W. C. H. WEFEL.

CIRCUIT CONTROLLING APPLIANCE FOR SERIES INCANDESCENT LIGHTING SYSTEMS.

APPLICATION FILED MAR. 21, 1917.

**1,280,914.**

Patented Oct. 8, 1918.

2 SHEETS—SHEET 1.

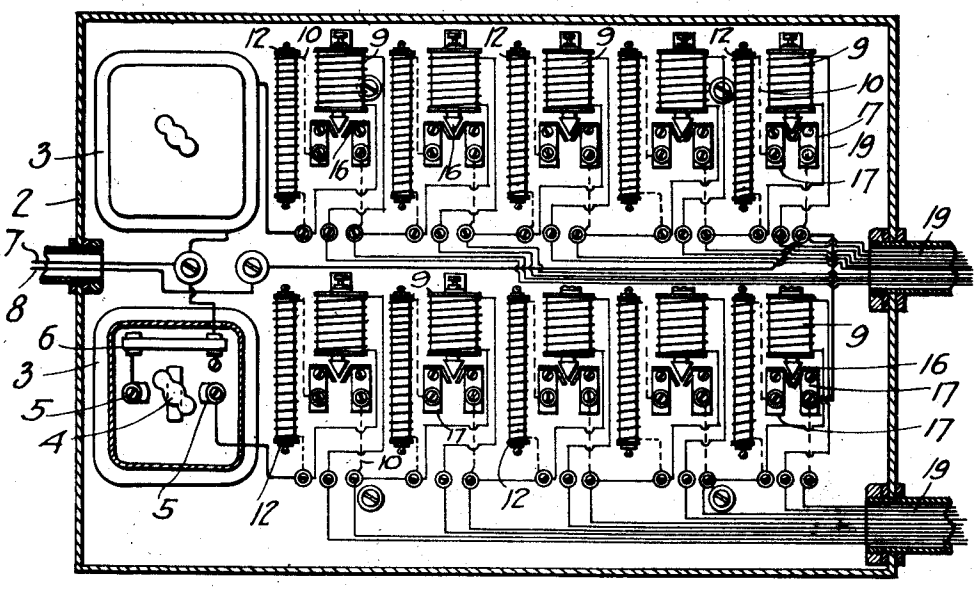



Fig. 1

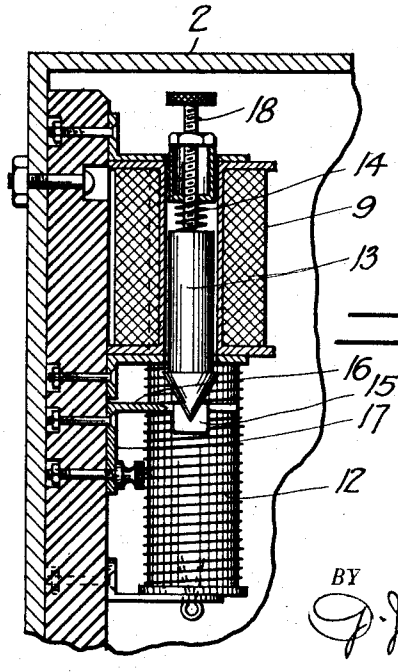



Fig. 2

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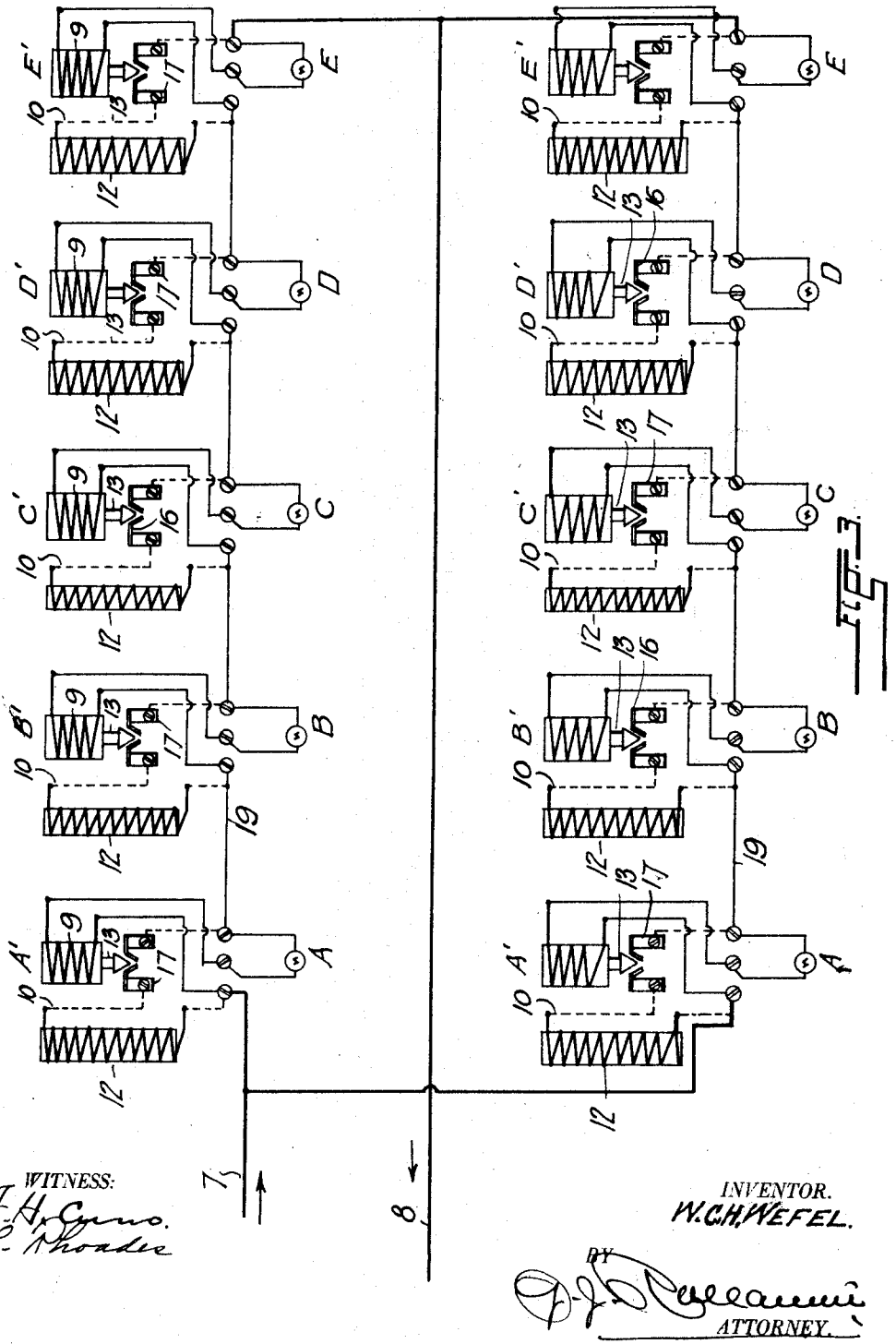



FIG. 3.

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# UNITED STATES PATENT OFFICE.

WILLIAM C. H. WEFEL, OF DENVER, COLORADO.

## CIRCUIT-CONTROLLING APPLIANCE FOR SERIES INCANDESCENT-LIGHTING SYSTEMS.

1,280,914. Specification of Letters Patent. Patented Oct. 8, 1918.

Application filed March 21, 1917. Serial No. 156,416.

*To all whom it may concern:*

Be it known that I, WILLIAM C. H. WEFEL, a citizen of the United States, residing at Denver, in the county of Denver and State of Colorado, have invented certain new and useful Improvements in Circuit-Controlling Appliances for Series Incandescent-Lighting Systems, of which the following is a specification.

This invention relates to circuit-controlling appliances for series incandescent lighting systems and its object resides in connecting in a circuit of an electric lighting system of this character, a group of interconnected, coöperative electrical devices which in case the filament of any one of the lamps connected in the circuit is broken or the path of the current through one of the lamps is otherwise interrupted, will automatically provide a by-pass for the current around the defective lamp and simultaneously include in the circuit a resistance equivalent to that ordinarily offered by the filament of the lamp and the therewith associated connections.

By virtue of the above, the extinguishment of one or more of the lamps connected in series in an incandescent lighting system will not affect the other lamps which remain continuously in an incandescent condition.

My invention is particularly adapted for use in lighting systems of electric street cars which usually include two or more series incandescent lighting-circuits connected with a common source of electricity.

It has heretofore been customary to distribute the lamps connected in these circuits, at different points of the car so that in case the lamps in one of the series were extinguished by the breakage of one of them, the lamps in the other circuits would distribute the light sufficiently to prevent any part of the car from being destitute of light.

The intricate and extensive wiring obviously required in a lighting system of this character is greatly simplified by the use of my improved system, inasmuch as the series of lamps of the different circuits may be placed in separate groups at different points of the car without danger of any one group being entirely extinguished by the breakage of the filament of one of the lamps included therein.

By the use of my improved system, incandescent lamps placed in series in a direct current lighting system of high voltage, may be employed to the same advantage as those connected in multiple in an alternating current circuit and one series of lamps may be used singly without any possibility that the entire series will be extinguished by a break in the circuit in one of the lamps included therein.

In accordance with my invention I provide a series of electro-magnetic circuit-breakers the coils of which are connected in a series of incandescent lighting circuit, and which correspond in number and relative positions with the lamps included therein.

The circuit breakers which normally are maintained in a circuit breaking condition by the flow of current through the windings of their coils, separately control the current flow through shunt circuits which are connected in the main circuit around the lamps and the corresponding electro-magnetic coils.

Each shunt-circuit includes a resistance coil the omhage of which exceeds the combined ohmages of the respective lamp and the corresponding magnet coil so that when the main circuit is initially closed for the flow of current through its lamps, the paths of least resistance lead through the coils of the magnetic circuit breakers which consequently are energized to break the shunt circuits they respectively control.

When the filament of one of the lamps in a series is broken or the flow of current through a lamp is otherwise interrupted, the respective circuit-breaker is simultaneously deënergized and thereby completes the normally broken shunt circuit it controls.

The primary circuit is thereby completed around the lamp and a resistance is at the same time included therein to compensate for the reduced resistance to the current flow by the elimination of the filament of the defective lamp from the circuit.

The coöperative circuit breakers and resistance coils together with their electrical connections, used in connection with a series incandescent lighting circuit including a determinate number of incandescent lamps, are preferably grouped within a casing which may be placed at any convenient point of a vehicle, building or other place in which the system is installed.

A switch for opening and closing the primary circuit may be placed in the same cas-

ing and in vehicle lighting systems in which two or more primary circuits are connected with a common source of electricity, the corresponding number of groups of electrical devices included in my invention and the switches which contral the flow of current through the circuits may for convenience be assembled in one and the same casing.

In the accompanying drawings, two series-incandescent lighting circuits have been shown in connection with the line wires which connect with the source of electricity,

Figure 1 representing the two groups of circuit-breakers and resistance coils with their respective electrical connections as assembled in one casing,

Fig. 2, an axial section through the coil of one of the circuit-breakers taken along the line 2—2, Fig. 1 and drawn to an enlarged scale, and

Fig. 3, a diagrammatic representation of the circuits included in a system of the type shown in Fig. 1.

Referring more specifically to the drawings in the various views of which like parts are similarly designated, the reference numeral 2 designates the casing in which are assembled the two groups of circuit breakers and resistance coils together with their electrical connections, and two switches which control the flow of current through the primary circuits.

The switches 3 may be of any approved construction and as shown in Fig. 1 of the drawings include a rotary blade 4 for the connection of insulated contacts 5, and a fuse 6 which is removably connected in a break of the circuit controlled by the respective switch.

Inasmuch as each group of electrical devices operates independent of the other, a detailed description of one will suffice to convey a complete understanding of the construction, operation and advantages of my invention.

The line wires 7 and 8 have been shown in the drawings in heavy full lines, the conductor 19 in which the series of lamps A, B. C., D and E and the coils 9 of the corresponding series of electro-magnetic circuit-breakers A′, B′, C′, D′ and E′ are connected, by light full lines, and the shunts 10 which short circuit around the lamps and include the resistance coils 12, by broken lines.

The circuit breakers are preferably composed of an electro-magnetic coil 9 in which an armature 13 has a longitudinal movement as shown in Fig. 2.

A spring 14 tends to move the armature into contact with oppositely disposed resilient blades 16 of two terminals 17 connected at opposite sides of a break in one of the shunt-circuits, and an adjustable stop 18 limits the inward movement of the armature when magnetized by energization of its coil.

The coils of the circuit-breakers are connected in series in the conductor 19 and correspond in number and relative positions with the series of lamps, and the shunt circuits are connected in the same conductor to form a by-path around each lamp and the coil of its respective circuit-breaker.

When the primary circuit is broken by the switch 3 in an open position, the demagnetized armatures of the electro-magnetic circuit-breakers rest upon the respective blades 16 and thus close the shunt circuits in which the circuit breakers are included.

If by adjustment of the switch the circuit is subsequently completed, the current following the paths of least resistance will energize the coils and incandesce the filaments of the lamps, owing to the fact that as hereinbefore explained the ohmage of each resistance coil exceeds the combined ohmages of the lamp-filament and the coil of the circuit-breaker.

The energization of the coils of the electro-magnetic circuit-breakers separates the respective armatures against the action of the springs 14, from the blades they formerly engaged, and the shunt circuits controlled by the circuit-breakers are consequently broken.

Now, if the filament of one of the lamps breaks or the flow of current through the lamp is otherwise interrupted, the coil of the respective electro-magnet is simultaneously deënergized.

The armature of the electro-magnet is in consequence moved into contact with the blades 16 by the action of the spring, and the shunt circuit is by the electrical connection of its terminals completed to form a by-path around the defective lamp and the respective demagnetized electro-magnet.

The resistance-coil connected in the shunt-circuit compensates for the decrease in resistance by reason of the omission of the lamp filament and the magnet-coil from the primary circuit, and the current-flow through the latter is in consequence continued without a moment's interruption, to effect the incandescence of the other lamps of the series.

When all the lamps in the series are in operative condition, the current flows from the source of electricity through the line wire 7, the conductor 19, the coil of the electro-magnet A′ corresponding with the first lamp A of the series, the filament of said lamp, the magnet coil of the electro-magnet B′ corresponding with the second lamp B of the series and so on until it has passed through the filament of the last lamp E of the series which by means of the return line wire 8 is connected with the opposite pole of the source of electricity.

Premising that the filament of the lamp C of the series is broken or the lamp is otherwise rendered defective, the coil of the corresponding electro-magnet C′ is simultaneously deënergized, the shunt connected around the lamp and the magnet is completed by the closing of the electro-magnetic switch, and the current after having passed through the filament of the lamp B now flows around the lamp C, and the corresponding magnet through the respective shunt and the resistance included therein, and thence to the electro-magnet corresponding with the lamp D and through the following lamps and electro-magnets of the series as before.

It will thus be seen that the incapacitation of any one or more lamps of the series does not affect the other lamps which remain in an incandescent condition, notwithstanding the fact that they are connected in series with the defective lamp or lamps.

By assembling the circuit-breakers and resistance coils into one group which may be disposed at any desired point of the vehicle, building or other place in which the system is installed, the sockets and lamps included in the circuit, may be used without changing their construction or arrangement, and the coils included in the invention can be placed sufficiently far from the lamps or inflammable parts of the vehicle, to insure against damage by the heat which is generated when a current passes through them.

Having thus described my invention what I claim and desire to secure by Letters Patent is:

1. In a circuit controlling appliance as specified, the combination of a casing, a series of rows of three connectors each arranged in the casing, main leads extending into the casing and connected to the opposite end connectors of the first and last rows of the series, intermediate leads in the casing connecting the adjacent end connectors of each adjacent row in the series, lamp circuit wires leading from two adjacent connectors of each row and from the casing, an electro-magnet in the casing for each row having its opposite ends connected to the end connectors of each row for completing a main circuit through said leads, the magneto and the lamp wires, a shunt circuit in the casing for each row leading from the end connectors thereof and including a resistance element and spaced contacts, and a spring-pressed movable element in the casing arranged in the field of each magnet and adapted to normally engage said contacts for closing said shunt circuits in said main circuit, said magnets being adapted to be energized by said main circuit when closed for withdrawing and maintaining said elements from engagement with the contacts and holding the shunt circuit open.

2. In a circuit controlling instrument of the character specified, the combination of a casing, a main circuit leading into the casing and including lamp wires leading from the casing and an electro-magnet in the casing, a shunt circuit arranged in the casing to exclude when closed the lamp wires and the magnet from the main circuit, and including spaced contacts and a resistance arranged in the casing, a movable element in the casing in the field of the magnet and adapted to bridge the contacts for closing the shunt circuit, said magnet when energized by the closing of the main circuit being adapted to maintain the element out of engagement with the contacts when the main circuit is uninterrupted, and means in the casing for advancing and maintaining the element against said contacts when the main circuit is broken and the magnet is deënergized.

In testimony whereof I have affixed my signature in presence of two witnesses.

WILLIAM C. H. WEFEL.

Witnesses:
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Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."