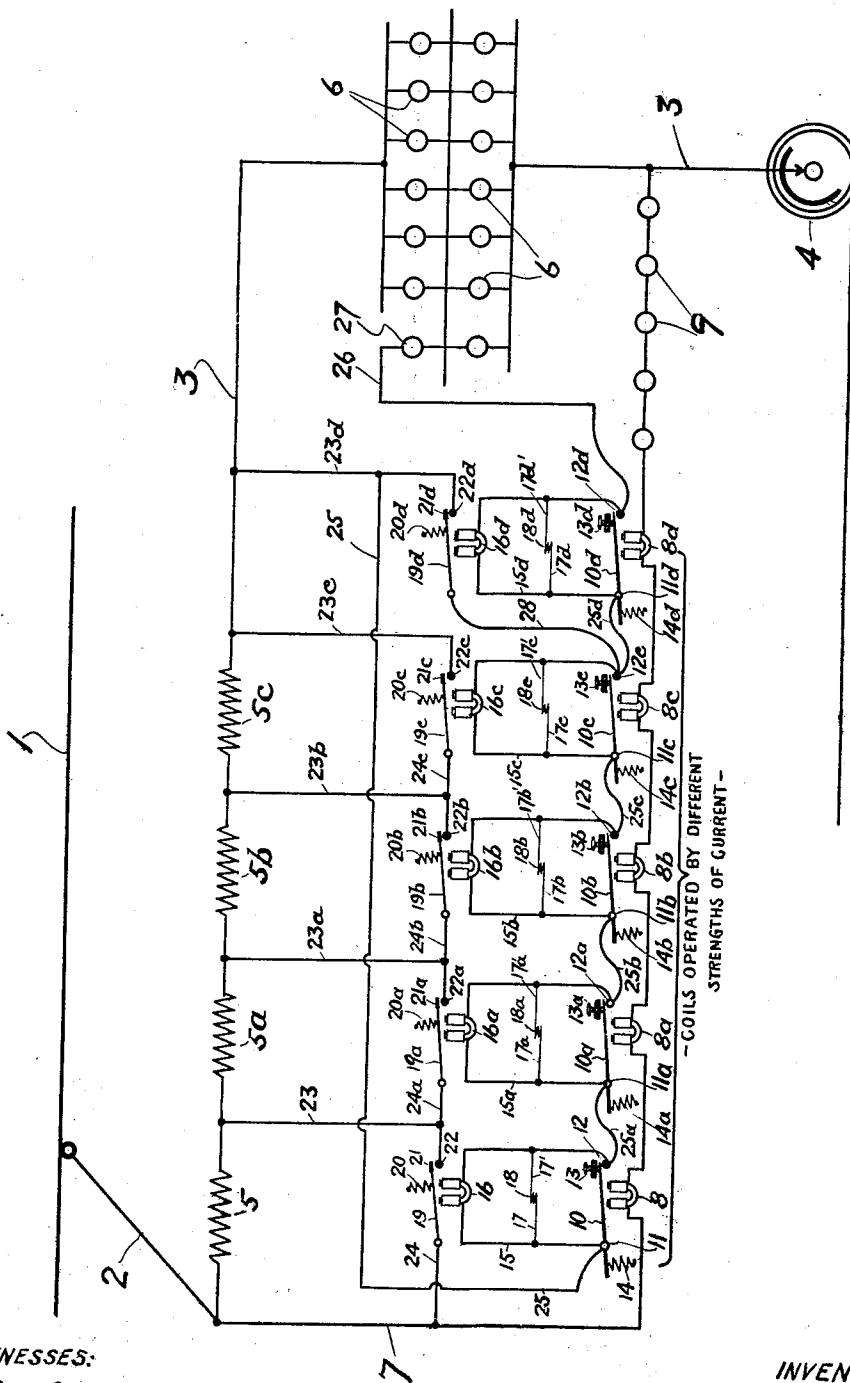


H. BALUSS.
ELECTRIC LIGHTING SYSTEM.
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1,070,099.

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WITNESSES:

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ELECTRIC-LIGHTING SYSTEM.

1,070,099.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, HAMILTON BALUSS, a citizen of the United States, residing at Kennett Square, in the county of Chester and State of Pennsylvania, have invented certain Improvements in Electric-Lighting Systems, of which the following is a specification.

My invention comprises an electric lighting system having means for regulating the supply of current so that the lamps shall receive a substantially constant voltage notwithstanding fluctuations in the line supplying the current, and more generally it comprises improved means for supplying to any device substantially uniform current regardless of current fluctuations in the circuit.

My improvements comprise, further, means for indicating current fluctuations whereby operators are guided in the use of current and machinery.

In the operation of trolley cars particularly there is a comparatively wide variation in the current supplied to the cars, primarily due to variations in the load, and leading purposes of my invention are to prevent the going out and fluctuation of the lights of such cars due to drops in current and also to indicate the drop in current so that the car can be slowed down to accommodate the condition of the power.

The characteristic features of my improvements are fully disclosed in the following description and the accompanying drawing in illustration thereof.

The drawing is a diagrammatic representation of a trolley car lighting system embodying my invention.

The mechanism, as illustrated in the drawing, has a main circuit comprising the trolley wire or a conductor 1; the conductor 2 movable in contact therewith, as the pole of a car; the conductor 3 connecting the conductor 2 with the ground through the car wheel 4 and containing the resistances 5, 5^a, 5^b, and 5^c and the parallel lamps 6.

A shunt circuit is provided by the conductor 7 connecting the conductor 2 with the conductor 3 at a point between the lamps and the ground, the shunt circuit containing the electro-magnets 8, 8^a, 8^b, 8^c, and 8^d and the serially arranged lamps 9. The electro-magnets 8, 8^a, 8^b, 8^c, and 8^d are adapted for attracting the respective armatures 10, 10^a, 10^b, 10^c, and 10^d which rock on the respective fulcrums 11, 11^a, 11^b, 11^c, and 11^d between the respective contact members 12, 12^a, 12^b, 12^c, and

12^d and the corresponding stops 13, 13^a, 13^b, 13^c, and 13^d which limit the retractions of such armatures due to the action of the respective springs 14, 14^a, 14^b, 14^c, and 14^d. These armatures are adapted for making and breaking auxiliary circuits comprising the respective conductors 15, 15^a, 15^b, 15^c, and 15^d connecting the respective armatures with the corresponding contact members and containing the respective electro-magnets 16, 16^a, 16^b, 16^c, and 16^d. The conductors 15, 15^a, 15^b, 15^c, and 15^d have their members on opposite sides of the electro-magnets connected with the respective conductors 17 and 17' connected with and through the carbon resistance 18, the conductors 17^a and 17^{a'} connected with and through the carbon resistance 18^a, the conductors 17^b and 17^{b'} connected with and through the carbon resistance 18^b, the conductors 17^c and 17^{c'} connected with and through the carbon resistance 18^c, and the conductors 17^d and 17^{d'} connected with and through the carbon resistance 18^d.

The electro-magnet 16 is adapted for moving the armature 19 against the retracting action of the spring 20, so that its carbon contact member 21 will engage a carbon contact member 22 which is connected by the conductor 23 with the conductor 3 between the resistances 5 and 5^a, the armature 19 being connected by a conductor 24 with the conductor 7. The electro-magnet 16^a is adapted for drawing the armature 19^a against the resistance of the spring 20^a, to cause its carbon contact member 21^a to engage a carbon contact member 22^a which is connected by the conductor 23^a with the conductor 3 between the resistances 5^a and 5^b, a conductor 24^a connecting the armature 19^a with the conductor 23. The electro-magnet 16^b is designed for attracting the armature 19^b, against the action of its spring 20^b, to bring the carbon contact member 21^b into engagement with the carbon contact member 22^b which is connected by the conductor 23^b with the conductor 3 between the resistances 5^b and 5^c, a conductor 24^b connecting the armature 19^b with the conductor 23^a. The electro-magnet 16^c is designed for attracting the armature 19^c, against the action of its spring 20^c, to cause its carbon contact member 21^c to engage the carbon contact member 22^c which is connected by the conductor 23^c with the conductor 3 between the resistance 5^c and the lamps 6, a conductor 24^c connecting

the armature 19^c with the conductor 23^b. The electro-magnet 16^d attracts the armature 19^d, against the action of the spring 20^d, to cause its carbon contact 21^d to engage the carbon contact 22^d which is connected by a conductor 23^d with the conductor 3 between the conductor 23^c and the lamps 6. The conductor 23^d is connected by a conductor 25 with the armature 10, the contact member 12 is connected with the armature 10^a by the conductor 25^a, the contact member 12^a is connected with the armature 10^b by the conductor 25^b, the contact member 12^b is connected with the armature 10^c by the conductor 25^c, the contact member 12^c is connected with the armature 10^d by the conductor 25^d which is connected by the conductor 28 with the armature 19^d, and the contact member 12^d is connected with the conductor 3 between the lamps 6 and the conductor 7 by the conductor 26 containing the lamp 27.

The electro-magnets 8, 8^a, 8^b, 8^c, and 8^d actuate their respective armatures 10, 10^a, 10^b, 10^c, and 10^d simultaneously at normal voltage and successively as the voltage rises from a minimum to the normal, which can be effected by graduating the strength of the springs 14, 14^a, 14^b, 14^c, and 14^d so that a voltage of, say, 300 is required to operate the armature 10^d, 500 to operate the armature 10^c, 525 to operate the armature 10^b, 550 to operate the armature 10^a, and 575 to operate the armature 10.

When normal current, above the assumed 575 volts, is transmitted from the conductor 1 through the conductor 7, the lamps 9 are lighted; the electro-magnets 8, 8^a, 8^b, 8^c, and 8^d operate the armatures 10, 10^a, 10^b, 10^c and 10^d to short circuit the electro-magnets 16, 16^a, 16^b, 16^c, and 16^d so that the current flows from the conductor 3 through the conductors 23^d, 25, 10, 25^a, 10^a, 25^b, 10^b, 25^c, 10^c, 25^d, 10^d, 26, 3 and 4 to the ground, lighting the lamp 27, and current at the same time flowing through the conductor 3 lights the lamps 6.

When the current drops so that the amount flowing through the conductor 7 is between the assumed 575 and 550 volts and is insufficient to effect the operation of the armature 10, current flows from the conductor 25 through the conductors 15, magnets 16, 25^a, 10^a, 25^b, 10^b, 25^c, 10^c, 25^d, 10^d, 26 and 3; the conductors 17 and 17' containing the non-inductive resistance 18 preventing sparking between the now separated but closely contiguous members 10 and 12. The electro-magnet 16 now being excited, its armature 19 is actuated to engage the contact members 21 and 22 (made of carbon to prevent sparking) and current from the conductor 7 flows through the conductors 24, 19, 23 and 3, providing a short circuit cutting out the resistance 5, thereby provid-

ing the normal voltage required for lighting the lamps 6; the lamps 9 receiving a reduced current and indicating the drop.

When the current drops, so that the voltage in the conductor 7 is between the assumed 550 and 525, the armatures 10 and 10^a not being actuated, current flows through the conductors 15 and 15^a (the non-inductive resistances 18 and 18^a preventing sparking between the open contact members of these conductors); the electro-magnets 16 and 16^a operate the armatures 19 and 19^a; current flows through the conductors 24, 19, 24^a, 19^a, 23^a and 3, cutting out the resistances 5 and 5^a, whereby normal lighting current is furnished to the lamps 6; the lamps 9 indicating the drop in current.

When the current drops so that the voltage in the conductor 7 is between the assumed 525 and 500 and the armatures 10, 10^a and 10^b are not attracted, current flows from the conductor 25 through the conductors 15, 15^a and 15^b; the electro-magnets 16, 16^a and 16^b attract the armatures 19, 19^a and 19^b, and current flows from the conductor 7, through the conductors 24, 19, 24^a, 19^a, 24^b, 19^b, 23^b and 3, cutting out the resistances 5, 5^a, and 5^b; the lamps 6 thus receiving the normal current and the lamps 9 indicating the drop.

When the current drops so that the voltage in the conductor 7 is between the assumed 500 and 300, which is insufficient to effect the operation of the armatures 10, 10^a, 10^b and 10^c, current flows from the conductor 25 through the conductors 15, 15^a, 15^b, and 15^c; the armatures 19, 19^a, 19^b, and 19^c are attracted, and current flows from the conductor 7 through the conductors 24, 19, 24^a, 19^a, 24^b, 19^b, 24^c, 19^c, and 23^c, cutting out the resistances 5, 5^a, 5^b and 5^c and thereby supplying the normal voltage required for lighting the lamps 6; the lamps 9 indicating the drop.

If the current falls below the assumed service limit, 300 volts in the conductor 7, or if the circuit containing the lamps 9 should be broken, the current flowing from the conductor 25 through the conductors 15, 25^a, 15^a, 25^b, 15^b, 25^c, 15^c, 25^d, 15^d, and 26 will operate the armatures 19, 19^a, 19^b, 19^c, and 19^d, and current will then flow from the conductor 7 through the conductors 24, 19, 24^a, 19^a, 24^b, 19^b, 24^c, 19^c, 23^c, 3, 23^d, 19^d, 23, 25^d, 15^d, 26 and 3, the lamp 27 being thus lighted, when the lamps 6 and 9 are dimmed to the degree indicating the current, if the circuit containing them is unbroken.

If, in the operation, the circuit containing the lamp 27 should be broken, as by breaking this lamp, all of the resistance is thrown into the circuit containing the lamps 6 because the circuits containing the electro-magnets 16, 16^a, 16^b, 16^c, and 16^d are broken and none of the armatures 19, 19^a, 19^b, 19^c, and 19^d can be attracted to close the circuits

in which they are contained and by which the resistance is cut out.

Having described my invention I claim:

1. In an electric system, the combination
5 with a supply circuit, of a work circuit, a plurality of resistors in series with the work circuit, and means for selectively cutting in and out said resistors in groups of one or more in proportion to changes in the voltage
10 of the supply circuit.

2. In an electric system, the combination with a supply circuit, of a work circuit, a plurality of resistors in series with the work circuit, and means for selectively cutting in
15 and out said resistors in groups of one or more in proportion to changes in the voltage of the supply circuit, said means maintaining all of the registers in circuit when the supply voltage falls below a predetermined
20 minimum.

3. In an electric system, the combination with a supply circuit, of a work circuit, a plurality of resistors in series with the work circuit, and means for selectively cutting
25 in and out said resistors in groups of one or more in proportion to changes in the voltage of the supply circuit, said means also successively controlling said resistors under successive changes in voltage of the supply
30 circuit.

4. In an electric system, the combination with a supply circuit, of a work circuit, a plurality of resistors in series with the work circuit, a shunt circuit for each resistor, a
35 switch for each shunt circuit, and means for the successive and for the simultaneous selective actuation of said switches by changes in the voltage of the supply circuit.

5. In an electric system, the combination
40 with a supply circuit, of a work circuit, a

resistor in series with the work circuit, a shunt circuit for the resistor, an armature in the shunt circuit, an electro-magnet for the armature, a shunt circuit for the electro-magnet, a controlling circuit, an electro-
45 magnet in the controlling circuit, and an armature for the last-mentioned magnet, said armature being in the shunt circuit of the first-mentioned electro-magnet.

6. In a system of the character described,
50 the combination with a supply circuit of a circuit having therein a sectional resistance, a second circuit having therein several electro-magnets, a third circuit having therein
55 several electro-magnets, means comprising armatures operated by said first named electro-magnets whereby said second named electro-magnets are short circuited, and means comprising armatures operated by
60 said second named electro-magnets, whereby sections of said resistance are cut out proportionately to the drop in voltage of the supply circuit.

7. In a system of the character described, the combination of a circuit containing re-
65 sistance, a second circuit containing an electro-magnet, a third circuit containing an electro-magnet, means operated by said first named electro-magnet for short circuiting
70 said second named electro-magnet, and means operated by said second named electro-magnet whereby resistance aforesaid is cut out of said first circuit.

In witness whereof I have hereunto set my name this 28 day of March, 1911, in the
75 presence of the subscribing witnesses.

HAMILTON BALUSS.

Witnesses:

JOS. G. DENNY, Jr.,
GILBERT S. BARLAGE.