A. J. CLINE.

CURRENT CONTROLLING DEVICE.

APPLICATION FILED JULY 8, 1909.

991,481. **Patented May 9, 1911.**

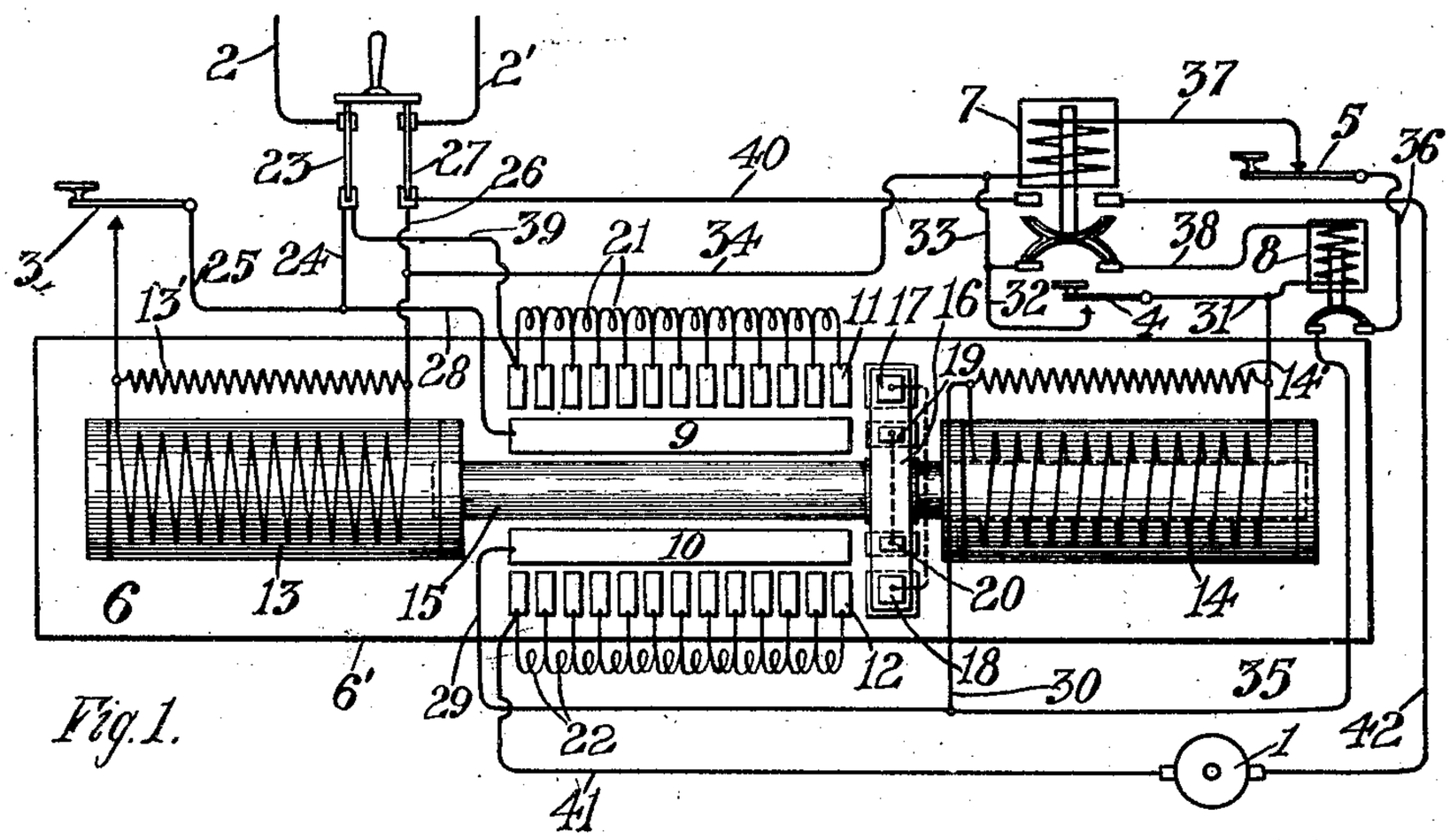


Fig. 1.

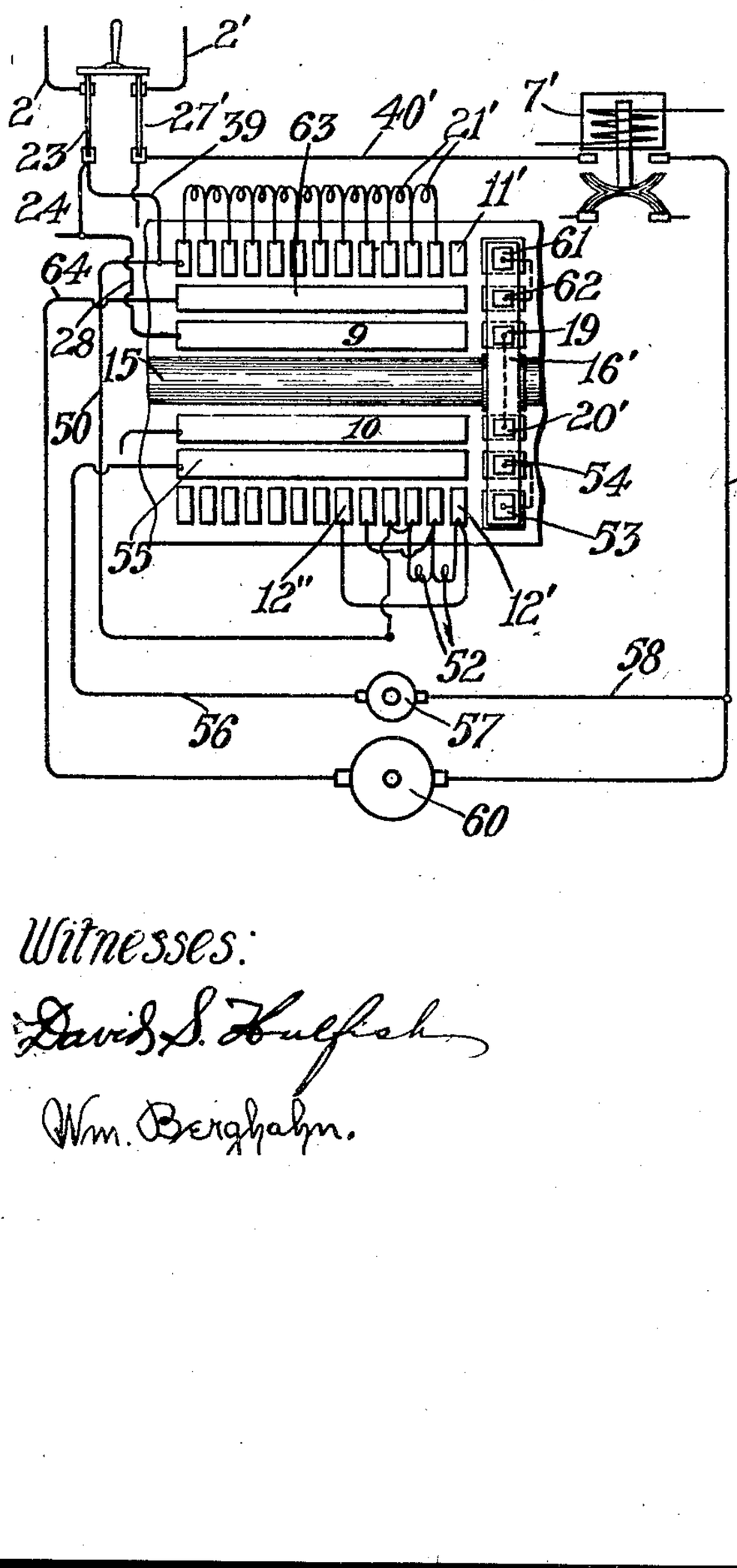
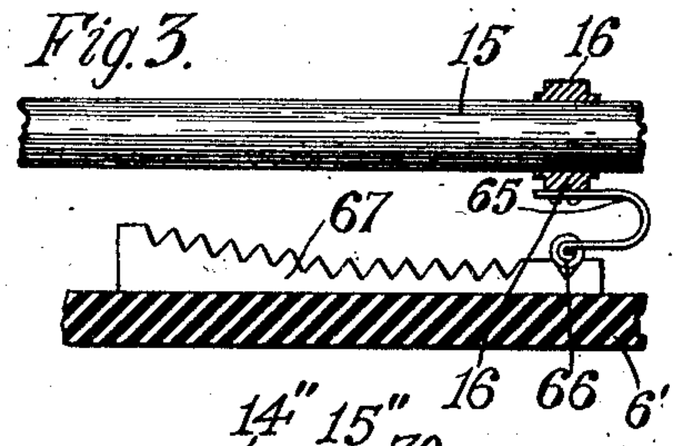


Fig. 2.

Fig. 3.



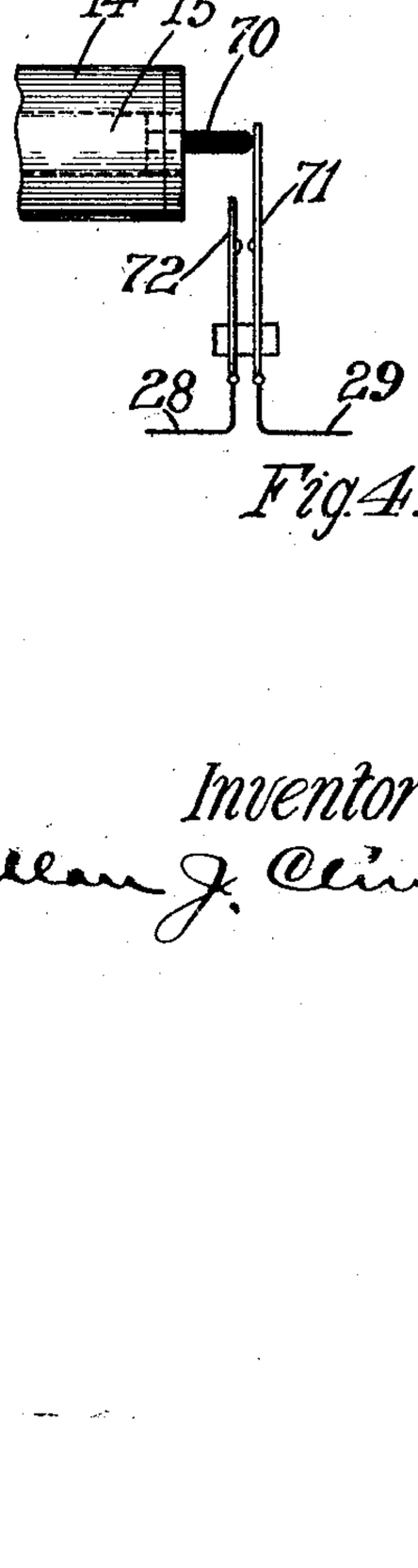


Fig. 4.

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CURRENT-CONTROLLING DEVICE.

991,481. Specification of Letters Patent. Patented May 9, 1911.

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To all whom it may concern:

Be it known that I, ALLAN J. CLINE, a citizen of the United States of America, and a resident of Chicago, county of Cook, and State of Illinois, have invented a new and useful Improvement in Current-Controlling Devices, of which the following is a specification.

My invention pertains to improvements in current controlling devices of a general type which may be designated as distance-control devices.

In many cases it is desirable to control a central source of power from a distant point or from any of many distant points. In such a condition it is customary to provide the power devices with controlling devices, which controlling devices themselves are operated or controlled by circuits which may be designated control circuits since their function is to transmit current to the centrally situated controlling device to cause that device to exercise upon the motor the control desired.

My improved device comprises a series of contact plates, a movable brush holder carrying brushes for making contact with said contact plates, a pair of opposingly placed solenoids for moving said brush holder in opposite directions, an armature or plunger for the solenoids which plunger is connected to the brush holder, and a restraining device for the plunger, the device thus described being associated with auxiliary switching devices and circuit connections.

In the drawings, Figure 1 shows a complete system, Fig. 2 shows a modification thereof, Fig. 3 shows the restraining device, and Fig. 4 shows a modified form of off-normal switch.

Referring first to Fig. 1, I show a motor 1 which may be driven by electric current received from main power wires 2 and 2′. Control buttons or control switches 3, 4 and 5 are adapted to be placed in any location and at any desired distances either from the motor 1 or from the current controlling device which may be designated as a whole 6. Any or all of these control keys may be duplicated as many times as desired. Auxiliary electro-magnetic switching devices 7 and 8 are shown in connection with the controller 6.

Upon a nonconducting base 6′ are mounted two contact bars 9 and 10 and two rows of contact plates 11 and 12; also two solenoids 13 and 14. The solenoids have a common plunger 15 which carries the brush holder 16, the brush holder in turn carrying brushes 17, 18, 19, 20. Brushes 17 and 18 are connected together electrically, and brushes 19 and 20 are connected together electrically. When the plunger 15 is attracted by solenoid 13, it carries the brush holder 16 to the left connecting 9 and 10 and connecting successively oppositely situated contact plates of the series 11 and 12. The series of plates 11 are connected by resistances 21 and the series of plates 12 are connected by resistances 22. The solenoids 13 and 14 are shunted by noninductive shunts 13′ and 14′ to reduce sparking in the controlling circuits.

The controlling circuits are as follows: For starting or increasing the speed of the motor 1, the controlling circuit extends from power wire 2 through switch blade 23, conductor 24, conductor 25, key 3, solenoid 13, conductor 26, switch blade 27 to power conductor 2′; when the key 3 is closed, solenoid 13 is energized attracting its end of plunger 15 and moving the brushes toward the left over 9, 10, 11 and 12. For decreasing the speed of the motor the control circuit extends from power conductor 2 through switch blade 23, conductor 24, conductor 28, plate 9, brush 19, which is in connection with plate 9 because the motor 1 is assumed to be running when the speed-decrease control circuit is to be operative, brush 20, plate 10, conductor 29, conductor 30, solenoid 14, conductor 31, key 4, conductor 32, conductor 33, conductor 34, conductor 26, switch blade 27 to power conductor 2′, thus energizing solenoid 14 when key 4 is closed. Solenoid 14 will attract its end of plunger 15 and draw the movable brushes toward the right. If the key is held down a sufficient length of time, the brushes will be drawn to the right to the limit of their possible motion, thereby interrupting the circuit just described between 9 and 19 and also between 10 and 20 and at the same time interrupting the motor circuit and stopping the motor 1.

The stop control circuit is as follows: from power conductor 2 through switch blade 23, conductor 24, conductor 28, plate 9, brush 19, brush 20, plate 10, conductor 29, conductor 35, bridging brush of unenergized solenoid switch 8, conductor 36, key 5, conductor 37, solenoid of switch 7, conductor 34,

conductor 26, and switch blade 27 to power conductor 2'. This is the quick-stop control circuit. It is normally a closed circuit in which current flows continuously and solenoid switch 7 is continuously energized. The operation of key 5 breaks the circuit of energizing solenoid 7 which drops its switching brushes to its lower pair of contacts and its upper pair thus breaks the main circuit of the motor 1, thus stopping the motor quickly, at the same time closing an auxiliary stopping circuit comprising elements 2, 23, 24, 28, 9, 19, 20, 10, 29, 30, 14, solenoid of 8, 38, bridging brush of 7, 33, 34, 26, 27, 2'. This auxiliary stopping circuit energizes solenoids 14 and 8. Solenoid 8 by lifting its bridging brush interrupts the quick-stop control circuit and holds it interrupted so long as the auxiliary stopping circuit remains closed. The solenoid 14 draws the movable brushes to the right, and as they reach the limit of their motion, the auxiliary stopping circuit is interrupted between 9 and 19, and also between 10 and 20. During the continuance of the auxiliary stopping circuit the solenoid 8 holds open the circuit containing solenoid 7, thus the solenoid 7 can not be energized until after the complete return to normal of the brush holder 16 and therefore the motor 1 can not be started except when brush holder 16 is in its normal position.

The operation of starting the motor 1 is as follows: On closing the key 3 solenoid 13 is energized as has been described. Brush holder 16 is moved to the left and closes by its brushes 19 and 20, the control circuits for decreasing the speed or for stopping the motor. It also closes by its brushes 17 and 18 a path between the first plate of series 11 and the first plate of series 12. The control circuits closed by brushes 19 and 20 extend from power wire 2 through 23, 24, 28, 9, 19, 20, 10, 29 to the junction of conductors 30 and 35 and then pass in multiple through 30, 14, solenoid of 8, 38, brush of 7, 33, to 34, 26, 27, 2, and also in multiple through 35, brush of 8, 36, 5, 37, solenoid of 7 to 34, 26, 27, 2. Upon the closing of this double circuit current flows through solenoid of 7 fed through brush of 8 and also through solenoid of 8 fed through brush of 7. These devices are so constructed mechanically and electrically that device 7 responds and interrupts the circuit of device 8 and at the same time closes the main motor circuit which extends as follows: from 2 through switch blade 23, conductor 39, all of resistance 21 to first plate of series 11, brush 17, brush 18, first plate of series 12, all of resistances 22, conductor 41, motor 1, conductor 42, bridging brush and upper contacts of solenoid switch 7, conductor 40, and switch blade 27 to power conductor 2'. This turns motor 1 at its lowest speed because of the inclusion in series with it of all of the resistances 21 and 22. As the control switch 3 is held down continuously, or as it is closed at intervals, the solenoid 13 draws its end of plunger 15 into the solenoid, moving the brush holder 16 at intervals toward the left and cutting out by successive steps the resistances 21 and 22, thus increasing the speed of the motor 1 until when the limit of travel of the brush holder 16 is reached all series resistance has been removed from the path of motor 1. No other circuit changes are effected by the movement of the current controlling device. The plunger 15 is horizontal and remains inert in any position when none of its control circuits are being controlled by the respective keys 3, 4 or 5. The method of decreasing the speed and stopping the motor 62 have been described above.

The keys 3, 4 and 5 may be controlled manually or in any way suitable to the conditions. For instance, where the motor 1 operates a pump to keep a water tank supplied, a low-level float valve may control key 3 and a high level float valve may control key 4 or 5. Where an air pressure is to be maintained, keys 3 and 4 or 5 are replaced by pressure-controlled electrical contact-making devices.

The arrangement of brushes upon the brush holder 16 and the arrangement of contacts for the brushes and the circuits controlled thereby will vary with the different installations in which my improved current controller is used. A modification is shown in Fig. 2. Fig. 2 shows a condition adapted particularly for printing presses where, in some of the processes of making a press ready for service, an extremely slow movement of the press is desired and a comparatively fast movement is required after the press is ready for printing. This has been accomplished in some instances by the use of two motors, a small motor operating through speed reducing gears to turn the press very slowly, and a larger motor for driving it rapidly. In the system of Fig. 2 the control circuits and the method of controlling the movement of the brush holder 16' are the same as in Fig. 1. When the first contact plates of series 11' and 12' are engaged, no circuit is closed through 11' and a circuit through 12' is closed through elements 2, 23, 39, 50, both of resistances 52, brushes 53, and 54, contact plate 55, conductor 56, motor 57, conductor 58, conductor 59, upper contacts and brush of solenoid switch 7', conductor 40', switch blade 27', power conductor 2'. The small motor 57 is started at its slowest speed while the large motor 60 is not started at all. At the second of the series of contact pieces the speed of the motor 57 is increased, and the motor 60 is started through circuit containing elements 2, 23, 39, 21', 11', 61, 62, 63, 64, 60, 59, 7', 40',

27′, 2′. At the next step with the brushes upon the third contact piece of the series the speed of motor 60 is increased, and motor 57 is running at full speed. At the fourth or fifth step motor 60 is assumed to take the load of driving the printing press and motor 57 is decreased in speed, stopping after the 6th step, while motor 60 carries the load and reaches full speed as the brush holder progresses to the left to its extreme position. When the speed is decreased slowly by the speed decreasing control circuit containing control switch 4, the engagement of brush 53 with contact piece 12″ will start the small motor, and the next two steps will increase the speed of the small motor, preparing the small motor to take the load of the press when the large motor stops or becomes inefficient in operation at a very low speed. In like manner the contacts of brushes controlled by the plunger 15 may be modified to care for alternating currents of two phase or three phase varieties.

When alternating currents are used for the motor, it is desirable sometimes to operate the control circuits by direct currents. In any instance control circuit conductors 24 and 26 are carried to the source of controlling current, and power conductors 29 and 40 are carried to the source of power current. In Fig. 1 these two pairs of conductors are shown carried to the same source, namely the power mains 2 and 2′, but it is obvious that they may be carried to different sources when desired. By this means the controlling circuits may be operated by direct currents and an alternating current may be controlled thereby.

In Fig. 3 is shown a detail which has first the function of centering the brushes of the brush holder 16 or of preventing the brushes from occupying an arcing position upon the contact plates 11 and 12, and second the function of opposing the movement of the plungers and brush holders as they approach their left-hand position. The spring carrier 65 is attached to brush holder 16 and carries wheel 66 which travels upon track 67. By reason of the notches in the track 67 the wheel 66 causes the brush holder, when not under the influence of the solenoids, to take and hold a suitable position with reference to the contact plates. As the plunger 15 passes into the solenoid 13 the magnetic attraction is increased. This is in part compensated for by the angle taken by the track 67 at the left, so that too rapid a movement of the plunger is not permitted.

A modification is shown in Fig. 4. In this figure the right hand end of the solenoid 14 is shown labeled 14″ and within it is the right hand end of the plunger labeled 15″. Plunger 15″ is provided with the insulating stud 70 which presses against spring 71 holding it out of engagement with spring 72 when the plunger 15″ is in its extreme right hand position. This constitutes an off-normal switch opened when the plunger 15″ is in its normal or extreme right hand position and closed under any other position of that plunger. It will be seen that its function is the same as that performed by the parts 9, 19, 20 and 10 which in themselves constitute an off-normal switch, and by connecting the spring 72 and 71 to conductors 28 and 29 of Fig. 1, the contact plates 9 and 10 and the brushes 19 and 20 may be omitted.

By closing the back end of each of the solenoids, a dash pot is formed for the plungers, preventing too rapid a motion of the brushes over the contact plates. The core working into the solenoids lies horizontally, hence has no tendency to move in either direction when neither solenoid is energized. When the size of the core is large, and its weight, therefore, is great, friction-reducing means may be desirable such as rollers or lubricated bearing surfaces, the provision of which lies within the skill of any workman. The core should be of magnetic construction, suitable for the conditions of service. A solid core of iron is suitable for direct signal currents, but a laminated core or a core of a bundle of wires, or even a helix may be required when the control currents are alternating. While the solenoid type of construction is illustrated herein and seems desirable, a modified type may be constructed using electromagnets of other forms.

It is immaterial in mounting the device represented by Fig. 1, whether the solenoids be above or below the base or mounted sidewise as upon a wall. I prefer to mount the contact-making device of Fig. 1 upon the top, side or bottom of a resistance housing containing the resistances 21 and 22, the device thus mounted being independent of the housing and being wired to the resistances.

I do not wish to limit myself to the exact device here shown, this device being merely a typical one embodying my invention, and many modifications being possible.

What I claim as new and desire to secure by United States Letters Patent is:

1. In a current controlling device, an electric switch having a movable part, solenoids for moving said movable part into and out of its normal positions; an auxiliary switch; and a control circuit including one of said solenoids and said auxiliary switch, said included solenoid being adapted to restore said movable switch part to its normal position, and said auxiliary switch being adapted to open said control circuit when said movable switch part is in its normal position, substantially as described.

2. In a current controlling device, an electric switch having a movable part, solenoids for moving said movable part into and out

of its normal positions, a plurality of control circuits for directly controlling the operating of said moving part, an auxiliary switch and a control circuit including one of said solenoids and said auxiliary switch, said included solenoid being adapted to restore said moving switch part to its normal condition, and said auxiliary switch being adapted to open said control circuit when said moving switch part is in its normal position, and means for gradually retarding said movable part as said movable part passes into one of said solenoids for the purpose herein described.

Signed by me at Chicago, county of Cook and State of Illinois, in the presence of two witnesses.

ALLAN J. CLINE.

Witnesses:
DAVID S. HULFISH,
HARRIET L. SMITH.