rotated from its open position, and a connection between the lever and the switch-blade adapted to throw the blade into the fixed-jaws when the lever is rotated to close the rheostat-circuit and into the disk-jaws when the disk is rotated to close the same circuit; whereby a parallel rheostat-armature circuit is established in one direction in series with the motor-field by rotating the lever, and a similar rheostat-armature circuit is established in the reverse direction in series with the motor-field by rotating the disk.

4. An electric motor controller including a lever and a disk co-axially pivoted, switch-jaws for one motor-brush fixed adjacent to the disk, switch-jaws for the other motor-brush and a main-wire switch-blade on the disk, a rheostat having its resistance-coils and contact-pieces on the disk, its arm on the lever in conducting connection with the fixed-jaws and its terminal in conducting connection with the disk-jaws, means for normally holding the lever and the disk in open position, a conducting-connection between the motor-field and the disk-jaws adapted to be switched to the fixed-jaws when the disk is rotated from its open position, and a connection between the lever and the switch-blade adapted to throw the blade into the fixed-jaws when the lever is rotated to close the rheostat-circuit and into the disk-jaws when the disk is rotated to close the same circuit, whereby a parallel rheostat-armature circuit is established in one direction in series with the motor-field by rotating the lever, and a similar rheostat-armature circuit is established in the reverse direction in series with the motor-field by rotating the disk.

5. An electric controller including a lever and a disk co-axially pivoted, switch-jaws fixed adjacent to the disk, switch-jaws and a main-wire switch-blade on the disk, a rheostat having its resistance-coils and contact-pieces on the disk, its arm on the lever in conducting-connection with the fixed-jaws and its terminal in conducting-connection with the disk-jaws, means for normally holding the lever and the disk in open position, a return-wire conducting-connection with the disk-jaws adapted to be switched to the fixed-jaws when the disk is rotated from its open position, and a connection between the lever and the switch-blade adapted to throw the blade into the fixed-jaws when the lever is rotated to close the rheostat-circuit and into the disk-jaws when the disk is rotated to close the same circuit, whereby a circuit in multiple-arc is established in one direction by rotating the lever, and a similar circuit is established in the reverse direction by rotating the disk.

6. An electric controller including a lever and a disk co-axially pivoted, switch-jaws fixed adjacent to the disk and switch-jaws on the disk, a main-wire switch-blade adapted to enter the fixed-jaws when the lever is rotated one way and the disk-jaws when the disk is rotated the other way, resistance-coils with contact-pieces and a terminal on the disk in conducting-connection with the disk-jaws, a contact-piece on the disk in direct conducting-connection with the disk-jaws, a return-wire conducting-connection with the disk-jaws adapted to be switched to the fixed-jaws when the disk is rotated, and an arm on the lever normally abutting the direct contact-piece and adapted to abut the resistance-contact-pieces successively by a rotation of the lever or the disk, whereby a circuit in multiple-arc is established in one direction or the other, the arm being arranged to re-abut the direct contact-piece before the blade is withdrawn from the respective jaws, and thereby to suddenly short-circuit the current.

7. An electric controller including a lever and a disk co-axially pivoted, switch-jaws fixed adjacent to the disk, switch-jaws and a main-wire switch-blade on the disk, a rheostat having its resistance-coils and contact-pieces on the disk, its arm on the lever in conducting-connection with the fixed-jaws and its terminal in conducting-connection with the disk-jaws, a return-wire conducting-connection with the disk-jaws adapted to be switched to the fixed-jaws when the disk is rotated to close the rheostat circuit, and a connection between the lever and the switch-blade adapted to throw the blade into the fixed-jaws when the lever is rotated to close the rheostat-circuit and into the disk-jaws when the disk is rotated to close the same circuit, whereby a circuit in multiple-arc is established in the reverse direction by rotating the disk.

8. An electric controller including a lever and a disk co-axially pivoted, switch-jaws

fixed adjacent to the disk and switch-jaws on the disk, a main-wire switch-blade adapted to enter the fixed-jaws when the lever is rotated one way and the disk-jaws when the disk is rotated the other way, a rheostat having its resistance-coils and contact-pieces on the disk, its arm on the lever and its terminal in conducting-connection with the disk-jaws, a return-wire conducting-connection with the disk-jaws adapted to be switched to the fixed-jaws when the disk is rotated to enter the blade in the disk-jaws, whereby a circuit in multiple-arc is established in one direction by rotating the lever, and in the reverse direction by rotating the disk.

9. In an electric controller, a lever and a disk co-axially pivoted, a rheostat having its arm on the one and its resistance contact-pieces and terminal on the other with a contact-piece on the same part having direct conducting-connection with the terminal, a main-wire adapted to be connected with the arm by a rotation of the one and with the rheostat-terminal by a rotation of the other, and a return-wire adapted to be connected with the terminal by a rotation of the one and with the arm by a rotation of the other, the arm being arranged to abut the direct contact-piece before the main-wire is disconnected from the arm or the disk, whereby a circuit is established through the rheostat in one direction by rotating the arm and in the other direction by rotating the disk, and is suddenly opened by the return of the arm or the disk to normal position.

10. In an electric controller, a lever and a disk co-axially pivoted, a rheostat having its arm on the one and its resistance contact-pieces and terminal on the other, a main-wire adapted to be connected with the arm by a rotation of the one and with the rheostat-terminal by a rotation of the other, and a return-wire adapted to be connected with the terminal by a rotation of the one and with the arm by a rotation of the other, whereby a circuit is established through the rheostat in one direction by rotating the arm and in the other direction by rotating the disk.

11. In an electric controller, a lever and a disk co-axially pivoted, switch-jaws fixed adjacent to the disk, switch-jaws and a switch-blade on the disk, and a connection between the lever and the blade adapted to throw the blade into the fixed-jaws when the lever is rotated one way and into the disk-jaws when the disk is rotated the other way, with means for normally holding the lever and the disk in open position.

12. In an electric controller, a lever and a disk co-axially pivoted, switch-jaws fixed adjacent to the disk, switch-jaws and a switch-blade on the disk, and a connection between the lever and the blade adapted to throw the blade into the fixed jaws when the lever is rotated one way and into the disk-jaws when the disk is rotated the other way.

13. In an electric controller, a lever and a disk co-axially pivoted, switch-jaws on the disk and switch-jaws fixed adjacent thereto, and a switch-blade adapted to be entered into the fixed-jaws by a rotation of the lever and into the disk-jaws by a rotation of the disk.

14. In an electric controller, a lever and a disk co-axially pivoted, one circuit-terminal fixed adjacent to the disk, the other circuit-terminal and a switch on the disk, and a connection between the lever and the switch adapted to throw the switch into contact with one terminal when the lever is rotated one way and into contact with the other terminal when the disk is rotated the other way.

15. In an electric controller, a lever and a disk co-axially pivoted, one circuit-terminal fixed adjacent to the disk, the other circuit-terminal and a switch on the disk, and a connection between the lever and the switch adapted to throw the switch into contact with one terminal when the lever is rotated and into contact with the other terminal when the disk is rotated.

16. In an electric controller, a lever and a disk co-axially pivoted, one circuit-terminal on the disk, the other circuit-terminal fixed adjacent thereto, and a switch adapted to be brought into contact with one terminal by a rotation of the lever and into contact with the other terminal by a rotation of the disk.

FRANK E. CASE.

Witnesses:
RUTH A. MILLER,
HARRY FREASE.