J. W. JEPSON.

ELECTRICAL SYSTEM AND APPARATUS THEREFOR.

APPLICATION FILED OCT. 2, 1908.

1,261,817.

Patented Apr. 9, 1918.

2 SHEETS—SHEET 1.

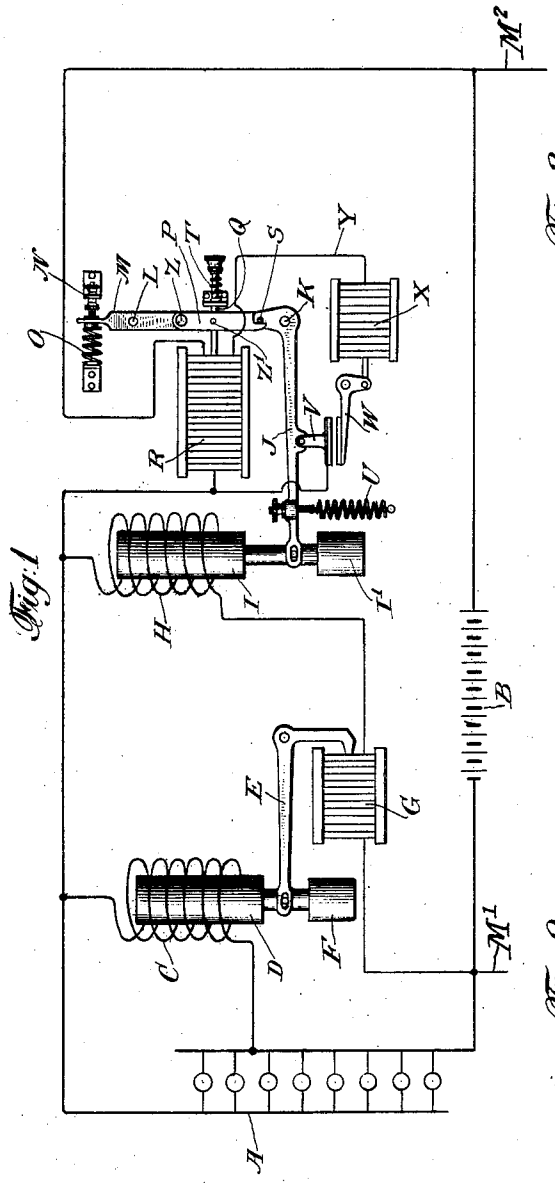


Fig. 1

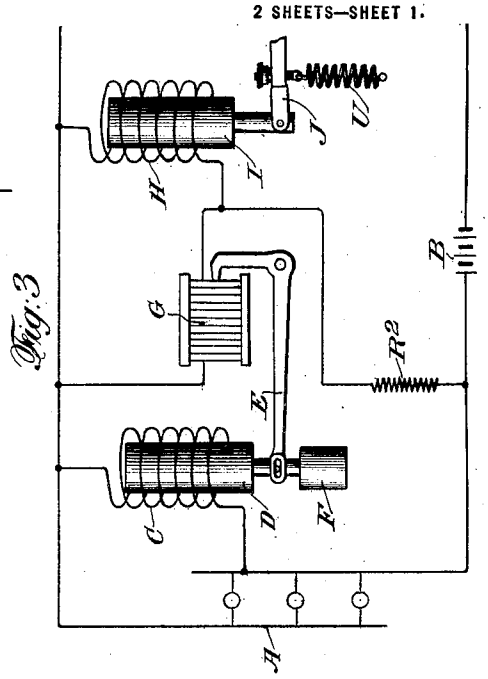


Fig. 3

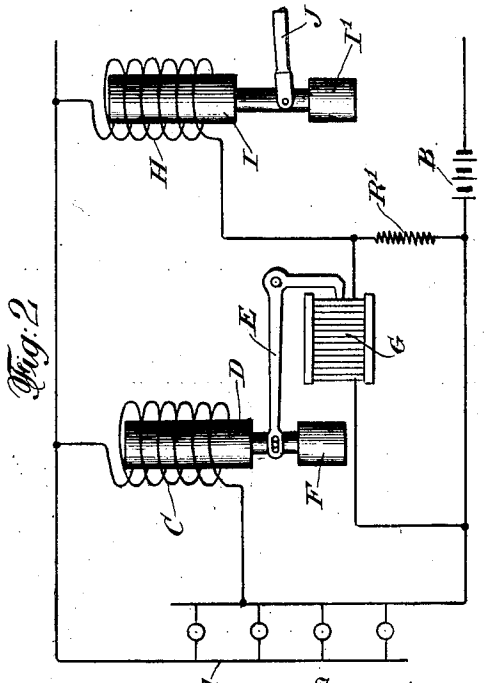


Fig. 2

Witnesses:
John O. Gunsler
W. A. Hutton

Inventor
John W. Jepson
By his Attorneys Kenyon & Kenyon

J. W. JEPSON.

ELECTRICAL SYSTEM AND APPARATUS THEREFOR.

APPLICATION FILED OCT. 2, 1908

1,261,817.

Patented Apr. 9, 1918.

2 SHEETS—SHEET 2.

Fig: 4

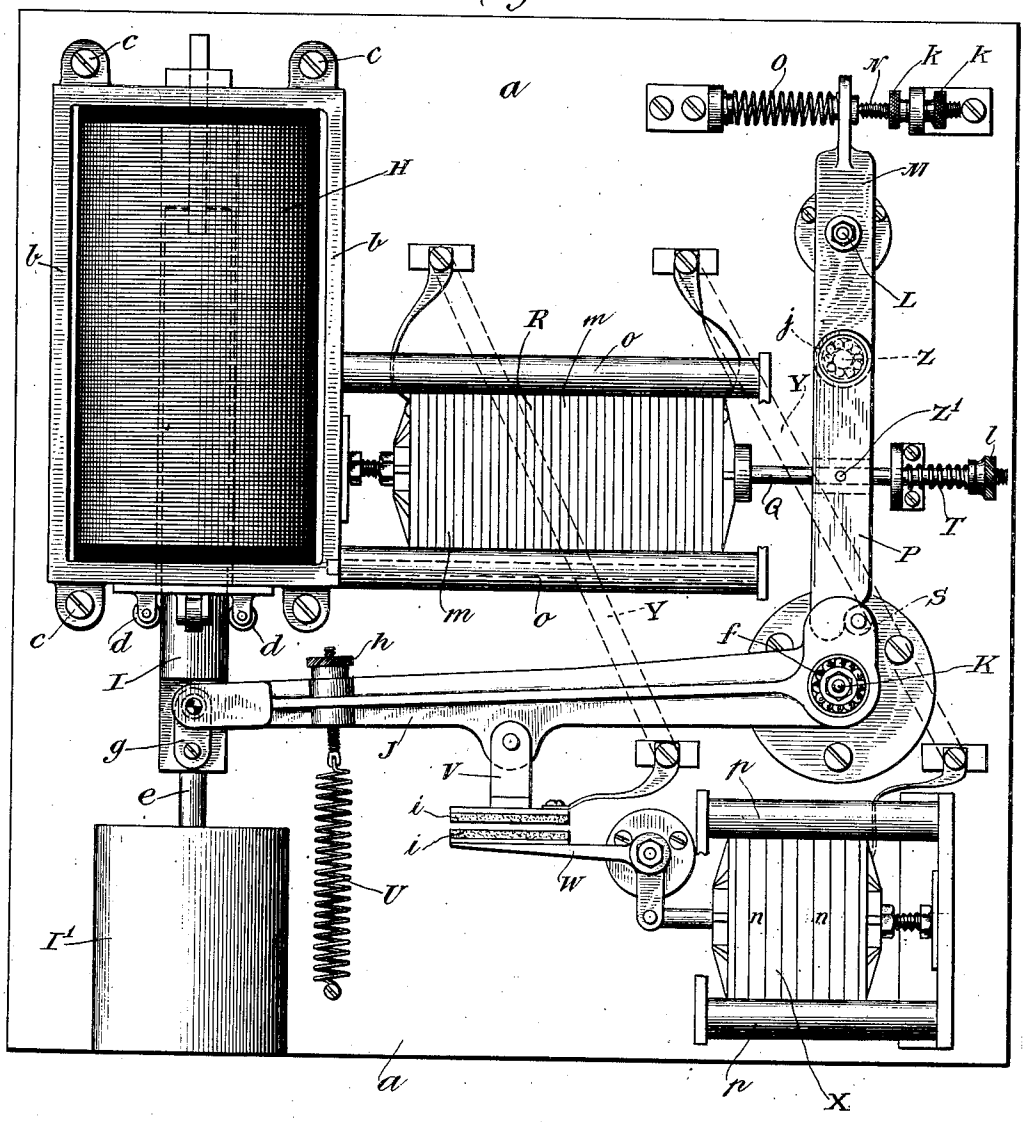
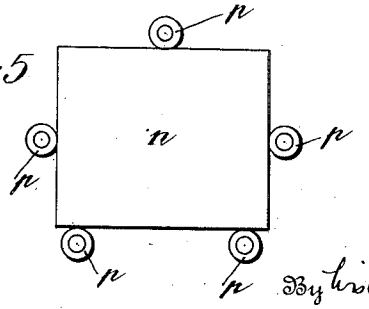


Fig: 5



Witnesses:
John O. Gempler.
W. A. Hutton.

John W. Jepson
Inventor

By his Attorneys Keuyon & Keuyon

UNITED STATES PATENT OFFICE.

JOHN W. JEPSON, OF NEW YORK, N. Y., ASSIGNOR TO GOULD COUPLER COMPANY, A CORPORATION OF NEW YORK.

ELECTRICAL SYSTEM AND APPARATUS THEREFOR.

1,261,817. Specification of Letters Patent. Patented Apr. 9, 1918.

Application filed October 2, 1908. Serial No. 455,873.

To all whom it may concern:

Be it known that I, JOHN W. JEPSON, a citizen of the United States, and residing in the borough of Manhattan, New York, N. Y., have invented certain new and useful Improvements in Electrical Systems and Apparatus Therefor, of which the following is a specification.

My invention relates to the regulation of electrical systems of distribution and more particularly to the regulation of the voltage applied to translating devices by means of a compressible variable resistance, the translating devices being supplied from a source having wide voltage variations, such as is common in car lighting systems wherein a generator and storage battery are commonly employed to alternately feed the translating devices or lamps, the generator being driven by the movement of the car and adapted to charge the battery and supply the translating devices when the car is running at sufficient speed, and the battery feeding the translating devices when the car is standing still. In such systems the voltage applied to the line feeding the translating devices is quite different when the battery is feeding the translating devices from what it is when the generator feeds the translating devices and charges the battery due to the difference between the charge and discharge voltage of the battery. In order to prevent these wide variations in voltage from falling upon the lamps or translating devices it has been suggested that an automatically controlled variable resistance be inserted in series between the battery and generator on one side and the lamps on the other side.

The carbon pile has been found to form a good variable resistance under certain conditions but in prior arrangements when used on cars it has not only been found that jarring and other causes seriously interfere with its proper operation, but also that it is inadequate in its range. It also is limited as to its minimum resistivity thereby causing a very considerable but useless loss of energy, which must be taken out of the battery, thereby making it necessary to increase the size of the battery for a given system which in turn increases the initial cost of the system, the maintenance cost, the cost of tonnage haulage, and the space taken up on the car. The last is a very important consideration. Various objects of my invention have been to provide a system in which the potential drop in the line varies in the proper proportion to the voltage variations across the generator or main source of electromotive force, also to overcome the serious objections above pointed out, and to provide a system in which the evil effects of jarring are substantially eliminated, and the rheostatic devices shall have adequate range to compensate for such wide variations of voltage as occur between charging and discharging of the battery, but yet be amply sensitive and still retain all the inherent advantages of the carbon pile if so desired and in which the size of the battery necessary and the space taken thereby are very materially decreased. A further object of my invention is to decrease the voltage drop across such a carbon pile after it has substantially reached its limit of compression, and to do so gradually, so that the voltage at the work circuit may be held substantially constant.

Further objects, advantages and features will more clearly appear from the detailed description given below taken in connection with the accompanying drawings which form a part of this specification.

In the drawings Figure 1 shows diagrammatically one form of my invention as applied to a system in which a storage battery is utilized.

Fig. 2 is a modification of the system shown in Fig. 1, certain parts being omitted.

Fig. 3 is another modification of the system shown in Fig. 1, certain parts being omitted.

Fig. 4 is a detail view of one form of my rheostatic devices.

Fig. 5 shows the manner in which I prefer to retain the carbon plates or blocks in position.

Referring to Fig. 1, A represents a lamp work circuit and B a storage battery which feeds the work circuit A when it is not otherwise supplied by the source of variable voltage applied to the circuit by the mains M', M^2. Across the work circuit A is connected a voltage coil, forming an electromagnet C. The electromagnet has a core D which is connected to and arranged to operate a pivoted lever E. The core D is also connected with a dash pot F to relieve the

parts of relative vibration due to jarring and other causes. The lever E is arranged to compress the carbon pile G which is connected across the work circuit and has in series therewith the solenoid of an electromagnet H. The electromagnet H has a core I arranged to operate a lever J pivoted at K. The core I is also connected with a dash pot I'. Pivoted at L is a movable member M the upper end of which is held quite firmly against the top N by a spring O. Pivoted at Z to the lower end of the movable member M is a lever P which has a rod Q, pivoted thereto at the end of its short radius of motion near its center at Z'. The rod Q is provided with means for contacting with the end block of the carbon pile R and is arranged to compress the blocks of the pile R when properly operated upon. The long radius of motion or lower end of the lever P is acted upon by a roller on the short arm or at the short radius of motion of the lever J. Spring T tends to retain the parts in a retracted position and take up all lost motion in the various parts. The spring U operates on the lever J in opposition to the electromagnet, H, to compress the carbon pile R which is connected in series with the work circuit A and is arranged to vary the resistance to said circuit. Pivotally mounted on the lever J is one member V of a switch arranged to open and close a circuit Y which is in shunt with the variable resistance R. The other member W of this switch is in the form of a lever which is arranged to compress or operate the carbon pile X connected in the shunt circuit Y. The details of the electromagnet H, resistances R and X and appurtenant mechanism are more clearly shown in Fig. 4.

Referring to Fig. 4 *a* represents a base to which various of the parts of one form of the rheostatic device are secured. The coil H is secured thereto by the frame *b* and screws *c*. The core I is guided in its movement by anti-friction rollers *d* secured to the frame work *b*. A rod *e* is secured to the lower end of the core I and has upon its lower end a plunger for operating in the dash pot I' in the usual manner. The lever J, pivoted at K, is provided with ball bearings, *f*, and the long arm, or long radius of motion, of this lever is pivoted to a short link *g* which in turn is pivoted to the core I. The tension exerted by the spring U may be adjusted by the thumb nut *h*. Both the switch member V and the long arm of lever W are provided with carbon contact plates *i* to prevent injurious sparking. The pivotal point Z is formed with ball bearings *j* and the various other pivotal points of the devices may be likewise formed if so desired. The stop N may be adjusted by means of thumb nuts *k* and the tension exerted by the spring T may be adjusted by a thumb nut *l*. The various carbon plates or blocks *m* and *n* of the piles R and X rest upon and are held in position by porcelain tubes *o* and *p* respectively. The arrangement of the tubes about the carbon pile is clearly shown in Fig. 5.

The operation is as follows: The electromagnet C being connected across the work circuit is responsive to all changes in voltage across said circuit. The electromagnet C with its core D operates the lever E to compress the carbon pile G when the voltage across the work circuit rises. This decreases the resistance of the carbon pile G and allows more current to pass through the coil of the electromagnet H. Thereupon the lever J is pulled upwardly reducing the pressure on the carbon pile R, causing it to have a greater resistance, thus cutting down the voltage at the lamps of the work circuit to bring said voltage back to its normal value. If the voltage at the work circuit falls below its normal value, the current in the electromagnet C is decreased thus releasing the pressure on the carbon pile G and cutting down the current in the electromagnet H. This allows the spring U to operate upon the levers J and P to compress the Pile R thus cutting down its resistance and increasing the voltage at the work circuit until it reaches its predetermined normal value. Thus far, it may be considered that the point Z has acted as the pivotal point of the member P, but when the carbon pile R has substantially reached the limit of its compression the point Z' becomes the pivotal point of the lever P which now moves the movable member M about the point L against the action of the spring O. This allows further movement of the lever J to be had which brings the switch members V and W together thus closing the shunt circuit Y and still further cutting down the resistance to increase the voltage at the work circuit. Further movement of the member J causes the lever W to operate upon the carbon pile X to compress the same. This still further cuts down the resistance of the pile X and consequently cuts down the resistance to the work circuit A and the voltage drop across the compressible resistance rheostat R to bring the voltage across the work circuit back to its normal value. Thus the range of the rheostatic devices is greatly increased and made amply great enough to take care of all fluctuations and variations that fall upon the system, and also the voltage drop across the pile R is slowly and gradually reduced and maintained at any of a plurality of graduations during such reduction after the pile has substantially reached its stage of maximum compression, so that substantially no energy is lost between the battery and work circuit, and with a given voltage at the work

circuit the battery may be just so much smaller, as it does not have to provide for the usual voltage drop across the pile R. Furthermore, this decrease in drop across the pile R after it has substantially reached its stage of maximum compression, is accomplished gradually so that it does not materially vary or affect the voltage at the work circuit. It will be noted that as the lever J moves downwardly under the action of the yielding means U and against the action of the yielding means O and the electro-responsive device H, to vary the resistance of the pile, it closes the switch at *i i* at a predetermined stage in the compression of the pile, the switch at *i i* being in circuit in shunt relation with respect to the pile. It is clear that certain advantages will be had in increasing the range of the pile in other ways and even the pile X may be omitted altogether, although there are certain additional advantages in its use.

The spring O permits movement of the lever J, etc., without altering the resistance of the pile R. The spring O limits the pressure exerted on the pile R and acts also as means for compensating for the expansion of the pile due to heat, since it permits the lever J to move downwardly to operate the shunt circuit even although the pile R has expanded, which would ordinarily tend to limit the downward movement of the lever J. The pivotal point Z is on that part of the member M which is movable with respect to the pile as a whole. It will also be noted that the member Q is operated upon by the member P movably connected therewith, and the member P is operated upon by the member J movably connected therewith, so that by thus compounding the members it takes a considerable movement of the core I to produce a slight change in the pressure on the compressible rheostat R. These features taken with the springs form a most compact and yet efficient and long range lamp regulator for car lighting systems.

The system may be operated without the electromagnet C and variable resistance G by connecting the electromagnet H directly across the work circuit. It is, however, very advantageous to use the magnet C and resistance G since these devices greatly magnify the effect of the voltage variations upon the electromagnet H, thus giving much better and closer regulation and enabling the various parts to operate with greater smoothness and accuracy.

Referring to Fig. 2 the system there shown is substantially the same except a resistance R′ has been inserted in shunt with the carbon pile G. Under certain conditions this arrangement may be preferred. In this figure certain parts have been omitted as they are clearly shown in Fig. 1.

Fig. 3 shows a still further modification some of the parts being omitted as in Fig. 2. In Fig. 3 a resistance R^2 is placed in series with the electromagnet H and the carbon pile G is placed in shunt with the electromagnet H. The operation of the lever E is reversed so that upon an increase in current in the electromagnet C the pressure on the pile G is reduced thus increasing its resistance and causing more current to pass through the coil of the electromagnet H. Under some conditions this arrangement may be preferred.

It will be understood that the devices and mechanism shown in Fig. 4 may well be substituted for the electromagnet C, resistance G and appurtenant mechanism and I desire it to be understood that my invention fully contemplates such an arrangement.

The porcelain tubes *o* and *p* form exceptionally good means for supporting the carbon blocks since they insulate the blocks from the surrounding mechanism and allow the block to slide back and forth with substantially no friction, the blocks bearing tangentially upon the tubes. The ball bearings *f* and *j* also decrease the friction in the mechanism and tend to considerably increase the sensitiveness of the device. The dash pots F and I′ and the spring T prevent any jarring movements from being communicated to and affecting the variable resistances and the rollers *d* maintain the core I in alinement so that the dash pot F will always act efficiently and effectively.

Although I have described my invention with much detail I do not desire to be limited to the exact details shown and described, but, having thus fully and clearly described the same what I claim and desire to secure by Letters Patent, is:

1. The combination of a compressible variable resistance, electroresponsive means controlling the operation of said resistance, and means adapted to gradually reduce the voltage drop across said resistance and maintain it at any of a plurality of gradations during such reduction, after the resistance has substantially reached its stage of maximum compression, said last mentioned means being also controlled by said electroresponsive means.

2. The combination of a compressible variable resistance and means for gradually reducing the voltage drop across said resistance and maintaining it at any gradation during such reduction after the resistance has substantially reached its stage of maximum compression, said resistance and said means being electro-responsively controlled.

3. The combination of a compressible resistance rheostat and means for gradually reducing the voltage drop across said resistance by gradually shunting current from the resistance to maintain said voltage drop

at any gradation during such reduction after the resistance has substantially reached its stage of maximum compression, said rheostat and said means being electro-responsively controlled.

4. The combination of a rheostat and means gradually reducing the voltage drop across said rheostat and maintaining it at any of a plurality of gradations during such reduction after said rheostat has substantially reached its limit of operation, said rheostat and said means being electro-responsively controlled.

5. The combination of a compressible resistance rheostat, electroresponsive means controlling the operation of said rheostat, and means adapted to gradually reduce the voltage drop across said rheostat and maintain it at any of a plurality of gradations during such reduction after said rheostat has substantially reached its limit of operation, said last mentioned means embracing shunting means for said resistance and said last mentioned means being controlled by said electroresponsive means.

6. The combination of an electrical circuit, a carbon pile in said circuit, an electro-magnetic solenoid operating said pile to vary its resistance, and means adapted to gradually reduce the voltage drop across said resistance and maintain it at any of a plurality of gradations during such reduction after said pile has been compressed substantially to its maximum, whereby the resistance of said circuit may be further reduced after the pile has been compressed, said last mentioned means being controlled by said solenoid.

7. An electric regulator comprehending resistance varying means comprising a member for varying the resistance under variations in mechanical pressure applied thereto, a yielding member normally tending to increase said pressure, a yielding member limiting the pressure exerted by said first named yielding member, and electro-magnetic means coöperating with said yielding members in determining said pressure.

8. The combination of a carbon pile resistance, a member for varying the pressure applied thereto, a resilient member normally tending to increase said pressure, a resilient member limiting the pressure exerted by said first named resilient member, and electro-responsive means coöperating with said resilient members to determine the pressure on said pile.

9. The combination of a carbon pile resistance, a member for varying the pressure applied thereto, a resilient member normally tending to increase said pressure, a resilient member limiting the pressure exerted by said first named resilient member, shunting means for said pile after the pile has reached said stage of limiting pressure, and electro-responsive means coöperating with said resilient members to determine the pressure on said pile.

10. The combination of a carbon pile resistance, a member for varying the pressure applied thereto, a resilient member normally tending to increase said pressure, a resilient member limiting the pressure exerted by said first named resilient member, means for shunting said pile and gradually decreasing the voltage drop across the pile after the pile has reached said stage of limiting pressure, and electro-responsive means coöperating with said resilient members to determine the pressure on said pile.

11. An electric regulator comprehending resistance varying means, movable means the motion of which operates the same, means whereby motion may be imparted to said movable member without operation of the resistance varying means, and means whereby the effect of said resistance varying means is independently and gradually modified responsive to said motion.

12. The combination of a compressible resistance rheostat, electro-responsive means for controlling the operation of said rheostat and means adapted to gradually decrease the voltage drop across said resistance and maintain said drop at any of a plurality of gradations during such decrease after it has substantially reached its stage of maximum compression, said last mentioned means embracing a switch and means for shunting the rheostat, both controlled by said electro-magnetic means.

13. The combination of a compressible resistance rheostat, a movable member acting on said rheostat, a second movable member movably connected with the first, a third movable member movably connected to move said second movable member, a spring acting on said third movable member to compress the rheostat, and electro-responsive means acting in opposition to said spring to release the pressure on said rheostat, and a spring for permitting further movement of said second movable member after said rheostat has substantially reached its stage of maximum compression.

14. The combination of a compressible resistance rheostat, a movable member acting on said rheostat, a second movable member movably connected with the first, a third movable member movably connected to move said second movable member, a spring acting on said third movable member to compress the rheostat, and electro-responsive means acting in opposition to said spring to release the pressure on said rheostat, and a spring for permitting further movement of said second movable member after said rheostat has substantially

reached its stage of maximum compression, and means whereby the voltage drop across said rheostat is gradually decreased during such further movement.

15. The combination of a compressible resistance rheostat, a movable member acting on said rheostat, a second movable member movably connected with the first, a third movable member movably connected to move said second movable member, a spring acting on said third movable member to compress the rheostat, and electro-responsive means acting in opposition to said spring to release the pressure on said rheostat, and resilient means for taking up lost motion between said first and second movable members.

16. The combination of a compressible resistance rheostat, an electro-responsive device for controlling pressure exerted thereupon, a resistance, and means for connecting it in shunt with respect to said rheostat when the rheostat has reached a point of low resistivity.

17. In an electrical device of the class described, a carbon pile, means for compressing said pile, an electro-magnet and core for operating said means, a second carbon pile, and a switch arranged to place said second carbon pile in shunt with the first.

18. In a device of the class described, a carbon pile, means for operating said pile, electro-responsive means for operating said means, a second carbon pile, a switch for connecting said second carbon pile in circuit, said switch having carbon contact surfaces, and arranged to be closed by the movement of said first mentioned means.

19. Regulating apparatus including a carbon pile, a controlling coil therefor, and a second carbon pile electrically connected with the first and a switch arranged to cause said second carbon pile to be brought into operation at a predetermined point in the operation of the first.

20. In an electrical device of the class described, a carbon pile, a lever for operating the same, an electro-magnet for operating said lever, a second carbon pile arranged in a shunt circuit with the first, a switch in said circuit operated by said lever, and means for compressing said second pile controlled by said lever, said switch being so arranged that the shunt circuit is closed when the first mentioned pile has reached a point of low resistivity.

21. In an electrical device of the class described, a carbon pile, a lever for operating the same, an electro-magnet for operating said lever, a second carbon pile arranged in a shunt circuit with the first, a switch in said circuit operated by said lever, and means for compressing said second pile controlled by said lever, said means being so arranged that it is not brought into operation until said first mentioned pile has reached a point of low resistivity.

22. In a device of the class described, a variable resistance, mechanism for operating said variable resistance, an electro-magnet for operating said mechanism, a second variable resistance arranged in a shunt circuit with the first variable resistance, a switch in said circuit and means for closing said switch and operating said second variable resistance at a predetermined point in the operation of the first mentioned variable resistance.

23. In a device of the class described, a carbon pile, a shunt circuit around said carbon pile, a switch for closing said shunt circuit, electro-responsive means for operating said pile and said switch at a predetermined point in the operation of said pile, said switch having carbon contact surfaces for closing the shunt circuit.

24. In an arrangement of the class described, a carbon pile, a lever having long and short radii of motion with its short radius of motion operating upon the pile, a second lever having long and short radii of motion with its short radius of motion acting on the long radius of motion of the first lever, and an electromagnet operating upon the long radius of motion of the second lever to operate the pile to vary its resistance.

25. In an electrical device of the class described, a carbon pile, an electro-magnet and core, a lever operated thereby, a second lever operated by the first mentioned lever for compressing said pile, and resilient means for maintaining said two levers in contact with each other.

26. In a device of the class described, a carbon pile, a lever for compressing said pile, a second lever for operating the first mentioned lever, means for moving the last mentioned lever to compress the carbon pile, means for preventing the occurrence of lost motion between said levers, and means for permitting further movement of said last mentioned lever after said pile has reached its limit of compression.

27. In a device of the class described, a carbon pile, a pivoted lever for compressing said pile and means whereby the pivotal point of said lever may be moved when the pile has substantially reached its maximum compression.

28. In a device of the class described, a carbon pile, a switch, a lever for compressing said pile, a second lever for operating said first mentioned lever, means for moving the last mentioned lever to compress the carbon pile, and means for permitting further movement of said last mentioned lever after said pile has reached its limit of compression, to operate said switch.

29. In an electrical device of the class described, a carbon pile, an electro-magnet and

core, a lever operated thereby, a second lever operated by the first mentioned lever for compressing said pile, and a movable member to which said second lever is pivoted, a stop for said member, said movable member being resiliently held against said stop.

30. In an electrical device of the class described, a carbon pile, an electro-magnet and core, a lever operated thereby, a second lever operated by the first mentioned lever for compressing said pile, the pivotal point of said second lever being resiliently held in position.

31. In an electrical device of the class described, a carbon pile, an electro-magnet and core, a lever operated thereby, a second lever operated by the first mentioned lever for compressing said pile, and a movable member to which said second lever is pivoted.

32. In an electrical device of the class described, a carbon pile, a lever for compressing said pile, a circuit in shunt to said pile, means for opening and closing said shunt circuit operatively related to said lever, and means for compensating for the expansion of said pile due to heat.

33. An electric regulator, comprising a plurality of carbon pile resistances, and means common to both for increasing the pressure thereon, the compression of one of said carbon piles being delayed until the compression on the other of said carbon piles has reached a predetermined maximum.

34. In a system of electrical distribution, translating devices and a voltage regulator for the translating devices, comprehending a voltage governed rheostat having always an appreciable resistance and voltage varying means in shunt relation thereto, having during its operation a point of resistance less than the minimum resistance of said rheostat.

35. In a system of electrical distribution, the combination with an electrical supply circuit, a storage battery and lamp or translation circuit fed thereby, of means for regulating the voltage on the lamps or translation circuit comprising a carbon pile rheostat in series therewith, the pressure on which is governed by variations in voltage and a voltage controlled compressible carbon pile for gradually reducing the voltage drop across said rheostat after it has substantially reached its stage of maximum compression.

36. In a system of electrical distribution the combination of a supply circuit generator, a storage battery and translating devices in operative relation thereto, voltage controlled compressible carbon pile resistance means for maintaining the voltage on the translating devices substantially constant during variations in voltage across the battery, and an automatically controlled carbon pile for reducing the voltage drop across said resistance means, after it has substantially reached its stage of maximum compression.

37. Means for regulating an electric circuit, comprehending a plurality of carbon pile resistances in operative relation to said circuit, automatic means for varying the resistance of said piles, and means for changing the electrical mutual relationship of said piles at a predetermined stage in the operation thereof.

38. An electrical system of distribution, comprising a supply circuit, a storage battery and translating devices in operative relation thereto, a regulator for regulating the voltage on the translating devices comprehending a plurality of carbon piles, means for effecting the compression of said piles responsive to voltage fluctuations, and means whereby the mutual electrical relationship of said piles is changed at a predetermined stage in the operation thereof.

39. A system of electrical distribution, comprising a supply circuit, a storage battery and translating devices in operative relation thereto, two carbon piles in series between the battery and translating devices, and in shunt relation to one another, means for operating one pile to maintain the voltage across the translating devices substantially constant and means whereby the other pile is adapted to be compressed when the battery supplies the translating devices.

40. Means for regulating an electric circuit comprehending a regulating element, means for regulating the value thereof, a variable resistance in shunt to said regulating element and means whereby the regulating element operating means operates to increase and decrease said variable resistance without appreciably varying the regulating element.

41. Means for regulating an electric circuit comprehending regulating means, operating means therefor, means for diverting current around said regulating means and means whereby the diverting means is operated by said operating means without appreciably affecting the regulating means.

42. Means for regulating an electric circuit comprehending a carbon pile having a substantially definite range of operation, operating means controlling the same, a variable resistance in shunt to said carbon pile and means whereby the operating means affects said variable resistance and is free to operate the carbon pile throughout certain movements without affecting said variable resistance.

43. Means for regulating an electric circuit comprehending a regulating element, electromagnetic means for controlling the same, a regulating element in shunt to the first named regulating element and means whereby the operating means affects the lat-

ter regulating element and operates the first regulating element throughout substantially its range without affecting the second regulating element.

44. In combination with an electric circuit, means for regulating the same, comprehending a plurality of regulating elements, means for controlling the latter, responsive to fluctuations in said circuit, operating one of the elements for substantially its full range, and then affecting another element while both said elements remain connected with said circuit.

45. The combination with a work circuit, of a resistance connected therewith; means for varying said resistance by varying the pressure thereon; an electro-magnet for controlling said means; a variable resistance in shunt with said magnet to control the same; and automatic means responsive to conditions in the work circuit for varying said last mentioned resistance.

46. The combination with a translation circuit, of a regulator connected therewith comprising a resistance adapted to be decreased by increasing the pressure thereon; an electro-magnet for varying the pressure applied to said resistance; a variable resistance in shunt with said magnet to regulate the same; and means connected across the said translation circuit and responsive to the voltage thereof for varying said last-named resistance.

In testimony whereof, I have signed my name to this specification, in the presence of two subscribing witnesses.

JOHN W. JEPSON.

Witnesses:
THOS. DOBBINS,
W. H. PATTENDEN.