No. 789,822. PATENTED MAY 16, 1905.

T. A. SWARTS.

AUTOMATIC ELECTRIC CURRENT REGULATOR.

APPLICATION FILED FEB. 29, 1904.

2 SHEETS—SHEET 1.

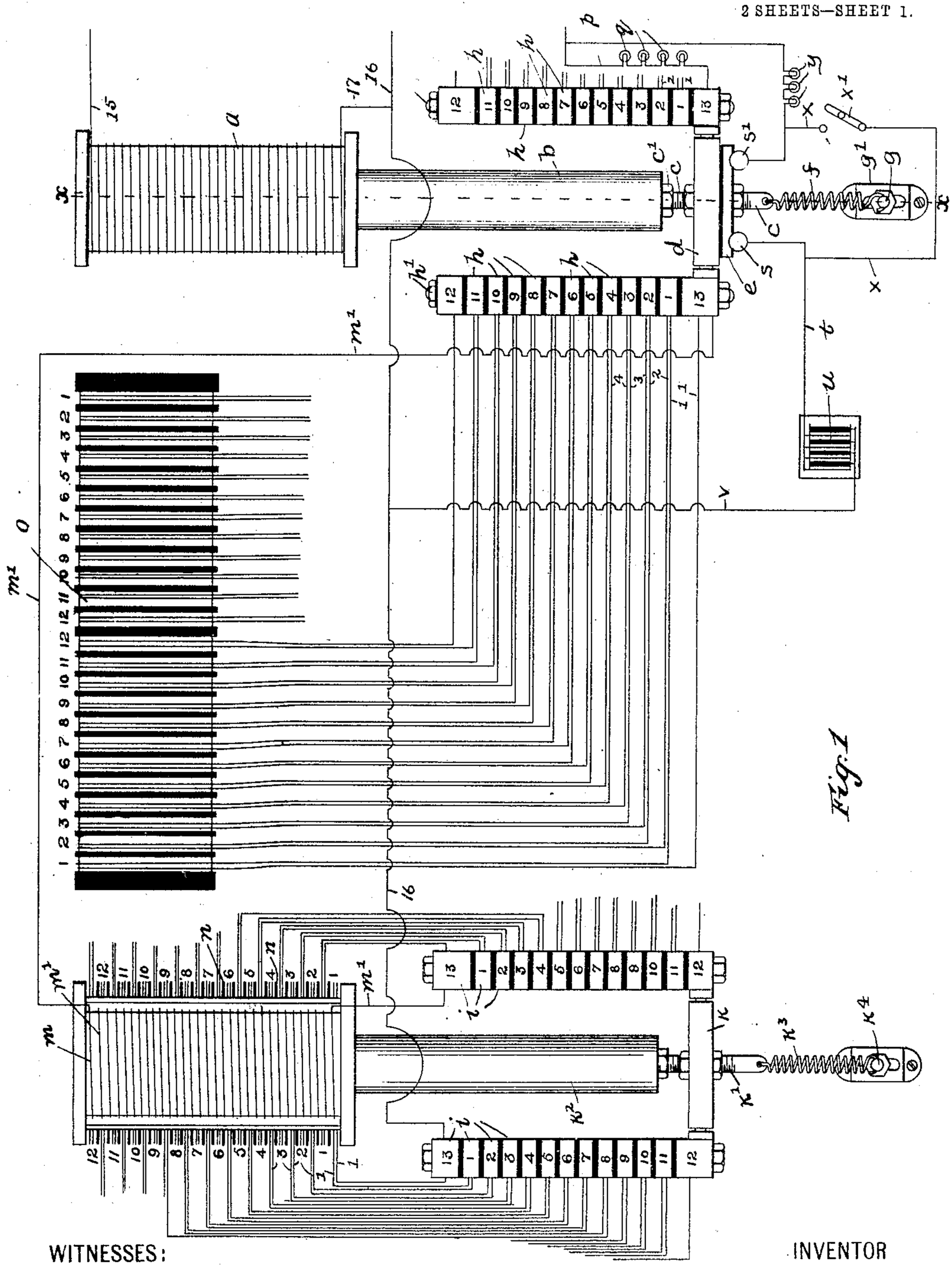

Fig. 1.

WITNESSES:

H. B. Bradshaw

A. L. Phelps

INVENTOR

Thomas A Swarts

BY

Shepherd & Parker

ATTORNEYS.

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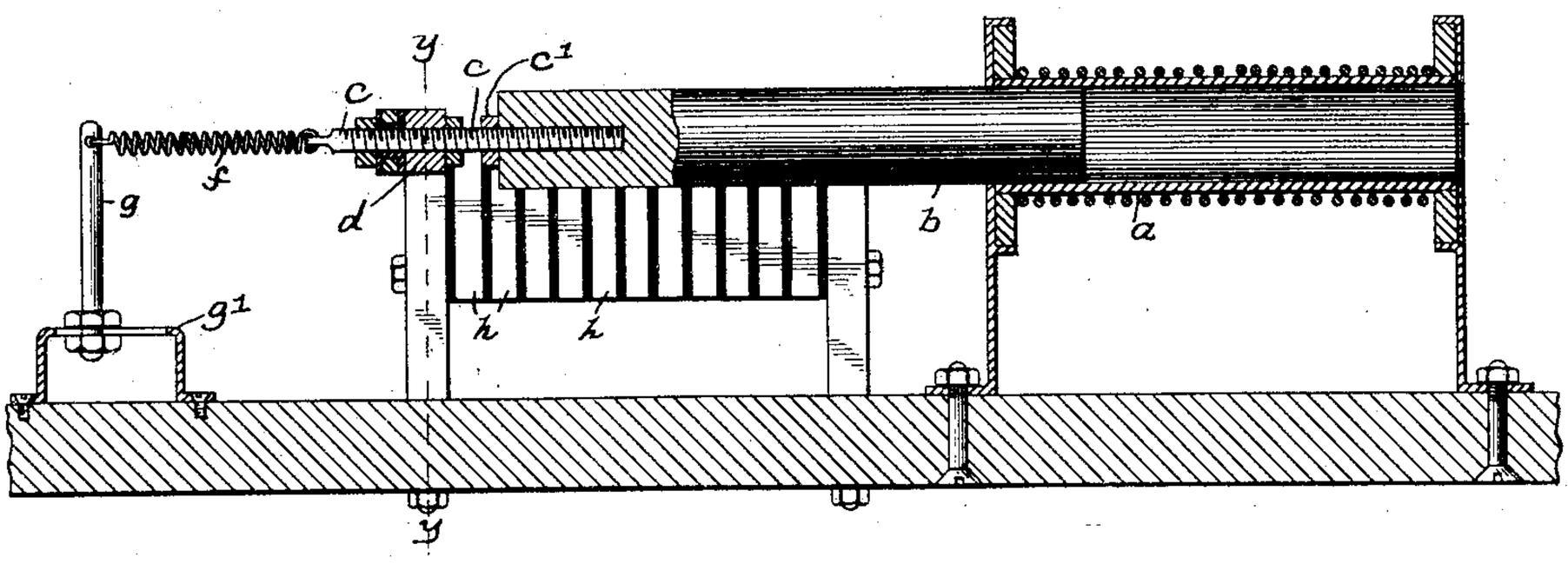

Fig. 2.

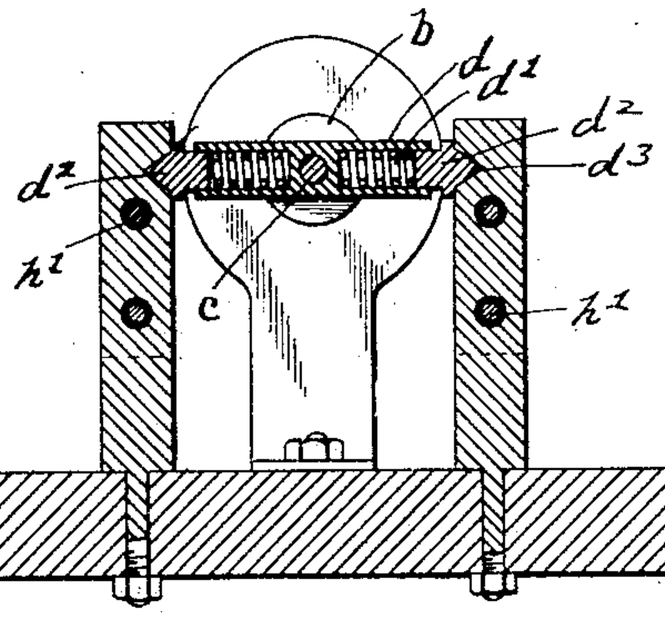

Fig. 3.

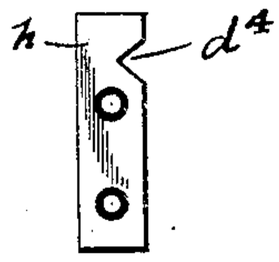

Fig. 4.

WITNESSES:

H. B. Bradshaw

A. L. Phelps

INVENTOR

Thomas A. Swarts

BY

Shepherd & Parker,

ATTORNEYS

No. 789,822. Patented May 16, 1905.

UNITED STATES PATENT OFFICE.

THOMAS A. SWARTS, OF COLUMBUS, OHIO.

AUTOMATIC ELECTRIC-CURRENT REGULATOR.

SPECIFICATION forming part of Letters Patent No. 789,822, dated May 16, 1905.

Application filed February 29, 1904. Serial No. 195,715.

To all whom it may concern:

Be it known that I, THOMAS A. SWARTS, a citizen of the United States, residing at Columbus, in the county of Franklin and State of Ohio, have invented a certain new and useful Improvement in Automatic Electric-Current Regulators, of which the following is a specification.

My invention relates to the improvement of automatic electric-current regulators, and has particular relation to that class of regulators which are adapted for use in maintaining a uniform current for lighting purposes when said current is required to be reduced and is subject to variation.

The objects of my invention are to provide an improved current-regulating system of this class adapted for use where the supply-current is subject to variation or fluctuation, to so construct and arrange my improved system as to adapt the same particularly for use on electrically-operated cars, to provide, in conjunction therewith, improved means for maintaining the electric lamps in a lighted condition when the main or supply current is cut off, and to produce other improvements the details of which will be more fully pointed out hereinafter. These objects I accomplish in the manner illustrated in the accompanying drawings, in which—

Figure 1 is in the nature of a diagram illustrating the relation of the parts and the nature of the connections between the same. Fig. 2 is a sectional view of a portion of the construction, said view being taken on line *x x* of Fig. 1. Fig. 3 is a transverse section on line *y y* of Fig. 2, and Fig. 4 is a face view in elevation of one of the contact-segments which I employ in the manner hereinafter described.

Like characters indicate like parts throughout the several views.

In carrying out my invention I employ a suitably-supported solenoid-coil *a*, within which is adapted to move in the usual manner a core *b*, the outer end of this core being connected, through the medium of a screw extension *c*, with a transverse contact-bar *d*, the latter being formed, as indicated in Fig. 3 of the drawings, with end sockets, in which are contained coil-springs *d'*. d^2 represents contact-heads, the shanks of which are inserted into the mouths of said sockets and caused to bear against the springs *d'*. The heads d^2 are preferably formed with pointed or wedge-shaped terminations d^3. The outer side of the contact-bar *d* is provided with a projecting contact-plate *e*, and the outer end of the screw *c* is connected with a spring *f*, the remaining end of which is connected with a post *g*, the latter being adjustably mounted upon a suitable bracket *g'*. The core *b* and screw *c* are adjustably connected through the medium of a nut *c'*, which is carried on said screw and which is adapted to abut against the outer end of the core.

On opposite sides of the fore *b* when the latter is extended I provide contact structures each consisting of a plurality of plates *h*, insulated one from the other and connected together by bolts *h'*. The outer plate of each of these contact structures is for the sake of convenience in illustration and description numbered 13, while the remaining plates are likewise numbered consecutively from 1 to 12 in Fig. 1 of the drawings. It will be observed that the plates of one of the contact structures is out of horizontal alinement with the corresponding plates of the remaining structure and that the pointed terminations d^3 of the contact-heads d^2 are movably supported in correspondingly-shaped inner side channels of the contact structures, said channels being formed, as indicated more clearly in Figs. 2 and 3 of the drawings, by producing in the plates *h* V-shaped notches d^4. I also provide another pair of opposing contact structures the plates of which are indicated at *i*, the arrangement of these plates and their structure conforming to the construction and arrangement of the plates *h* of the first-described contact structures. Of these plates 13 what we will term the "inner end plates" are numbered on the drawings as 13, and from said plates 13 the remaining plates are numbered consecutively up to and including the numeral 12. Between the contact structures composed of the plates 1, insulated one from the other, I provide a contact-bar *k*, the latter conform-

ing in construction to the bar *d* and being adapted to slide or move in said contact structures, as prescribed for the bar *d*. The bar *k* is likewise pressed by a screw *k'*, which is adjustably connected with one end of a core k^2 and which at its other end is connected with a spring k^3, the remaining end of which is connected with an adjustable post k^4, corresponding with the post *g*. The core k^2 is adapted to move in the usual manner within a solenoid-coil *m*, the body of the latter being in the nature of a spool. The exterior of said spool is provided with a plurality of wire coils which are arranged at a distance one from the other and which are preferably insulated one from the other, as indicated at *n*. A portion of these coils are made up of wires which run from one of the contact structures formed of the plates *i* to said coil-body, and an equal number thereof are made up of wires which run from the plates *i* of the opposing contact structure to said coil-body. For example, the wire which is marked 1 on the left side of the core k^2 leads from the contact plate or section 13 to and about the solenoid-coil body, thence to the plate or section 1, which adjoins said plate or section 13. From the section 1 a wire 2 leads to and about the coil-body, thence to the section 2, and from the section 2 a wire 3 leads to the coil and thence to the section 4, this order of connection being continued throughout the wires, which are numbered from 1 to 12 consecutively, and throughout the contact-plates, which are numbered as heretofore described. Leading from the plates *i* of the opposing contact structure are wires numbered from 1 to 12 consecutively, which are also coiled upon said coil-body or spool, these last-mentioned coils being formed between the coils first described and the wires forming said last-mentioned coils being connected with the plates of said last-mentioned contact structure in the manner prescribed for the connection of the first-mentioned numbered wires with the plates of the first-mentioned contact structure.

o represents a resistance-coil which comprises a suitable body on which is wound two sets or groups of wires, one of these sets or groups being shown in the drawings on one side of the center of the length thereof and the remaining set on the other side of said center. The group of wires to the left of the center in the drawings are for convenience in illustration numbered from 1 to 12 consecutively. One end of the wire 1 of the group to the left leads from the outer contact-plate 13 of one of the contact structures which are formed of the plates *h* to the body *o*, about which it is coiled, and its remaining end is connected with the plate *h*, which is numbered 1. One end of the wire, which is indicated at 2, is also connected with said plate 1, coiled about the body *o* and connected with the plate 2. Following this order the various wires of the left-hand group, which are numbered from 1 to 12, in a like manner connect the coil, or that portion of the latter which is to the left of its center, with the plates of the corresponding contact structure. In a like manner the wires of the coil *o*, which are to the right of the center thereof and which are numbered from 1 to 12 consecutively, are connected with the plates *h*, forming the contact structure to the extreme right.

p represents a light-circuit wire, the latter being connected through electric lamps, (indicated at *q*.) This wire *p* runs to ground or to a track-rail and forms the return-circuit wire. The wire of the coil *a*, which I have indicated at 15, is also a return-circuit wire.

16 represents the feeding-circuit wire, which may lead from a trolley or other suitable source. This wire 16 is connected, as indicated, with the wire 17 by a wire of the coil *a*, and said wire 16 is also connected with the plate (marked 13) of the outer contact structure, which is formed of the plates *i*.

The wire *m'* of the solenoid-coil *m* has one of its ends connected with the contact-plate 13 of the inner contact structure formed of the plates *i*, and the remaining end of said coil-wire is connected, as shown, with the contact-plate, (marked 13,) which is included in the inner contact structure formed of the plates *h*. When the core *b* is in its extreme outer position and its bar *d* is in contact with the plates 13 of the corresponding contact structures, the plate *e* is in contact with separated contact-posts *s* and *s'*. The post *s* has leading therefrom a wire *t*, which connects, through a suitable storage battery *u*, with a wire *v*, the latter connecting with the feed-circuit wire 16. The post *s'* has leading therefrom a wire *w*, which connects with the ground or rail wire *p*. A wire *x* is also adapted to connect, as shown, the wires *t* and *w*, this connection, however, being adapted to be broken by a suitable form of switch *x'*. The wire *w* forms a circuit for a group of emergency-lamps, such as are indicated at *y*.

In utilizing the hereinbefore-described system it will be understood that the current with which the wire 16 is charged from the trolley or other source is greater than that required for the light-circuit of the car or other structure. From the wire 16 the comparatively high voltage current passes to the contact-segment 13 of the contact structure to the extreme left in Fig. 1. Through the arrangement of wires heretofore described it will be seen that the various segments of said structure to the extreme left are connected with the alternate resistance-coils on the solenoid-body *m*, and that through the contact-bar *k* the remaining external coils of said solenoid-body are connected with the contact plates or segments *i* of the opposing contact

structure. It will also be observed that through the solenoid-coil wire m' a circuit is established from the last-mentioned contact-plates through the solenoid-coil m to the segment or contact-plate 13 of the inner structure formed of the plates h and that through the connecting-bar d a connection is established to the opposing contact-plates 13 and thence through the light-circuit p. For the purpose of illustration we will assume that the voltage of the current carried by the wire 16 is six hundred and that the voltage required for the light-circuit is three hundred. In this connection it will be observed that the position of the contact-bar k is such as to interpose the full resistance of all the external coils of the solenoid-body m, which resistance, we will assume, amounts to three hundred volts, the voltage thus being reduced through the light-circuit to the desired degree and preventing the burning out of said light-circuit when the wire 16 is first charged with the current from the trolley. As a result, however, of the charging of the wire 16 and of its connection with the solenoid-coil a and of the connections heretofore described with the coil m it is obvious that both the solenoid-coils are so charged as to result in the usual operation of drawing within said coils the cores b and k^2, which are normally held outward by the springs f and k^3. In the movement of the core k^2 it will be understood that as the contact-bar k moves into and out of successive contact with the contact-plates i the corresponding external coils of the solenoid-body m will be cut out and the resistance thus reduced. In the corresponding movement of the contact-bar d caused by the movement of the core b it will be understood that as said bar travels toward the opposite ends of the contact structures composing the plates h the resistance on the light-circuit will increase. It will also be observed that through the wiring heretofore described the inward movement of the core b and corresponding movement of the bar d must result in cutting in the resistance offered by the wires of the resistance-coil o, this coil o thereby operating to maintain the additional resistance necessary to maintain the desired reduction in the light-circuit. Owing to the equality in the force of the current in the solenoid-coil m it will be understood that when the contact-bar k has in the manner described been brought into contact with the contact bars or segments i which are numbered 13, said contact-bar will remain in this position during the continuance of a current in the feed-wire 16. It will be readily understood, however, that any reduction in the current of the feed-wire must result in a corresponding outward movement of the core b, a movement of the bar d thus cutting out resistance in the coil o sufficient to compensate for the reduction in the current of the wire 16. In this manner it will be seen that the movement and position of the bar d will depend upon the degree of current to which the wire 16 is subjected and that the current in the lighting-circuit will thus be automatically maintained at uniform voltage regardless of the variation or fluctuation of the current in the feed-wire. It will be understood that during the continuance of the current in the wire 16 the storage battery u will be charged through its connection with said wire 16 and that when the contact-bar d is in its outer position and in contact with the posts s and s' a circuit will be established through the wire t, contact-plate e, wire w, and emergency-lamps y, this current being supplied from the storage battery u and insuring a lighting of the lamps y when the current on the wire 16 is cut off and the bar d has moved to its outer position. In case, however, of a failure of the contact-bar d to move to its extreme outer position, and thereby prevent contact of the plate e with the posts s and s', the circuit through the emergency-lamps y may be maintained by closing the switch x' and completing the circuit through the wire x. It will thus be understood that means are provided for maintaining lights in a car or other structure while the current from the trolley or other source of supply is completely cut off.

From the construction and operation which I have herein described it will be seen that improved means are provided not only for preventing the passage of an undesirable current through the lamps of a car when the current is first switched onto the main or feed wire, but that simple and reliable means are provided for maintaining a uniform degree of current in the light-circuit regardless of the variation or fluctuation of the current in the feed-wire, thus providing for uniform brilliancy of the lights in the car.

Having now fully described my invention, what I claim, and desire to secure by Letters Patent, is—

1. In an electric system, a feed element, a potential-regulating device having parallel series of contact-points with the feed element connected to the contact-point at one end of one of the series, a solenoid connected to the corresponding contact of the other series, a core working in the solenoid and coöperating with the series of contact-points, means regulating for changes in the load having parallel series of contact-points with a contact-point of one series connected with the solenoid, a conductor leading away from a contact-point of the opposite series, and a solenoid connected to the feed element and having a core working between and in cooperative relation with the second-mentioned series of contact-points.

2. In an electric system, a feed element, potential-regulating means, means regulating

for changes in the load connected thereto, one of these elements being connected to the feed element, a conductor leading away from the other means, each of said means including a series of contacts, a solenoid and a core working therein in coöperative relation with the contacts, a normally open supplemental circuit connected to the feed element and including a storage battery, and means operated by one of the cores for closing the supplemental circuit when the feed element is dead.

3. In an electric system, a feed element, potential-regulating means, means regulating for changes in the load, one of said means being connected to the feed element, a conductor leading away from the other means, each of said means including a series of contacts, a solenoid and a core working therein in coöperative relation with the contacts, and a normally open supplemental circuit connected to the feed element and including a storage battery, the supplemental circuit being controlled by the regulating means which has the conductor leading away therefrom.

THOMAS A. SWARTS.

In presence of—
A. L. PHELPS,
C. C. SHEPHERD.