

953,404.

Patented Mar. 29, 1910.

2 SHEETS—SHEET 1.

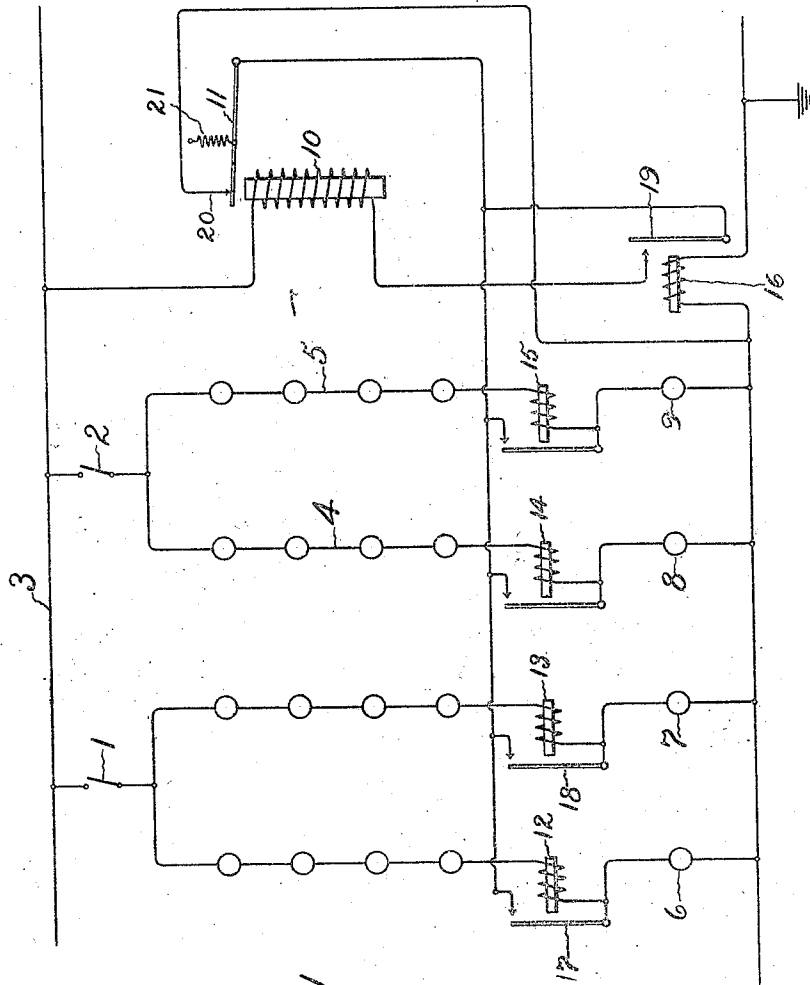


Fig. 1

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LIGHTING SYSTEM.
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2 SHEETS—SHEET 2.

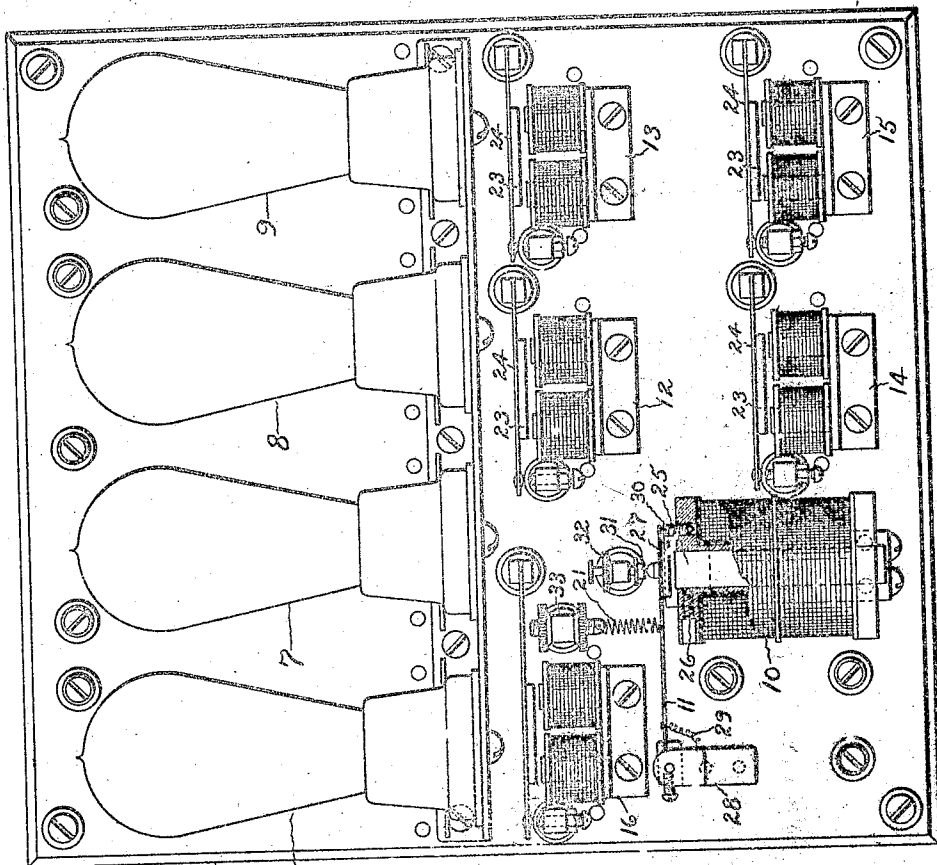


Fig. 2

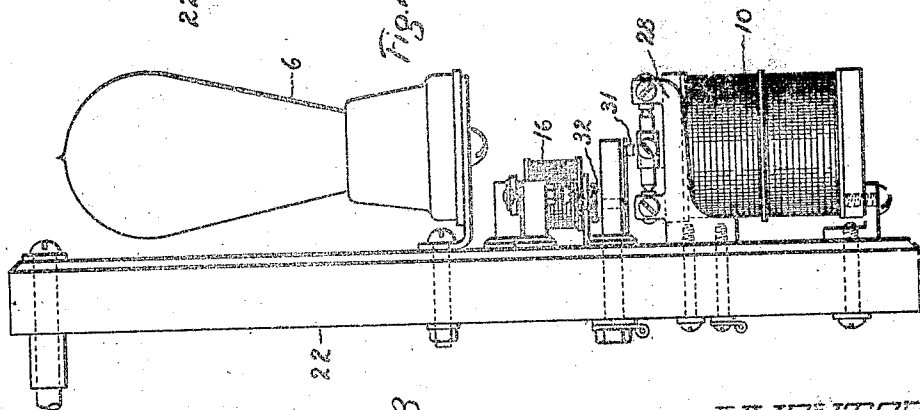


Fig. 3

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UNITED STATES PATENT OFFICE.

MAGNUS UNGER, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

LIGHTING SYSTEM.

953,404.

Specification of Letters Patent. Patented Mar. 29, 1910.

Application filed January 19, 1907. Serial No. 351,538.

To all whom it may concern:

Be it known that I, MAGNUS UNGER, a citizen of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Lighting Systems, of which the following is a specification.

This invention relates to an electric lighting system suitable for use in street cars and in other places where the voltage of the circuit is liable to vary through a relatively great range.

The ordinary arrangement of electric lights on a street car includes one or more groups of lamps connected in series between ground and the trolley side of the electrical circuit. For trolley circuits operating at say 550 volts the series circuit usually includes five lamps. In case of an overload on the trolley circuit, such as may occur when the car is climbing a steep grade or when the trolley feeders are inadequate for the service demanded, the voltage of the system may drop off fifty or even one hundred volts. Such a decrease in voltage, or even one of considerably less magnitude, will cause a great change in the light given out by the lamps of the car.

According to my invention, automatic means are provided for periodically short circuiting one of the lamps of the series circuit, thus increasing the voltage on the other four lamps. In case the line voltage is very low the automatic means keeps the fifth lamp short circuited all, or practically all, of the time and thus puts the full line voltage on the other lamps, but if the voltage is only slightly below normal line voltage the automatic means vibrates at such a rate that the fifth lamp is in circuit the greater part of the time.

It is common practice to arrange the lamps of street cars in two groups, each consisting of two series of five lamps each, and I have therefore adopted such a system of car wiring for purposes of illustration.

In the drawings forming a part of this specification, Figure 1 is a diagrammatic representation of the lamp circuits and of the regulating mechanism; Fig. 2 is an elevation of the regulating lamps and cut-outs; and Fig. 3 is an end elevation of the same.

The lighting system illustrated in Fig. 1 comprises two groups of lamps controlled

respectively by the switches 1 and 2 through which connection may be established with the conductor 3 on the trolley side of the power circuit. Each of these groups of lamps comprises two series circuits 4 and 5. 60 Five lamps are included in each series circuit. The last or fifth lamp of each series circuit, namely lamps 6, 7, 8 and 9, are the lamps which are periodically short circuited to keep proper voltage on the other lamps of 65 the system. These regulating lamps constitute light giving resistances in series with the other lamps of the car. The regulating or vibratory mechanism comprises an electromagnet 10 provided with a contact arm 70 or vibrator 11 which serves to periodically short circuit the regulating lamps of the various series circuits. As it is desirable to regulate the voltage on the lamps independently of the number of lamps in circuit, I 75 have provided four automatic cut-outs 12, 13, 14 and 15, arranged respectively in the four series groups and serving to place the five regulating lamps in parallel when all the lamps of a car are in use, and also serving to cut out the regulating lamp of any 80 particular series in case the switch controlling that series is open or the circuit incomplete because of a broken lamp. The regulating mechanism thus operates to periodically 85 short circuit one lamp in case only one series of lamps is in use, or two lamps for two series, or four lamps for four series. The regulating mechanism when once adjusted is entirely suitable for any condition 90 arising in ordinary practice. In order that the regulating mechanism may not continue to vibrate when all the lamps are turned off, I provide a cut-out 16 in the ground connection of the lamps so arranged that when 95 no current is flowing through the lamps the circuit of the regulating electromagnet will be open and the vibratory arm or contact 11 will not vibrate.

Fig. 1 shows the various switches and 100 vibrating contacts when the lamp circuits are open. If the main lamp switch 1 is closed, current flowing through the electromagnets 12 and 13 will cause them to attract their respective armatures 17 and 18 and 105 thus throw the regulating lamps 6 and 7 in parallel with the vibratory arm 11. The current will also energize electromagnet 16 and cause it to attract its armature 19 and thereby complete the circuit through electro- 110

magnet 10 and set arm 11 in motion. So long as the arm 11 remains in contact with conductor 20, the full voltage of the traction system will be impressed across the four lamps of each series, but this voltage will be sufficient to powerfully energize electromagnet 10 and draw down the vibratory arm 11 and thus open the path in parallel with the lamps 6 and 7 and thereby introduce these lamps in series with their respective groups of four. When the arm 11 moves out of contact with the conductor 20 the energizing electromagnet 10 suffers a diminution of current because of the introduction of the regulating lamps in series therewith; this permits the return of arm 11 to its initial position. If the voltage is low electromagnet 10 is relatively weak and vibratory arm 11 stays in contact with conductor 20 a good proportion of the time; if the voltage is normal or a little high, electromagnet 10 will be strong and keep the vibratory arm out of contact with conductor 20 for a good proportion of the time. By properly proportioning the electromagnet 10 and the controlling spring 21, the current through the main lamps of the car may be regulated to within a few hundredths of an ampere, and the light distributed by the four lamps of each series may be maintained substantially constant irrespective of variations in the voltage of the traction system.

Fig. 2 illustrates one manner of assembling the various elements described in connection with Fig. 1. The main lighting lamps of the car are not shown, but the four regulating lamps 6, 7, 8 and 9 are mounted on a single panel 22 suitable for mounting in any convenient place in the car. The automatic cut-outs 12, 13, 14 and 15 may be of ordinary type as shown, provided with armatures 23 carried on conductive strips or springs 24. The series cut-out 16 is of similar type, but the vibratory regulator is preferably more delicate in adjustment and capable of greater regulating range. This regulator may comprise an electromagnet 10 having a movable core 25 held in position by a set screw 26. The vibratory arm of contact member 11 carries an armature 27 and is pivotally supported to a rigid standard 28 to which it is electrically connected by a flexible conductor 29. The downward movement of this vibratory arm may be regulated by adjusting the screw 30, and the upward movement may be regulated by a spring stop 31 held in position by suitable adjusting means 32. This stop serves also as means for completing the circuit through the vibratory arm 11 according to the general scheme illustrated diagrammatically in Fig. 1. Suitable adjusting means 33 are provided for regulating the tension of spring 21.

To avoid complications in the drawings,

the electrical connections have been omitted from Figs. 2 and 3 but the several parts bear the same reference numerals as the corresponding parts in Fig. 1, to which reference may therefore be conveniently made for details of the circuit used.

This system of lamp regulation is applicable to either alternating current or direct current systems.

What I claim as new and desire to secure by Letters Patent of the United States, is,—

1. The combination with a source of electrical energy subject to material fluctuations in voltage, of lamps receiving energy from said source, and vibratory means responsive to variation in voltage on said source and co-operating with at least one of said lamps to maintain substantially constant light from other lamps of the system.

2. The combination with a source of power subject to substantial fluctuations in voltage, of a plurality of lamps disposed in series and receiving energy from said source, a resistance in series with said lamps, and vibrating means responsive to variations in voltage on said source for automatically regulating the voltage across said resistance to maintain substantially constant light from said lamps.

3. The combination with a circuit and an electric lamp connected across said circuit, of a resistance in series with said lamp, and current responsive regulating means connected across said circuit to intermittently cut said resistance out of circuit in response to variations of voltage on said circuit and thereby maintain said lamp at substantially uniform brilliancy.

4. The combination with an electric lamp connected across a circuit, of a resistance in series with said lamp, a vibratory contact for intermittently short-circuiting said resistance, and an electromagnet connected across said circuit and arranged to vibrate said contact in response to voltage across said circuit.

5. The combination with a circuit and an electric lamp connected across said circuit, of a resistance in series with said lamp, an electromagnet connected across said circuit in series with said resistance, and a vibratory armature for said electromagnet arranged to control a shunt circuit around said resistance.

6. The combination with a main circuit, and a plurality of lamps connected in series across said circuit, of a vibratory contact for controlling a shunt circuit around part of said lamps, and contact vibrating means dependent on current and connected across the main circuit whereby the vibration of said contact depends on the voltage on said main circuit and is controlled to maintain substantially constant illumination by the remainder of said lamps.

7. The combination with a main circuit and a plurality of lamps connected in series across said circuit, of a vibratory contact arranged to intermittently open and close a shunt circuit around one of said lamps, and contact actuating means dependent on current and connected across said main circuit in series with said lamp whereby said contact is vibrated to maintain constant voltage across the remainder of the lamps.

8. The combination with a main circuit and a plurality of lamps connected across said circuit, of an electromagnet connected across said circuit in series with one of said lamps, a short circuit around the lamp with which said electromagnet is in series, and a vibratory armature connected to control said shunt circuit and responsive to said electromagnet, whereby said shunt circuit is intermittently opened and closed and substantially constant voltage thereby automatically maintained across the remainder of the lamps.

9. The combination of a plurality of lamps connected in series, a regulating lamp in circuit therewith, an electromagnet in shunt with said series of lamps and a vibratory conductor for automatically varying the voltage across said regulating lamp to maintain substantially constant current in the other lamps.

10. The combination with the power conductors of a traction system, a plurality of lamps connected across said conductors, an electromagnet in shunt with said lamps and a vibrator in parallel with at least one of said lamps for automatically regulating the voltage on the other lamps.

11. The combination with conductors of a traction system, of a plurality of series circuits connected between said conductors each containing a plurality of lamps, a vibrating regulator, and automatic means for varying the resistance in parallel with said vibrating regulator to correspond with the number of lamps in operation.

12. The combination with a power circuit subject to material changes in voltage, a plurality of lamps receiving energy therefrom, a vibrating member for regulating the voltage on said lamps, and means for automatically varying the resistance in parallel with said vibrating member to correspond with the number of lamps in circuit.

13. The combination of a source of power, a circuit supplied therefrom containing a

plurality of lamps in series, means for regulating the effective voltage on said lamps, and means for discontinuing the regulating action upon cessation of current in the lamps.

14. The combination of a plurality of circuits each containing lamps in series, means for regulating the effective voltage on lamps in each of said circuits, and automatic means for discontinuing the regulating action on any one of said circuits upon cessation of current in that circuit.

15. The combination of a lamp circuit containing a plurality of lamps, a device in circuit with said lamps, means for periodically shunting said device, and means for discontinuing the periodic shunting of said device upon cessation of current in said circuit.

16. The combination of a circuit containing lamps to be regulated, a device in said circuit possessing resistance, means for varying the effective drop in voltage across said device, and automatic means for interrupting the action of the first mentioned means.

17. The combination of a circuit containing a plurality of lamps in series, a regulating lamp also in said circuit, a vibrator for periodically short circuiting or shunting said regulating lamp, and a cut-out for interrupting a connection between said vibrator and said regulating lamp.

18. The combination of a plurality of lighting circuits connected to the same source of power, lamps in each of said circuits, a regulating lamp in each circuit, a device for varying the voltage consumed by the regulating lamps, and means for disconnecting any one of said circuits from said device upon cessation of current in said circuit.

19. The combination with a source of power subject to substantial fluctuations in voltage, of a plurality of lighting circuits supplied with energy therefrom and each containing lamps in series, and a single vibratory means for regulating the voltage across some of said lamps to maintain substantially constant light from the other lamps.

In witness whereof, I have hereunto set my hand this 8th day of January, 1907.

MAGNUS UNGER.

Witnesses:

BENJAMIN B. HULL.
HELEN ORFORD.