L. BRADLEY.

ELECTRIC CURRENT CONTROLLER.

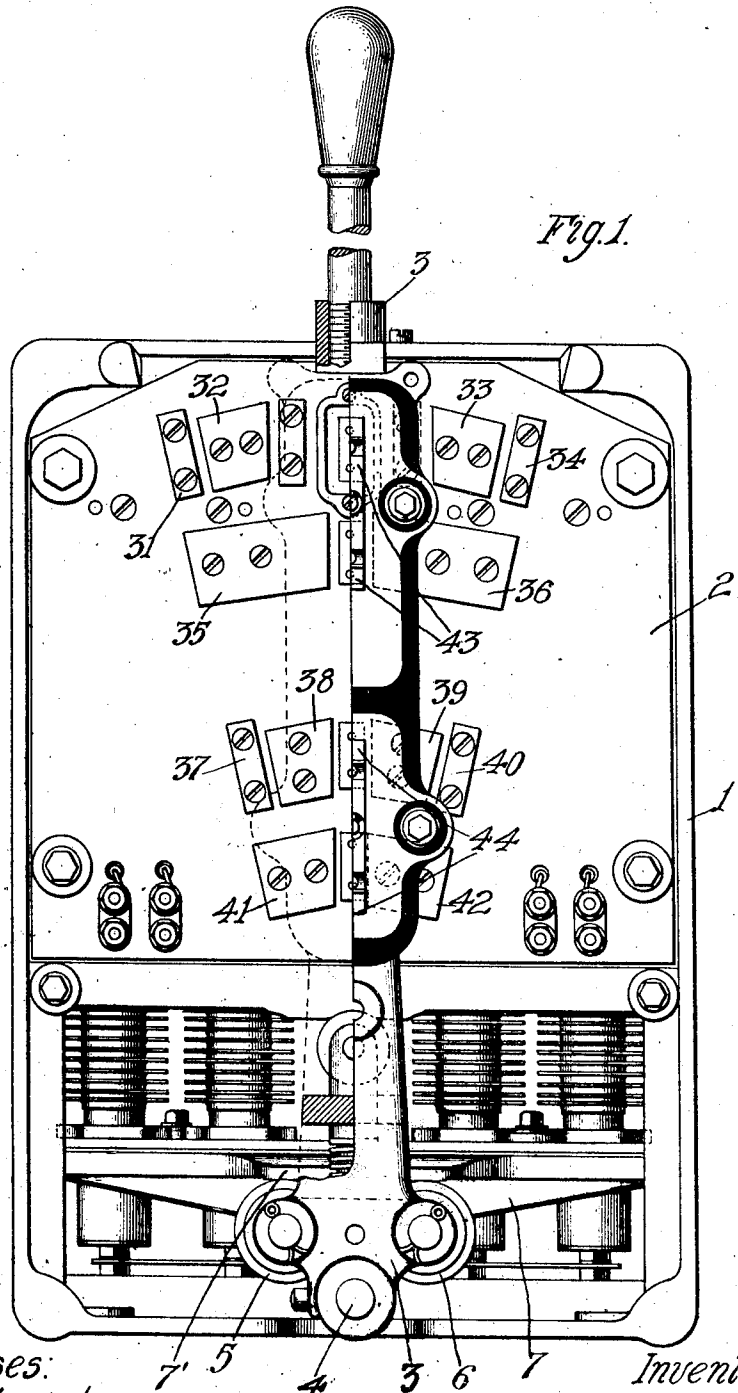
APPLICATION FILED NOV. 20, 1909.

1,051,481.

Patented Jan. 28, 1913.

6 SHEETS—SHEET 1.

Fig. 1.



Witnesses:
David L. Hulfish.
Wm. Brighahn.

Inventor
Lynde Bradley
By McCulloch & Miller
Attys.

L. BRADLEY.

ELECTRIC CURRENT CONTROLLER.

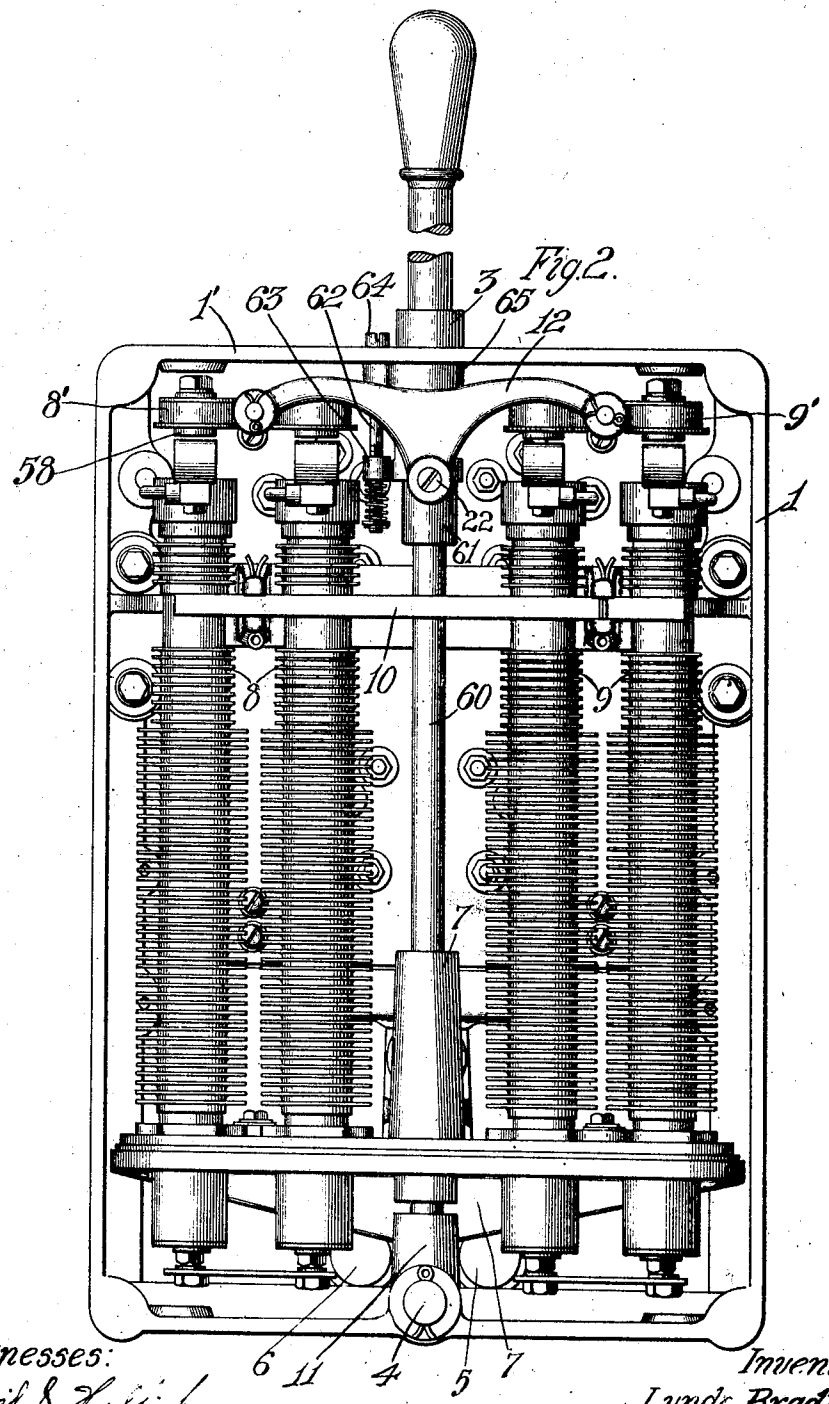
APPLICATION FILED NOV. 20, 1909.

1,051,481.

Patented Jan. 28, 1913.

6 SHEETS—SHEET 2.

Fig. 2.



Witnesses:
David S. Knipial
Wm Borghahn

Inventor
Lynde Bradley
By McMeen & Mueller
Attys.

L. BRADLEY.

ELECTRIC CURRENT CONTROLLER.

APPLICATION FILED NOV. 20, 1909.

1,051,481. **Patented Jan. 28, 1913.**

6 SHEETS—SHEET 3.

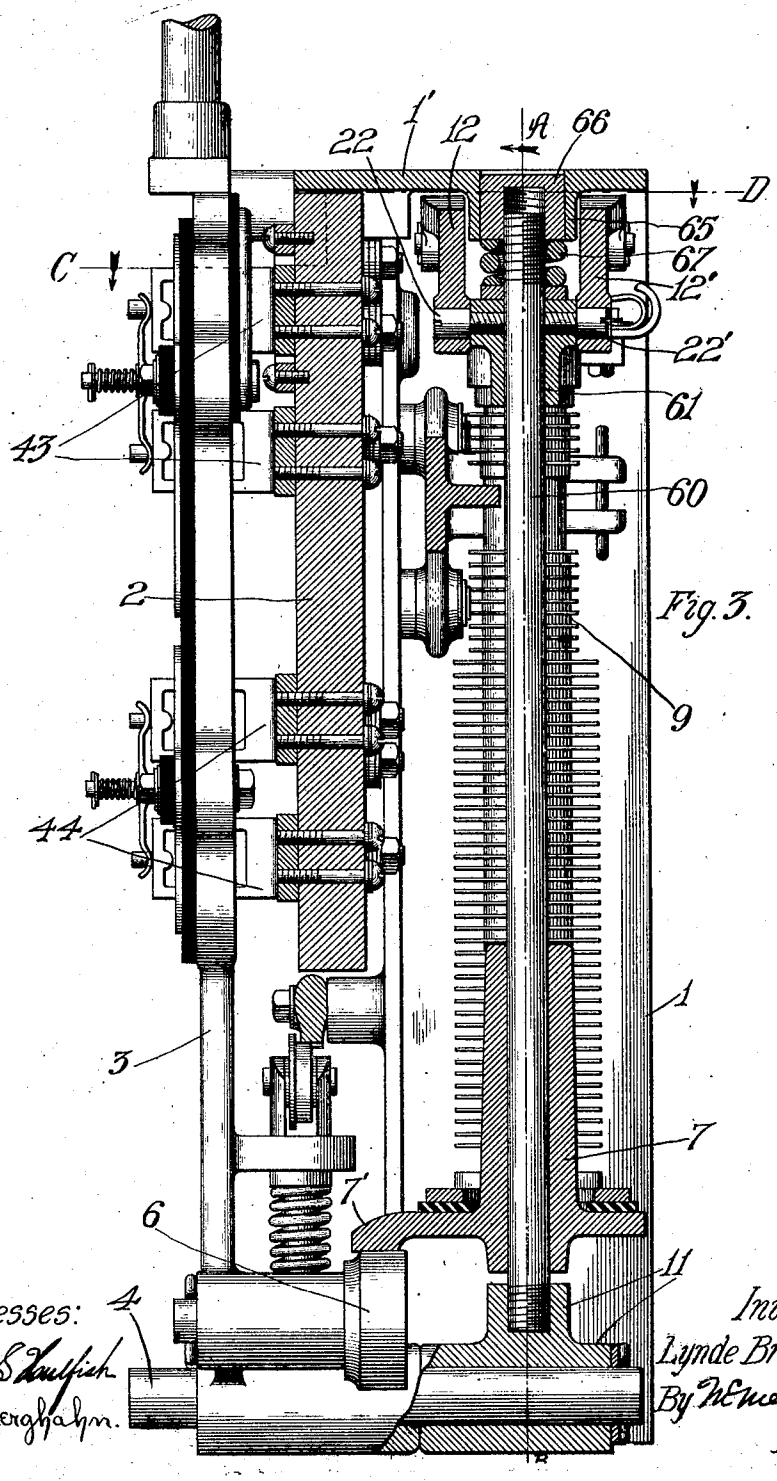


Fig. 3.

Witnesses:
David S. Zeulfish
Wm. Berghahn.

Inventor
Lynde Bradley
By McCann & Miller
Attys.

L. BRADLEY.

ELECTRIC CURRENT CONTROLLER.

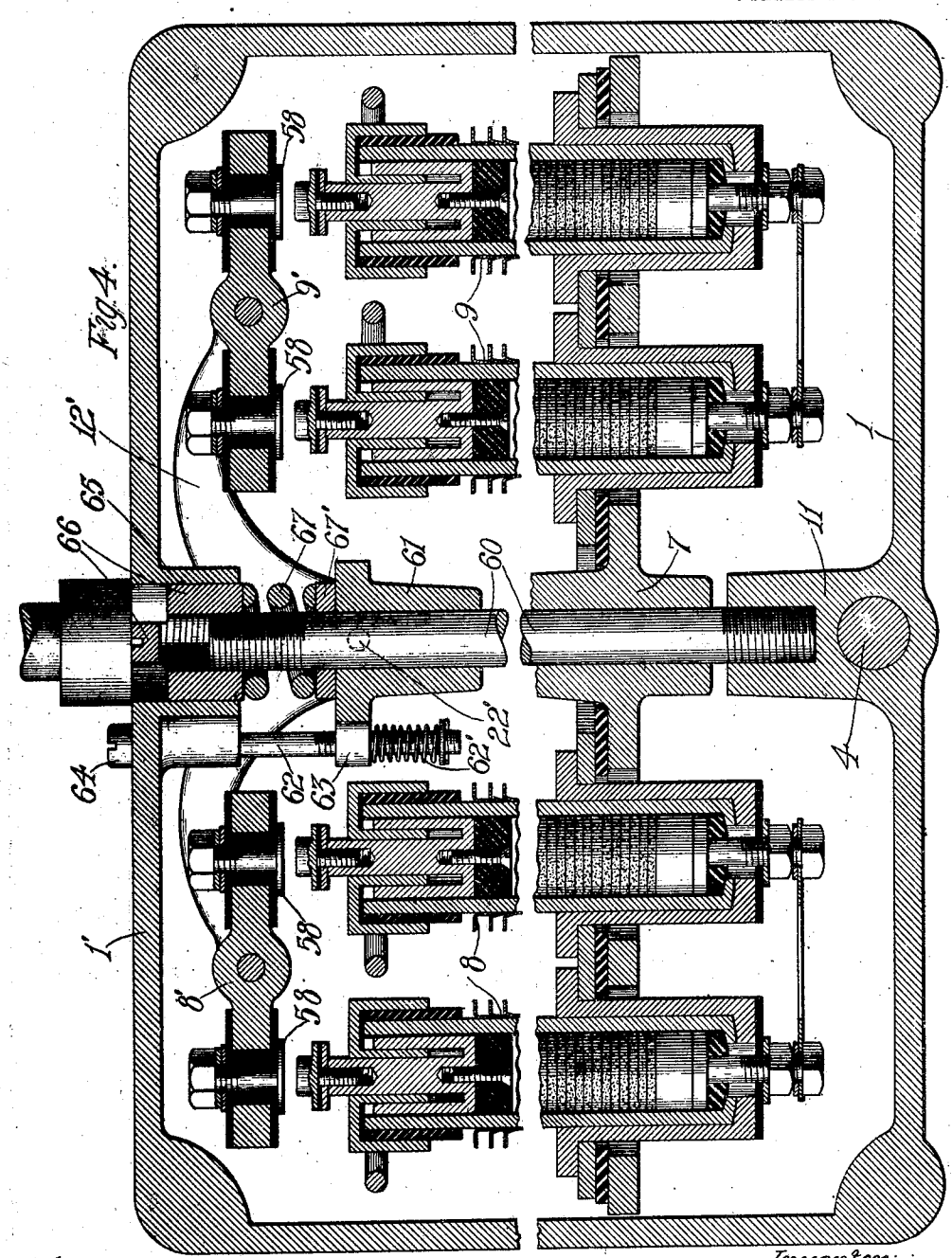
APPLICATION FILED NOV. 20, 1909.

1,051,481.

Patented Jan. 28, 1913.

6 SHEETS—SHEET 4.

Fig. 4.



Witnesses:
David S. Denfish
Wm. Berghahn

Inventor:
Lynde Bradley
By. McNeely & Miller
Attys.

L. BRADLEY.

ELECTRIC CURRENT CONTROLLER.

APPLICATION FILED NOV. 20, 1909.

1,051,481.

Patented Jan. 28, 1913

6 SHEETS—SHEET 5.

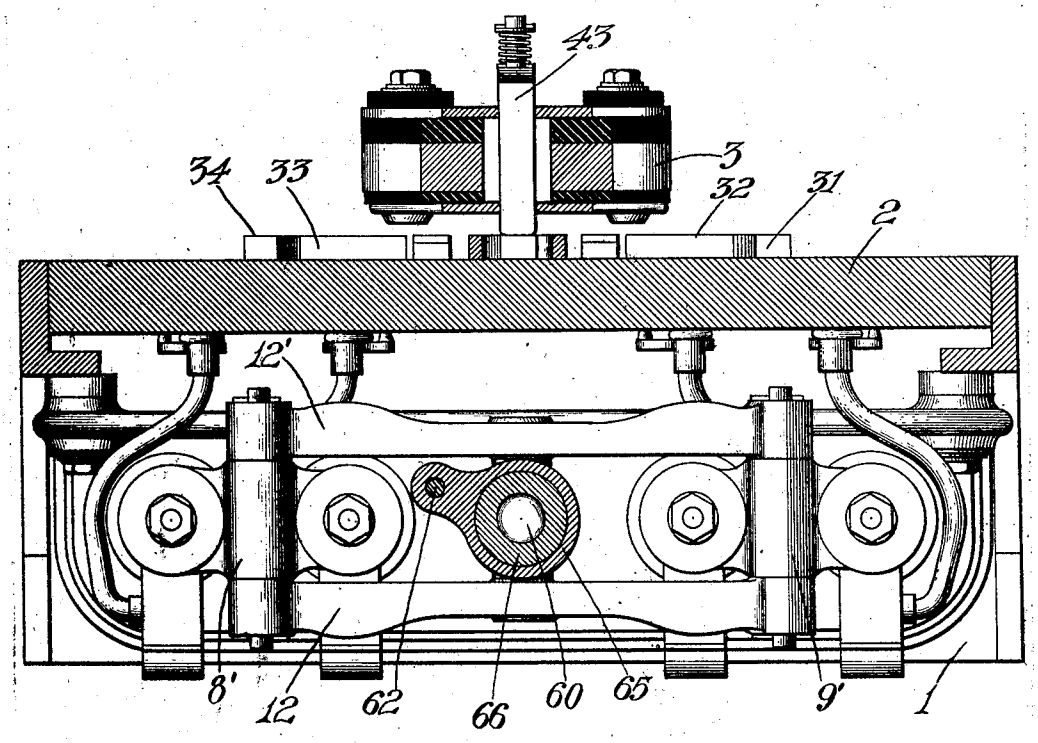


Fig. 5.

Witnesses:
David S. Kulfisher
Wm. Berghahn.

Inventor:
Lynde Bradley
By McManus Miller
Attys.

L. BRADLEY.

ELECTRIC CURRENT CONTROLLER.

APPLICATION FILED NOV. 20, 1909.

1,051,481.

Patented Jan. 28, 1913.

6 SHEETS—SHEET 6.

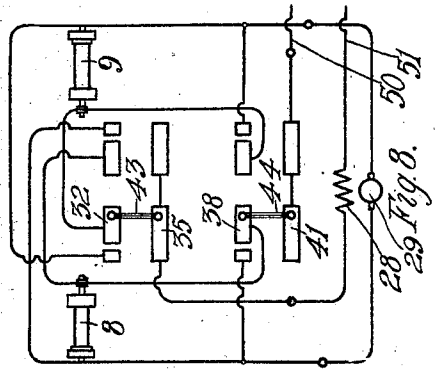


Fig. 8.

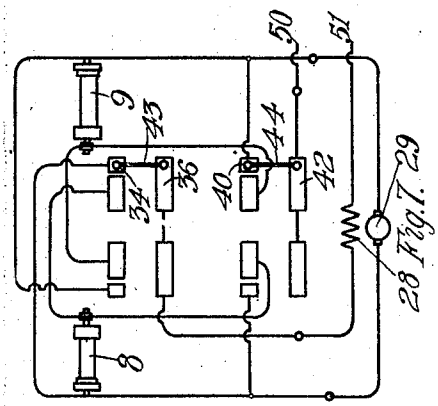


Fig. 7.

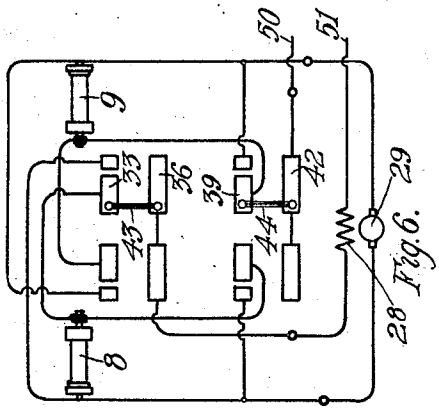


Fig. 6.

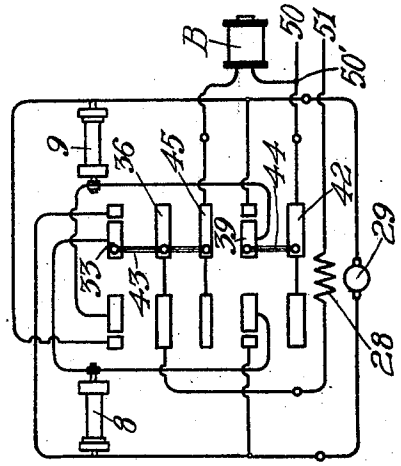


Fig. 10.

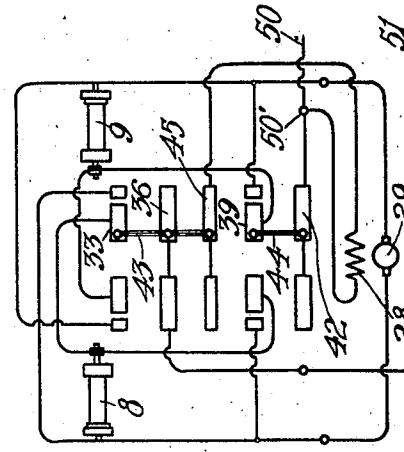


Fig. 9.

Witnesses:

David S. Kendrick

Wm. Berghahn.

Inventor:

Lynde Bradley

By McCormick

Attys.

UNITED STATES PATENT OFFICE.

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

ELECTRIC-CURRENT CONTROLLER.

1,051,481. Specification of Letters Patent. Patented Jan. 28, 1913.

Application filed November 20, 1909. Serial No. 529,124.

To all whom it may concern:

Be it known that I, LYNDE BRADLEY, a citizen of the United States of America, and resident of Milwaukee, county of Milwaukee, and State of Wisconsin, have invented a new and useful Improvement in Electric-Current Controllers, of which the following is a specification.

My invention pertains to electric current controllers and particularly to those kinds of controllers using electrical resistors or resistance mediums whose resistance is subject to change by pressure and in which the change of resistance of the medium by pressure placed upon it by associated mechanism, is used to vary and control the currents passing through the device.

My invention is illustrated as adapted to a current controlling device of the general type of that illustrated and described in United States Letters Patent 821,697, issued to me under date of May 29th, 1906.

In my improved construction I provide an arrangement of parts such that the stresses of structural elements resulting in the compression of the resistor are carried for the most part by the apparatus mounted within the cast frame of the current controlling device, attaining by this arrangement a device in which the frame for assembling the parts is not subjected to the excessive stresses and consequent strains involved in compressing the resistor during the use of the apparatus. I provide, also, novel and simple means for adjusting the critical point of beginning pressure when the apparatus is operated, and also for adjusting the value of the maximum compression of the resistor.

The compressible resistor units which I illustrate in the accompanying drawings form the subject matter of other applications now pending, viz; Serial No. 467,352, filed December 14, 1908, and Serial No. 535,223, filed December 27, 1909, by Harry L. Bradley and myself as joint inventors. While the compressible resistor here illustrated is the one which I prefer to use, it is to be understood that any form of resistance element, the resistance of which may be altered by varying pressure, may be employed without departing from the spirit of my invention.

In the drawings accompanying and forming a part of this specification, Figure 1 shows a front elevation of a device embodying my invention, a portion of the operating lever being removed; Fig. 2 shows a rear elevation of same; Fig. 3 shows a central vertical section of the device, with the operating lever shown in elevation; Fig. 4 shows a vertical section of the device taken on the broken line A B in Fig. 3 and showing the top and bottom portions only of the device, the central portions being broken out to permit of the presentation upon a larger scale; Fig. 5 shows a sectional view taken on the irregular broken line C D of Fig. 3; Figs. 6 to 10, inclusive, show circuits of the complete device illustrated and embodying my improvement.

The frame 1 supports the insulating slab 2 upon which are mounted fixed contact parts of an electric switch, and before which moves the operating lever 3, carrying the moving parts of the switch. The lever 3 is pivotally held by the shaft 4 and carries two roller bearings 5 and 6. A central boss 11 is shown cast integrally with the frame 1. It carries the shaft 4 and is threaded to receive the lower end of the vertical rod 60. This part 11 is the only part of the frame which carries any strain and is in substance not a part of the frame but a part cast for convenience at the same time as the frame and may, if desired, be a separate integral part attached to the frame. The rod 60 extends vertically from the boss 11 and centrally through the frame to the top web 1′ of the frame. It carries at its top a cylindrical screw threaded nut 66 which has its upper face so cut that it may be turned by a screw-driver or by a wrench. The nut 66 is in engagement with the inner cylindrical surface of the boss 65 upon the upper web of the frame and serves by such engagement to aline the rod 60, but does not restrain it in any other way, the nut 66 being free to slide vertically within the boss 65. A movable carriage 7 slides upon the rod 60 and is sustained by engagement with rollers 5 and 6, engaging both of them upon the horizon-

tal track 7′ when the lever 3 is in its middle position, and engaging one or the other of them alone when the lever is moved to right or left. The moving of the lever to right or left forces the carriage 7 upward, sliding it upon the rod 60, regardless of the direction of movement of the lever, the carriage 7 being lifted further as the lever 3 moves away from its middle position in either direction, and being lowered as the lever 3 is returned toward its middle position.

The carriage 7 carries two resistors, each of two resistance elements or tubes; one pair of tubes being labeled 8 and the other 9. These resistors may be of any suitable type or number to be compressed as the carriage 7 is raised. The resistors are held slidably near the top by restraining bar 10 and a yielding abutment is provided, as follows: Each pair of resistor tubes has an equalizer bar 8′ 9′ against which the upper terminals of the resistor units impinge when they are lifted by the carriage 7. These two equalizer bars are connected by a pair of equalizer bars or yokes 12, 12′ which are pivotally attached by the screws 22, 22′ to the sliding sleeve 61 sliding upon the rod 60. Above the sleeve 61 is the washer 67′, the compression spring 67, and finally the nut 66. A projection 63 upon the sliding sleeve 61 is threaded to receive the screw-threaded portion of the alining dowel 62, which passes freely through a hole drilled in the boss 65 of the frame and whose function is to prevent the rotation of the sleeve 61 upon the rod 60. The part 62 has a further function in that by the addition of the slotted head 64 with its shoulder engaging the frame 1′, it serves as an adjusting part to determine the lower limit of motion of the sleeve 61. When by impingement of resistors 8 and 9 against the upper abutment the sleeve 61 is lifted, sliding along the rod 60, the dowel or guide 62 also is lifted and the head 64 is lifted away from the frame. When the resistors are lowered by the carriage 7 the upper abutment follows carrying sleeve 61 with it, until the head 64 engages the frame, at which time the sleeve and upper abutment members are arrested and cease to exert any pressure as an abutment upon the resistors even though the resistors may continue to descend, carried by carriage 7. It will be seen that by an adjustment of the part 62, which may be effected by the slot in the head 64, the point in the movement of carriage 7, and therefore in the movement of arm 3, at which the resistors are relieved from all pressure when arm 3 is returning toward normal and consequently at which pressure is initiated upon the resistors when arm 3 is moving away from normal, may be predetermined and adjusted. The spring 62′ provides a friction to prevent accidental movement of the part 62 which might tend also to unscrew in service.

The contact parts 31 to 36, inclusive, and 37 to 42, inclusive, mounted on the insulating slab 2, are so arranged as to be connected by the bridging brushes 43 and 44, respectively, mounted on the lever 3 but insulated from it and from each other, so as to form the switching or circuit changing element of the device when the lever 3 is moved to the right or left of its middle position. Since the movement of the lever also serves to compress or decompress the resistors and thereby alter the resistance included in the circuits of the motor or other translating device, it is seen that the movement of this lever accomplishes both the circuit commutation and the resistance varying functions simultaneously or in proper order. The details of the electrical circuits of these contact parts are shown in Figs. 6 to 10, inclusive, the contacts in said figures occupying similar positions to those shown in Fig. 1 and being numbered in accordance with the numbering of that figure.

The mechanical operation of the device is as follows: By a movement of arm 3 in either direction away from its middle position, one of the rollers 5 or 6 will lift carriage 7, sliding it upon rod 60, thus moving the lower ends of the resistors upward. The upper ends of the resistors also move upward at the same rate until the abutments 58 are engaged. At this time a compression of the resistor begins, the pressure at one end being exerted by carriage 7 and being sustained by the lower end of rod 60 through boss 11, shaft 4, lever 3, wheel 5 or 6 and carriage 7, and the pressure at the upper end being applied by abutments 58 and being sustained by the upper end of rod 60 through nut 66, spring 67, washer 67′, sleeve 61, pivot screws 22, 22′, yokes 12, 12′, equalizer bars 8′ 9′ and abutments 58. As this pressure is exerted through spring 67 and also through the compressible resistors, both of the elements will yield to some extent, resulting in the compression of the spring 67 and the lifting of sleeve 61, until such time as the lever 3 has reached its ultimate travel, at which time the ultimate compression upon the resistors will depend upon the compression of spring 67 which in turn depends upon the adjustment of nut 66 upon rod 60. It is to be noted that the frame of the device other than in the boss 11, is not included in the parts placed under stress when the resistors are compressed, but that the structural element carrying the stress from one end to the other of the resistors is the rod 60, an element adapted to be made of material of great tensile strength, and well adapted to sustain such

a stress. It is obvious that the adjusting screw 62 may be so set as to permit the abutments 58 to be at all times in contact with the resistors, if so desired, and that the nut 66 may be so set that in the progress of the movement of the sleeve 61, the successive turns of the spring 67 will make contact with each other, thereby providing a solid and unyielding abutment, all further movement of the carriage 7 resulting in direct compression of the resistors and thus attaining a high degree of compression. If an unyielding abutment for the upper end of the resistor is desired, the nut 66 may be screwed down until the spring 67 is closed, or a solid washer may be substituted for the spring 67, in which case the position of the upper abutment may be determined and adjusted by proper setting of parts 62 and 66, and the point of travel of the resistors at which engagement with the abutment is made may be predetermined and adjusted.

Referring to the circuit drawings, Figs. 6 to 10, inclusive—Figs. 6, 7 and 8 show circuits of the complete current controlling device connected for control of a series motor, Fig. 6 indicating circuits when starting in one direction; Fig. 7 the circuits for maximum speed of the motor in the same direction of rotation as in Fig. 6; and Fig. 8 showing the circuits when the motor is being started in the reverse direction. In each of these figures two resistors are shown, one at 8 and the other at 9, the two being in series. This corresponds to the wiring connections shown in the detail figures. Fig. 9 shows the complete device connected for control of a shunt-wound motor, an additional pair of contact plates 45 being provided in the switching elements for this purpose. Fig. 10 shows circuits of a similar device with additional contact plates, the connection being for control of a series motor equipped with an electromagnetic brake of a type used in elevator and hoisting machinery, whose magnet is shown at B.

In the construction shown in Figs. 1 to 5, inclusive, four resistor tubes are employed, two on each side. These tubes are connected in series, and it is evident that a smaller or a greater number may be employed if desired. For simplicity in illustration in the diagrams of circuit connections, only two tubes are shown in each diagram and it may be considered that the reference numeral 8 may indicate a single tube or it may indicate both of the tubes 8 of Fig. 4, for instance, while the numeral 9 may be taken as indicating a single tube or both of the tubes 9 in Fig. 4. When taken as indicating more than one tube, the tubes are to be considered as connected together in series.

Referring to Fig. 6, current enters over conductor 50, passing the contact plate 42, conductively-connected pair of brushes 44, contact plate 39, thence through the resistor 9 which is a pair of tubes in the detail figures, thence through armature 29 and resistor 8 (also a pair in the detail figures) to contact plate 33, bridged pair of brushes 43, contact plate 36, field winding 28, and returning over conductor 51. Referring to Fig. 7, the circuit may be traced similarly from 50 through 42, 44, 40, 29, 34, 43, 36, 28 to 51, from which circuit the resistances 8 and 9 have been eliminated.

Referring to Fig. 8, current entering over wire 50 passes through elements 41, 44, 38, 8, 29, 9, 32, 43, 35, 28 to 51, in which the direction through the armature 29 is reversed and therefore the direction of rotation of the armature is reversed.

Referring to Fig. 9, current passes from conductor 50 to junction point 50′, thence over the first path through 42, 44, 39, 9, 29, 8, 33, 43, 36 and 51. The second path is from junction point 50′ through 28, 45, 43 and 51, the brush 43 being in this case a triple bridged brush.

Referring to Fig. 10, the brake magnet B is required to be energized during all the time that the motor is in motion. In this figure, current entering on conductor 50 passes to the junction point 50′, thence through the brake magnet B to contact plate 45 and brush 43, also from the junction point 50′ through elements 42, 44, 39, 9, 29, 8, 33, 43, joining the circuit from the brake magnet B, and continues through contact plate 36 and field winding 28 and conductor 51.

While I have, in order to obtain uniformity between the apparatus drawings and the circuit diagrams, shown the resistor tubes connected in series, I do not wish to be limited to this form of connection, as it is obvious that numerous tubes and various combinations of series and multiple connections may be made without departing from the spirit of my invention.

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

1. In an electric current controller, a compressible resistor; a tension rod; means for compressing said resistor comprising two abutments situated one at each end of said resistor; further means connecting said abutments to the ends of said rod, and imposing a stress upon said rod when imposing a compression upon said resistor.

2. In an electric current controller, a compressible resistor, a tension rod, means for compressing said resistor comprising two abutments situated one at each end of said resistor, said abutments being attached also to the ends of said rod, and imposing a

stress upon said rod when imposing a compression upon said resistor; a frame supporting said devices; fixed switch elements also supported by said frame; a switch lever carrying movable switch elements and also supported by said frame, said switch lever being at the same time the operating lever for said compression means.

3. In an electric current controller, a compressible resistor; a rod constituting a tension member of the compression means for said resistor; an abutment at one end of said resistor and attached to one end of said rod; an abutment at the other end of said resistor and slidable upon said rod; and means attached to the remaining end of said rod for sliding said second abutment to compress said resistor.

4. In an electric current controller, a compressible resistor; a rod constituting a tension member of the compression mechanism for said resistor; a spring; an abutment at one end of said resistor and anchored to one end of said rod through said spring; an abutment at the other end of said resistor and slidable upon said rod; and means attached to the remaining end of said rod for sliding said second abutment to compress said resistor.

5. In an electric current controller, a compressible resistor; two abutments for said resistor and between which said resistor is compressed; a guide rod for said abutments and a sliding alining screw for one of said abutments preventing rotation upon said rod, and constituting also an adjusting element whereby the movement of said abutment in one direction is limited.

6. In an electric current controller, a compressible resistor; two abutments for said resistor and between which said resistor is compressed; a guide rod for said abutments and a screw constituting an alining pin and an adjustment limiting the movement in one direction of one of said abutments.

7. In an electric current controller, a compressible resistor; a tension member parallel thereto; abutments for compressing said resistor and slidable upon said tension member; a spring; and an adjusting nut upon said tension member and engaged by said last mentioned abutment through said spring.

8. In an electric current controller, a compressible resistor; a tension member; abutments for compressing said resistor, one anchored to said tension member and the other slidable thereon; and an operating lever pivotally attached to one end of said tension member, and acting to move the adjacent abutment to slide upon said tension member and to compress said resistor.

9. In an electric current controller, a compressible resistor; a tension member; abutments for compressing said resistor and slidable upon said tension member; means at one end of said tension member engaging the tension member and adapted to force the adjacent abutment slidably along said tension member to compress said resistor; and means at the other end of said tension member and adapted to obstruct the movement of the abutment adjacent thereto.

10. In an electric current controller, a compressible resistor; a tension member parallel thereto; abutments for compressing said resistor and slidable upon said tension member; means at one end of said tension member engaging the tension member and adapted to force the adjacent abutment slidably along said tension member to compress said resistor; a nut at the other end of said tension member and adapted to obstruct the movement of the abutment adjacent thereto; and a spring interposed between said last abutment and said nut, whereby the movement of said abutment is yieldingly resisted.

11. In an electric current controller, a tension rod, members affixed to the ends of said tension rod, a compressible resistor disposed parallel to said tension rod, two abutments for said resistor and disposed at the end thereof and slidable each upon said tension rod, and means interposed between one of said abutments and the adjacent end of the tension rod and adapted to force said abutment to compress said resistors against the other end of the tension rod.

12. In an electric current controller, a pair of compressible resistors; a tension rod; means for compressing said resistors comprising two abutments situated one at each end of said pair of resistors, said abutments engaging also the ends of said rod, through intermediate apparatus and imposing a stress upon said rod when imposing a compression upon said resistors.

13. In an electric current controller, a pair of compressible resistors; a tension rod parallel to said resistors and positioned between them; means for compressing said resistor comprising in part two abutments situated one at each end of said pair of resistors, said abutments being anchored upon the ends of said rod, and imposing a stress upon said rod when imposing a compression upon said resistors; a frame supporting said device; fixed switch elements also supported by said frame; a switch lever carrying movable switch elements and also supported by said frame, said switch lever being at the same time the operating lever for said compression means.

14. In an electric current controller, a plurality of compressible resistor units; a rod constituting a tension member of the compression means for said resistors; an

abutment at one end of said resistors and attached to one end of said rod; an abutment at the other end of said resistors and slidable upon said rod; and means attached to the remaining end of said rod for sliding said second abutment to compress said resistors.

15. In an electric current controller, a plurality of compressible resistor units, a rod parallel to said resistors and constituting a tension member of the compression mechanism for said resistors; a spring; an abutment at one end of said resistors and anchored to one end of said rod through said spring; an abutment at the other end of said resistor and slidable upon said rod; and means attached to the remaining end of said rod for sliding said second abutment to compress said resistor.

16. In an electric current controller, a plurality of compressible resistor units, two abutments for said resistors and between which said resistors are compressed; a guide rod for said abutments and a sliding alining screw for one of said abutments preventing rotation upon said rod, and constituting also an adjusting element whereby the movement of said abutment in one direction is limited.

17. In an electric current controller, a tension rod; members affixed to the ends of said tension rod; a compressible resistor disposed parallel to said tension rod; two abutments for said resistor and disposed at the ends thereof and slidable each upon said tension rod; means interposed between one of said abutments and the adjacent end of the tension rod and adapted to force said abutment to compress said resistors against the other end of the tension rod; and a spring included between an abutment and one end of the tension rod, whereby the applied force of compression is limited and regulated by the tension of said spring.

18. In an electric current controller, a compressible resistor; a rod parallel to said resistor and constituting a tension member of the compression mechanism for said resistor; a spring; an abutment at one end of said resistor and anchored to one end of said rod through said spring; an abutment at the other end of said resistor and slidable upon said rod; means attached to the remaining end of said rod for sliding said second abutment to compress said resistor; a frame supporting said parts; an electric switch supported by said frame; and a lever operating both said switch and the compression devices of said resistor.

19. In an electric current controller, a compressible resistor; two abutments for said resistor and between which said resistor is compressed; a guide rod for said abutments; a sliding alining screw for one of said abutments preventing rotation upon said rod, and constituting also an adjusting element whereby the movement of said abutment in one direction is limited; a frame supporting said parts; an electric switch supported by said frame; and a lever operating both said switch and the compression devices of said resistor.

20. In an electric current controller, a compressible resistor; a cylindrical tension member parallel thereto; abutments for compressing said resistor and slidable upon said tension member; an operating lever pivotally attached to one end of said tension member, and acting to move the adjacent abutment to slide upon said tension member and to compress said resistor; a frame supporting said parts; an electric switch support d by said frame; and a lever operating both said switch and the compression devices of said resistor.

21. In an electric current controller, a compressible resistor; a cylindrical tension member parallel thereto; abutments for compressing said resistor and slidable upon said tension member; means at one end of said tension member engaging the tension member and adapted to force the adjacent abutment slidably along said tension member to compress said resistor; means at the other end of said tension member and adapted to obstruct the movement of the abutment adjacent thereto; a frame supporting said parts; an electric switch supported by said frame; and a lever operating both said switch and the compression devices of said resistor.

22. In an electric current controller, a tension rod, members affixed to the ends of said tension rod, a compressible resistor disposed parallel to said tension rod, two abutments for said resistor and disposed at the ends thereof and slidable each upon said tension rod; means interposed between one of said abutments and the adjacent end of the tension rod and adapted to force said abutment to compress said resistors against the other end of the tension rod; a frame supporting said parts; an electric switch supported by said frame; and a lever operating both said switch and the compression devices of said resistor.

23. In an electric current controller, a compressible resistor, a lever for subjecting said resistor to compressive stresses, a base upon which said resistor and lever are mounted, and a tension member independent of said base for counteracting the compressive stresses imposed by said lever.

24. In an electric current controller, a plurality of compressible resistor units, a lever for subjecting said resistor units to compressive stresses, a base upon which said resistor units and lever are mounted, and a

tension member independent of said base for counteracting the compressive stresses imposed by said lever.

25. In a controller for an electric translating device, switch contacts for changing the circuits of said translating device, a compressible resistor for varying the resistance of said circuits, a lever for effecting said circuit and resistance changes, a base upon which said contacts, resistor and lever are mounted, and a tension member independent of said base for counteracting the compressive stresses in said resistor.

Signed by me at Milwaukee, county of Milwaukee and State of Wisconsin, in the presence of two witnesses.

LYNDE BRADLEY.

Witnesses:
LUELLA M. BASSE,
JOHN F. HARPER.