L. BRADLEY.

CURRENT CONTROLLER.

APPLICATION FILED MAR. 18, 1909.

1,051,480. Patented Jan. 28, 1913.

2 SHEETS—SHEET 1.

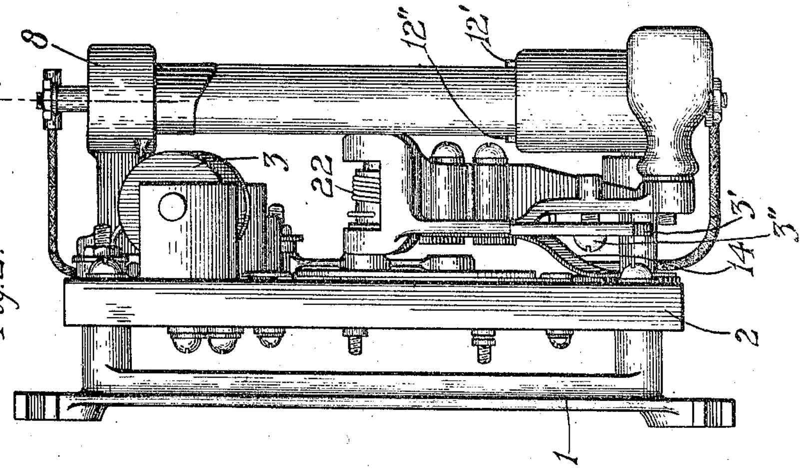


Fig. 2.

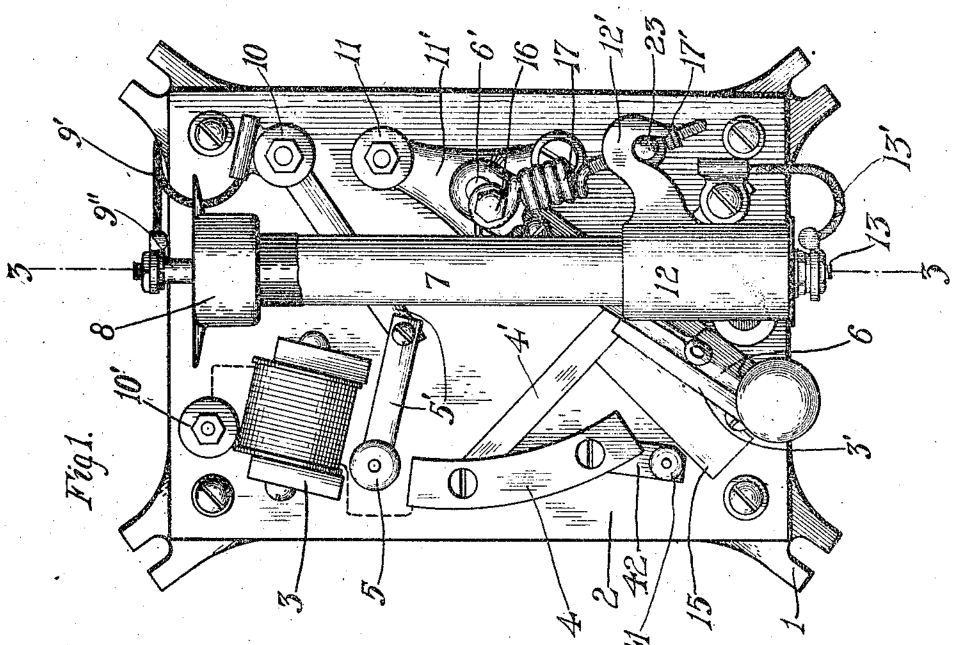


Fig. 1.

Witnesses:

David S. Hulfish

Wm. Berghahn.

Inventor:

Lynde Bradley

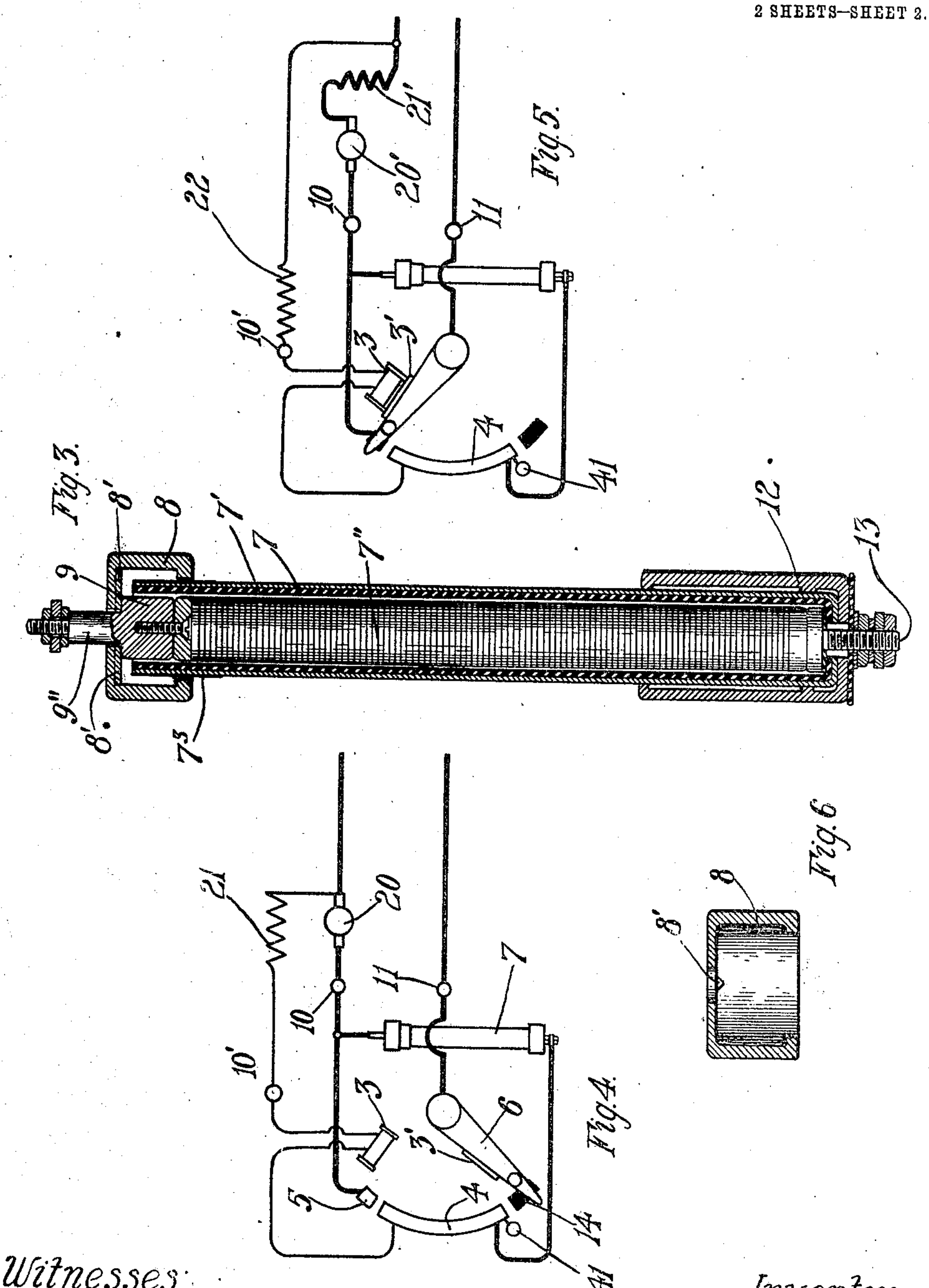
By McMeen & Miller

Attys.

L. BRADLEY.
CURRENT CONTROLLER.
APPLICATION FILED MAR. 18, 1909.

1,051,480. Patented Jan. 28, 1913.

2 SHEETS—SHEET 2.



Witnesses:
David S. Hulfish
Wm Berghahn.

Inventor:
Lynde Bradley
By McMean & Miller
Attys.

UNITED STATES PATENT OFFICE.

LYNDE BRADLEY, OF MUSKEGON, MICHIGAN, ASSIGNOR TO ALLEN-BRADLEY COMPANY, A CORPORATION OF WISCONSIN.

CURRENT-CONTROLLER.

1,051,480. Specification of Letters Patent. Patented Jan. 28, 1913.

Application filed March 13, 1909. Serial No. 484,129.

To all whom it may concern:

Be it known that I, LYNDE BRADLEY, a citizen of the United States of America, and a resident of Muskegon, county of Muskegon, and State of Michigan, have invented a new and useful Improvement in Current-Controllers, (Case III,) of which the following is a specification.

My invention pertains to current controllers of the type which comprises a combination of electric switches and variable resistances.

It relates more particularly to devices in which the progression of a control lever through a predetermined movement operates a switch to change the controlling circuits of a motor or other power using device, and of a resistor, and also to vary the resistance value of the resistor.

My present invention contemplates the employment of a resistance varying device in which the variations of resistance are secured by placing a variable pressure upon the resistor proper. The resistance medium or resistor of such resistance-varying devices, I make preferably of specially treated carbon disks (as disclosed in an application filed by Harry L. Bradley and myself, jointly, Serial No. 467,352, filed December 14, 1908,) but I do not limit myself to this form of resistor, as resistors of ordinary carbon such as are disclosed in my Patent 815,317, March 13, 1906, or of other materials, may be employed. Instead of the resistor being in the form of disks, I may employ other shapes, such as granular, spherical or other forms, in any of which cases I confine or retain the resistor in a suitable manner in a container or retainer of form such as to make it offer a suitable path for the current to be varied and to hold it in readiness for the required compression.

My improved current controller comprises novel means for supporting and for varying the pressure upon the compressible resistor forming the variable resistance part of a current controller, and novel electrical and mechanical features involved in the arrangement and adapted to assist in the functions of such means. One feature of such an arrangement involves the sustaining of the resistor directly upon the controlling lever which results in great simplicity of construction.

Another feature is the arrangement of the various parts in relation to each other whereby the same motion of the controlling lever which accomplishes the compression or decompression of the resistor, also will accomplish the desired circuit changes and other functions of the controller.

In the drawings, Figure 1 shows front elevation of a current controller constructed according to my invention. Fig. 2 shows a side elevation of the same. Fig. 3 shows section of the variable resistor, on the line 3 of Fig. 1. Figs. 4 and 5 show circuits of the device for shunt and series motors, respectively. Fig. 6 shows a sectional view of the cap 8 on the line 6 of Fig. 2.

Referring to Figs. 1 and 2, the cast base 1 carries the insulating slab 2. Upon slab 2 are mounted holding magnet or no-voltage release coil 3, fixed switch elements 41 and 4 and 5, switch lever 6 and a container 7, for a compressible resistance element, or resistor. I prefer, as far as possible or convenient, to mount all conducting portions of the device on the face of the insulating slab 2.

The element 7 is a tube having an insulating lining, and contains a resistor 7″ (Fig. 3) in the form of a compressible column. The upper end of the tube is held in a fixed yoke 8. The yoke 8 is attached rigidly to the slab 2, and surrounds the upper end of the tube 7, but is insulated from the tube. The floating block 9 rests upon the top of the resistance column within the container 7. This floating block 9 has a stud 9″ which projects through the closed end of the cap 8 and offers a terminal for the connection of the flexible conductor 9′. Thus a connection is obtained through the block 9 stud 9″ and flexible conductor 9′ between the upper end of the compressible resistor and terminal 10. Terminals 10 and 11 are binding posts for the conductors leading to the armature of the motor to be controlled, and to one side of the power mains, respectively. The lower end of the tube 7, containing the resistor proper, is held in a cup 12, having a double or twin hook extension 12′, 12″. The cup 12 is insulated from the resistor 7″ contained in the tube 7. The terminal 13 is insulated from the cup 12, and tube 7, and passes within the tube 7 into contact with the lower end of the resistor column. By means of the terminal 13, the flexible conductor 13′ and conductor 4′, the lower end of the resistor is connected permanently to the arc conductor 4, which lies in the path of the lever 6. Lever 6 is pivoted upon tripod bracket 11′ which carries also binding post 11, and lever and bracket are made of conducting material.

The contact spring 14 is attached to the lever, and forms a conducting contact part or brush therefor. Insulating plate 15 is provided to lift contact spring 14 to the proper level to pass upon the surface of switch element 41.

The fixed switch element 41 lies beyond the arc of the fixed element 4 when measured radially from the pivot 6′ along the arm 6, hence the contact of conducting spring 14 with part 41 is made at a point on the spring 14 different from that at which the spring 14 connects with the part 4. Part 41 is an auxiliary fixed switch element whose function it is to provide for breaking the current of the spring 14 at a point other than that where 14 rubs upon 4, in order that the unavoidable burning and consequent roughening of the spring 14 may take place at a point where the continuous carrying surfaces will not be affected. When this device is to be used in controlling circuits of comparatively high voltage, for instance 500 volts or over, the conductor 42 which joins the button 41 and fixed conductor 4 may be omitted and a blow-out magnet connected in the circuit in its place. Preferably I locate this blow-out magnet immediately behind the slate panel 2 but in such position that the magnet field which it produces will be effective in destroying the arc across the gap between the button 41 and the spring 14 as the spring leaves this button.

Lever 6 carries a self-alining armature or keeper 3′ for the holding magnet 3. This keeper is suspended loosely or pivotally upon the screw 3″ so that it has freedom to move through a small angle and thereby has freedom to aline itself against the pole-pieces of the holding magnet 3. Two lugs cast upon the under surface of the lever 6 form stops for the keeper 3′, limiting its angular motion.

The spring 22 is the decompressing spring for the resistor 7″. The function of the spring 22 is to return the arm 6 completely to its normal position, or lowest position, thereby returning the current controller to that condition of all its parts in which the compressible resistor is completely decompressed or at its minimum of compression

Upon the lever 6, which is pivoted at 6′, is mounted eccentric wrist pin 16, forming a movable support for the lower end of the resistance unit 7. An insulating, elastic and at the same time adjustable connection is attained between the pin 16 and the cup 12 which supports the lower end of the resistance unit 7, by providing double or twin hooks 12′, 12″ upon the cup 12 and integral with it, hanging a spring upon the movable pin 16, and uniting the spring and the hooks by a bar 23 of insulating material set transversely to the twin hooks, the hooks catching over the ends of the bar and the spring passing through the middle of the bar. The bar 23 is shouldered or enlarged between the hooks to prevent any endwise slipping, thus avoiding accidental contact between the spring 17 and the hooks 12′, 12″. The spring 17, upon the part passing through the bar 23, is threaded, and adjusting nuts 17′ are provided.

The adjusting nuts 17′ provide a means for raising and lowering the resistance unit 7 to compensate for any inaccuracy in the length of the contained resistor; also for controlling the point in the movement of the arm 6 at which the compression of the resistor 7″ shall begin or for controlling the maximum or the minimum pressure to which the resistor shall be subjected. Thus a greater or less current may be allowed to flow into the motor or other controlled device at any given point in the arc of motion of the lever 6, as may be desired and determined by the adjustment of the nuts 17′.

The sole means of support for the weight of the resistance unit 7 is the system of devices just described whereby the movable pin 16 sustains the weight of cup 12 and tube 7. By reason of the eccentric position of wrist pin 16, the cup 12 and tube 7 are drawn upward when lever 6 is moved upward. This lifts the resistor without change until floating block 9 engages mechanically the closed end of yoke 8, after which the cup 12 and tube 7 will be urged with great force toward the yoke 8 by reason of the small radius of eccentricity of the wrist pin 16 and the high tension of the spiral spring 17. But by reason of the detention of floating block 9 by yoke 8, the resistor column will be subject to compression by all the force supplied through spring 17. This compression will increase as lever 6 progresses through its arc, and will be a maximum only when the limit of movement of arm 6 is reached. As the resistor column reduces its resistance under pressure, the resistance of the column will become gradually less as the arm 6 is moved upward. The movement of the arm 6 over conductor 4, therefore, occurs simultaneously with a progressive reduction of the resistance of the resistor 7″.

The lower end of tube 7 is supported solely by spring 17 and bar 23 engaging hooks 12′, 12″, and is loose to swing to a very small degree. The upper part is supported slidingly by yoke 8. The resistor may be detached by unhooking the hooks 12′, 12″ from spring 17, and disconnecting 13′ and 9′ when it may be lowered out of engagement with yoke 8 for inspection or repairs.

The part 8 is a triple-functioned structural part, consisting of a tubular guide and an abutment which closes the end of the tubular guide, the abutment and guide together forming a protecting cap for the resistor. The tube 7 slides within the tubular guide, formed of the wall portions of the part 8; the floating block or upper electrode of the resistor abuts against the end of the cup-like part 8 and resistor 7″ thus may be compressed. At the same time, the cup form of the combined guide and the diaphragm-like abutment is such in shape and position as to protect the upper end of the tube containing the resistor.

The ribs 8′, 8′, project inwardly from the face of the diaphragm wall of the part 8. The floating block 9 engages these points and rocks upon them as a pivotal engagement when the tube 7 swings within its very small angle. The ribs 8′, 8′ thus enable the floating block 9 to press upon the top of column 7″ with a pressure at all times equally distributed over the top of the column.

By loosely suspending the entire resistor from a movable part of the controlling switch lever, I am not only able to subject the column of resistor elements to variable pressure by movement of the lever, but the same movement of the lever which effects this compression or decompression, also serves to agitate the column of resistor elements, and thus to properly loosen the column of elements when they are relieved from pressure and thus insure the restoration of the resistance of the column to its desired normal high value. This is particularly true when the lever arm is allowed to fly back to its normal position when released by the holding magnet 3. This movement occurs suddenly and gives the entire resistor element a violent shake just at the time when it is released from compression. This desirable feature is made possible by the particular eccentric suspension of the entire resistor including its containing tube, from the lever itself rather than mounting this tube in a stationary position, as is ordinarily done.

The inner structure of the resistance tube 7 is shown in Fig. 3. The fixed cap is shown is section at 8, within which the tube 7 slips freely. The tube 7 has an insulating lining, preferably of fire-clay, suitably cemented to the tube, and within the tube is a column of resistance disks, 7″, having a comparatively high contact resistance, which contact resistance is variable by pressure applied to the ends of the column of disks. It will be seen by reason of the clearance offered for tube 7 to slip upward into the cap 8, that the resistance column 7″, will be compressed when the tube thus is moved upward. The sustaining cup, or socket 12, is insulated from the resistance column and its terminal 13, while at the top the tube 7 is insulated from the cap 8 in any convenient manner, the insulation here shown being a coating of enamel upon the tube at 7^3.

Following the action of contact spring 14 as lever 6 is moved upward, it will be seen that at first a path entering the device at terminal 11 is broken for switching purposes, at the contact spring 14. The first contact is made between spring 14 and contact boss or switch element 41, which is connected to the switch element 4 by the metallic strip 42, or by the helix of the blow-out magnet where such is used. This gives circuit through 11, 11′, 6, 14, 41, 42, 4, 4′, 13′, 13, resistor of 7, 9, 9′, 10. This circuit continues throughout a major portion of the movement of arm 6. Just before the arm 6 completes its movement, spring 14 makes contact with fixed switch element 5, completing a direct circuit through 11, 11′, 6, 14, 5, 5′, 10, thus switching out of the circuit the resistance within tube 7. When lever 6 reaches its limit of upward movement, the self-alining keeper 3′ engages with the pole piece of magnet 3 and is held thereby, retaining the arm 6 in its extreme position until forcibly removed, or so long as a sufficient voltage is maintained between terminals 11 and 10′ as hereinafter described. In case of no voltage between these terminals, the keeper is released, and the arm 6 is returned to its lowest position by springs 17 and 22.

Fig. 4 shows the circuit of the device in connection with a shunt motor. Fig. 5 shows the circuit of the same device in connection with a series motor. In Fig. 4 the motor is shown in a condition of rest; in Fig. 5 it is shown with circuits for full speed. In referring to Fig. 4, it will be seen that current from terminal 11 will flow, after the first movement of the arm, through lever 6 to arc 4, thence through resistor 7 and armature 20; and also through the shunt path containing holding magnet 3 and field coil 21. When the arm 6 reaches its upper and final position, the current will flow from arm 6 to contact plate 5, and thence directly through armature 20, while at the same time the circuit of the field and holding coil is changed, passing now through 11, 6, 5, 7, 4, 3, 10′, and 21.

Referring to Fig. 5, the armature 20, and field 21′ are in series, and current through them is controlled as is the current through the armature in Fig. 4. Holding coil 3 has its control circuit between the points 10′ and 11 similar to that of Fig. 4, but auxiliary resistance 22 may be required in case the magnet 3 is not of sufficiently high resistance within itself.

While I have shown in my drawings a tubular container for the resistor, I do not wish to limit myself to this form since it is obvious that any structure which will accomplish the desired purpose of holding the resistor material in suitable form for compression may be employed. Thus instead of a tube a series of parallel rods might be employed for retaining the disks in the form of a column, or the disks might be made of annular form and strung like beads on an insulated rod, thus retaining them in a suitable column. Wherever in the claims I have used the word "container" or "retainer" I desire to have it understood that any device for retaining the resistor material in form suitable for compression is meant.

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

1. In a current controller, a pivoted lever, a compressible resistor, a container therefor, said container being suspended at one end upon said lever, and laterally movable by said lever; and a fixed abutment for the other end of said resistor.

2. In a current controller, a pivoted lever, a compressible resistor, a container therefor, said container being suspended upon said lever and laterally movable by said lever, and a fixed abutment against which said movable resistor is compressed by said lever.

3. In a current controller, a resistor, a container therefor, a lever and a fixed abutment, said container being yieldingly suspended from said lever and adapted to be moved by it against said fixed abutment.

4. In a current controller, a movable support for a resistor; a spring; a resistor suspended at one end by said spring from said movable support; a fixed support for the other end of said resistor; means for moving said movable support to act through said spring to draw said resistor against said fixed support and to apply a pressure to said resistor by the tension of said spring.

5. In a current controller, a movable support; a spring; a resistor suspended at one end by said spring from said movable support; a fixed support for the other end of said resistor; means for moving said movable support to act through said spring to draw said resistor against said fixed support and to apply a pressure to said resistor by the tension of said spring, said means for moving said support being further adapted to increase or decrease the spring tension to control the pressure applied to said resistor.

6. In a current controller, a movable support; a spring; a socket suspended by said spring from said movable support; a fixed support comprising at the same time a guide member and an abutment member; and a resistor whose resistance is variable by pressure, said resistor being held by said socket at one end and controlled by said guide at the other end, and compressible against said abutment.

7. In a current controller, a tubular resistor container; a resistor whose resistance is subject to change by pressure, said resistor being within said container; a movable support for said container; a spring connecting said container to said movable support; a guide for said container; and a fixed abutment for said contained resistor, whereby by the movement of said container said resistor will be pressed against said abutment.

8. In a current controller, a combination of a resistor whose resistance is variable by pressure; a container for said resistor; means for subjecting said resistor to pressure, said means comprising a fixed abutment for said resistor against which said container does not abut; and a spring suspension for said container, and adapted to urge said container toward said abutment.

9. In a current controller, a resistor; a fixed abutment for one end of said resistor; a container for said resistor, an operating lever to which said container is attached eccentrically; and a spring between said supporting lever and said container, whereby a smoothly graduated pressure may be applied to said resistor by said lever.

10. In a current controller, a compressible resistor; a tubular container for same; a combined guide and abutment composed of a tubular guide for said container, within which said container may slip and a diaphragm at one end of said guide and closing said guide and forming at the same time a cup for closing the end of the resistor container and an abutment against which said contained resistor may be compressed.

11. The combination of a tubular resistor container; a compressible resistor contained within said tube; and a hood for the end of said tube; the sides of the hood being adapted to form a guide, within which said tube may slip, and the end of the hood being adapted to form an abutment against which the contained resistor may be compressed, said contained resistor being provided with a contacting terminal projecting from said containing tube and engaging the top of said hood, whereby pressure may be applied to said contained resistor, but not to the end of said tube.

12. In a current controller, a compressible resistor medium loosely suspended at one end from a movable support; a guide hood slidably engaging the opposite end of said resistor medium; a lever pivoted at one end and adapted to compress said resistor medium against the closed end of said guide hood.

13. In a current controller, a switch lever; a socket suspended by a spring from said switch lever; a fixed support comprising at the same time a guide member and an abutment member; and a resistor whose resistance is variable by pressure, said resistor being held by said socket at one end and controlled by said guide at the other end, and compressible against said abutment when said switch lever is moved.

14. In a current controller, a combination of a resistor whose resistance is variable by pressure; a container for said resistor; a means for subjecting said resistor to pressure, said means comprising a fixed abutment for said resistor against which said container does not abut, a lever, and a spring suspension for said container adapted to press said container toward said abutment, said spring suspension being attached to said lever.

15. In a current controller, a resistor subject to pressure; a fixed support for one end of said resistor; a movable support attached by an elastic suspension member to the other end of said resistor, said elastic suspension member sustaining the weight of said resistor and urging it toward said fixed support; and a controlling lever upon which said movable support is mounted eccentrically to its fulcrum, and by which the tension of said elastic suspension member is controlled, said controlling lever operating also to control the circuits of the current controller.

16. The combination of a tubular resistor container; a compressible resistor contained within said tube; and a hood for the end of said tube, the sides of the hood being adapted to form a guide, within which said tube may slip, and the end of the hood being adapted to form an abutment against which the contained resistor may be compressed.

17. In a current controller, a controlling lever; a compressible resistor loosely suspended at one end from said controlling lever; a guide hood slidably engaging the opposite end of said resistor, against the closed end of which said resistor may be compressed by means of said controlling lever.

18. In a current controller, a compressible resistor; a cup holding said resistor; a spring-supported insulating bar; and hooks on said cup and engaging said spring held bar.

19. In a current controller, a movable member; an insulating bar spring-hung from said member; a compressible resistor; and a cup suspended by hooks from said bar and sustaining said resistor.

20. In a current controller, a compressible resistor, a pivoted lever operating to switch said resistor into and out of circuit, said resistor being suspended at one end on said lever and both laterally and longitudinally movable therewith, and a fixed abutment for the other end of said lever against which said resistor is compressed by said lever.

21. In combination with an electric motor, a motor starter comprising a compressible resistor for varying the current through said motor, a lever adapted to vary the pressure on said resistor, a release magnet adapted to hold said lever in its position of maximum compression for said resistor during the normal operation of said motor, and means for returning said lever to its position of least compression when released by said magnet.

22. In combination with an electric motor, a motor starter comprising a compessible resistor for varying the current through said motor, a lever pivoted to vary the pressure on said resistor, a switch controlled by said lever for commutating the circuits of said motor, a release magnet adapted to hold said lever in its position of maximum compression for said resistor during the normal operation of said motor, and means for returning said lever to its position of least compression when released by said magnet.

23. A motor starter, a compressible resistor for varying the current strength through said motor, a fixed abutment for one end of said resistor, a lever supporting the other end of said resistor and adapted to move said resistor longitudinally and also to compress it against said abutment, a release magnet adapted to hold said lever in its position of maximum compression, and means for quickly returning said lever to its position of least compression when released by said magnet, whereby said resistor is decompressed and violently shaken.

Signed by me at Muskegon, county of Muskegon, and State of Michigan, in the presence of two witnesses this fifteenth day of March 1909.

LYNDE BRADLEY.

Witnesses:
JOSIE VANDERWERP,
JOHN VANDERWERP.