

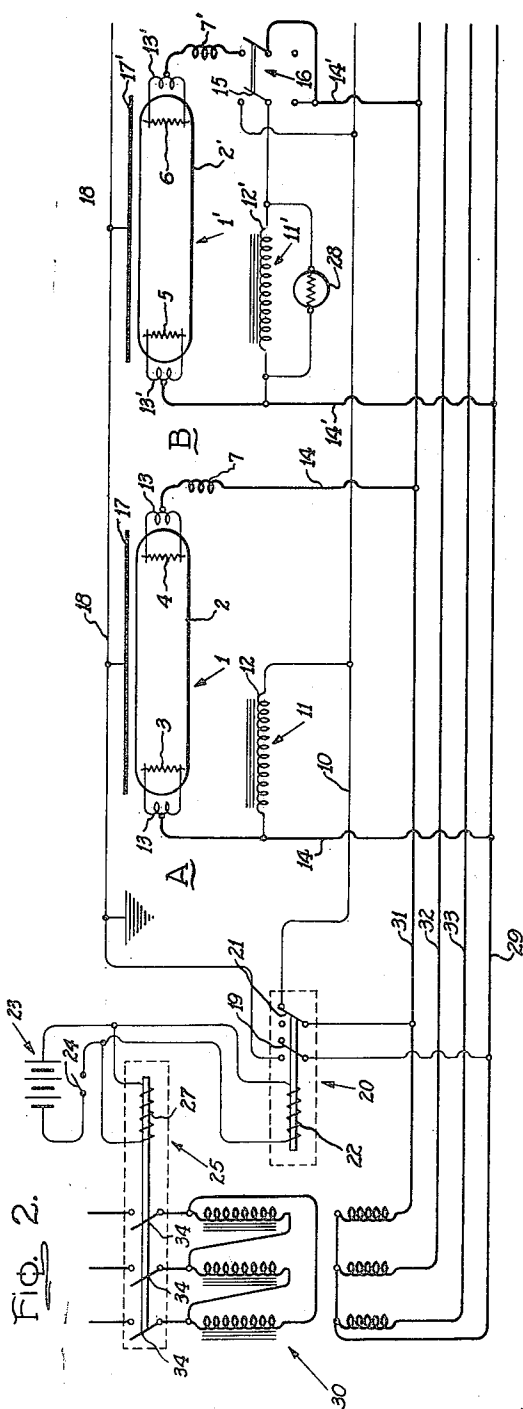
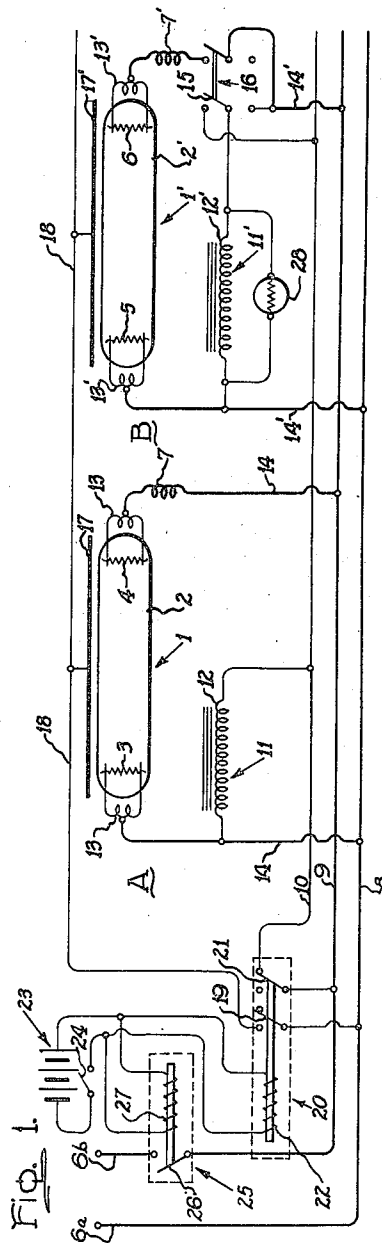
May 20, 1952 P. WAGUET 2,597,604
STARTING AND OPERATING DEVICE AND CIRCUITS
FOR ELECTRIC DISCHARGE DEVICES
Filed July 8, 1948 2 SHEETS—SHEET 1

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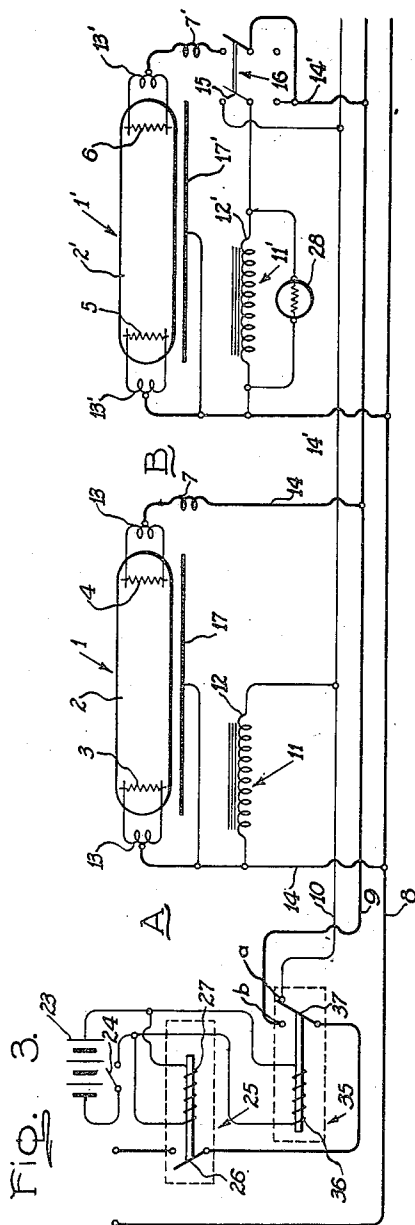
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2 SHEETS--SHEET 2



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STARTING AND OPERATING DEVICE AND
CIRCUITS FOR ELECTRIC DISCHARGE
DEVICESPhilippe Wagnet, Paris, France, assignor to Gen-
eral Electric Company, a corporation of New
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4 Claims. (Cl. 315—250)

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This invention relates to electric discharge devices of the type employing ionizable mediums such as gases or vapors, and more particularly to starting and operating devices and circuits therefor.

An object of my invention is to provide new and improved starting and operating circuits for electric discharge lamps.

Another object of my invention is to provide new and improved starting and operating circuits which will cause a discharge to occur between electrodes of an electric discharge device, after desired preheating thereof, by establishing a potential difference either between the electrodes or between one electrode and an auxiliary electrode which is mounted near the lamp.

A feature of the starting circuit, in accordance with my invention, is the suppression of an electrode heating current and the substantially simultaneous application of potential to the electrodes of a device to effectuate an arc discharge therebetween. The time elapsing between the suppression of the heating current and the application of the potential which effectuates the ignition, is sufficiently short for the electrodes to remain, by reason of their thermal capacity or inertia, at a temperature high enough to sustain an arc discharge without knocking off or sputtering of the electron-emissive coating.

Further features and advantages of my invention will appear from the following detailed description of species thereof.

For a better understanding of my invention reference may be had to the following description taken in connection with the accompanying drawings, and its scope will be pointed out in the appended claims. Fig. 1 is a diagrammatic view of a starting and operating device for electric discharge devices employing a single-phase supply system for any number of lamps connected in parallel incorporating my invention; Fig. 2 is a modification of Fig. 1 employing a three-phase source of supply; Fig. 3 is a modification of Fig. 1 wherein one wire of the discharge circuit is used as a common wire for auxiliary starting electrodes associated with the discharge devices.

The starting device described herein is particularly suited for the lighting of railway cars on an alternating current of 80 cycles per second and at a voltage of 220 volts. If a higher frequency is available, the device is capable of functioning at a lower supply voltage; if the frequency is lower, then the supply voltage must be raised or the auxiliary electrodes must be brought to a potential which is higher than that of one of the main electrodes or filaments.

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The general ignition of the lamps in a railroad carriage takes place, once the supply voltage is applied between the filaments, by raising the potential of the auxiliary electrode of each lamp to that of one of the filaments; this general ignition is brought about by means of a time-delay relay which, according to a characteristic feature of the invention, first eliminates the heating current, and then raises the potential of the auxiliary electrodes to that of one of the filaments.

The instantaneous ignition of the lamps in the compartments of a carriage is effected by applying the supply voltage between the filaments, which are being permanently heated, while the auxiliary electrodes are raised to the potential of one of the filaments. To bring this about, a hand-operated double throw switch is actuated which (according to a characteristic feature of the invention) cuts out the heating current and then applies the supply voltage between the filaments.

The starting and operating circuit incorporating my invention prevents the flickering of defective lamps; it does not necessitate a relay for suppressing the heating of each lamp, and permits a simplification in wiring with resultant savings. Moreover, my invention has all the advantages which result from the use of equipotential filaments and from the deferred application of the ignition voltage, which is applied after the heating voltage has been applied. Some of these advantages are as follows: The life of the lamps is lengthened, the luminous flux remaining equal; or the luminous flux is increased, the life of the lamps remaining equal.

In these figures, the hook-up A refers to lamps that are permanently lighted and controlled as a unit, for instance, the lamps in the aisles, corridors and entrances; the hook-up B applies to the case where the lamps are switched on and off individually by the passengers themselves, such as the lamps in the compartments.

Referring to the drawing, I have there illustrated one embodiment of my invention as applied to electric discharge devices 1, 1'. The electric discharge devices 1, 1' such as fluorescent lamps, therein illustrated comprise elongated tubular or cylindrical envelopes 2, 2' having sealed into the ends thereof filamentary electrodes 3, 4 and 5, 6, respectively. These filamentary electrodes may comprise coils, preferably in the form of coiled coils of tungsten wire activated with oxides of alkaline earth metals such as a mixture of barium and strontium oxides. The envelopes 2, 2' may contain gaseous atmospheres such as a rare gas like neon, argon or mixtures thereof at a

pressure of a few millimeters and a small quantity of mercury which, during the operation of the lamps, has a low pressure of the order of 10 microns. Devices, 1, 1' may be low pressure positive column lamps of a fluorescent type provided with a suitable phosphor or fluorescent coating. This fluorescent coating, upon excitation by the radiation produced by an electric discharge between the electrodes, transforms a shorter wave radiation due to the discharge into longer wave radiation, such as radiation within the visible range.

Devices 1, 1' are connected in parallel across a suitable single-phase alternating current distribution system 6a, 6b through stabilizing impedances or resistances 7, 7'. The single-phase distribution system comprises conductors 8 and 9. An auxiliary conductor 10 comprises part of a starting circuit hereinafter described. A pair of heating transformers 11, 11' comprising primary winding sections 12, 12' and center-tapped secondary winding sections 13, 13' serve to heat the thermionic filamentary electrodes 3, 4 and 5, 6 respectively. A pair of discharge circuits 14, 14' connect devices 1, 1' through the center-tapped secondary winding sections 13, 13' across conductors 8 and 9 of the current supply 6a, 6b. The primary winding sections 12, 12' of transformers 11, 11', respectively, are connected across conductor 8 of the single-phase distribution system 6a, 6b and auxiliary conductor 10, either directly as in circuit A, or through an intermediate contactor 15 of a double-pole switch 16, as in circuit B. Auxiliary electrodes 17, 17', mounted adjacent devices 1, 1', respectively, are connected to a common conductor 18 which, in turn, is connected through a normally open contactor 19 of a relay or switching means 20 to conductor 8 of the current supply 6a, 6b. A second contactor 21 of switching means 20, when in its inactive position, connects conductor 9 of the current supply 6a, 6b to the auxiliary conductor 10 of the starting circuit. A coil 22 of switching means 20 is connected across a source of direct current supply 23 through a manual make-and-break switch 24. A second switching means 25 comprising a contactor 26 in series with conductor 9 and a coil 27 connected across the direct current supply 23 controls the energization of the alternating current supply circuit to devices 1, 1'.

The operation of the circuit illustrated in Fig. 1 is as follows: In the rest position, as shown in the Figure 1, and with contactor 21 closed and contactor 19 open, as soon as the ignition switch 24 is closed, the coil 27 (which actuates the contactor 26) and the coil 22 of the time-delay relay 20 are connected across the terminals of the storage battery 23 in the railroad car. The control contactor 26 closes, the primary windings 12, 12' of the heating transformers 11, 11', respectively, are energized and the thermo-emissive filamentary electrodes 3, 4 and 5, 6 are heated. After a few seconds, the time-delay relay 20 operates, the contactor 21 separates the auxiliary conductor 10 from the circuit, as a result of which the heating of the filamentary electrodes is discontinued, and the contactor 19 applies voltage to the conductor 18 which the auxiliary electrodes 17, 17' have in common, thus lighting the lamps of circuit A and those of circuit B whose double-throw switches 16 are in the contact-closed position. The lamps of circuit B whose double-throw switches are in the inactive or extinguished position have their filamentary electrodes permanently heated as soon as the supply or control

contactor 26 is closed. Placing these double-throw switches in the contact-closed position will discontinue the heating of these filaments and effects the instantaneous flashing or ignition of the lamps. A small night lamp 28 is on whenever the double-throw switch 16 is in the contact-open position.

In Figure 2, wherein the elements which are the same as in Figure 1 carry the same reference characters, the conductors 8 and 9 of Figure 1 are replaced by a neutral wire 29 of a three-phase supply transformer 30 and one of phase wires 31, 32 or 33, respectively. The auxiliary wire 10 is connected to one of the phase wires, for instance, wire 31 through contactor 21 of time-delay relay 20, while contactor 19 of that relay may connect the neutral wire 29 to wire 18 which the auxiliary electrodes 17, 17' have in common. The contactor 26 is replaced with a three-pole supply contactor 34 which interrupts each phase of the supply instantaneously.

The operation of the circuit illustrated in Figure 2 is as follows: In the rest position, as shown in the figure, contactor 21 is closed and contactor 19 is open. As soon as switch 24 is closed, coil 27 which controls the three-pole supply contactors 34, and coil 22 of the time-delay relay 20 are connected to the terminals of the railroad car storage battery 23. The three-pole supply contactor 34 closes, the primary windings 12, 12' of the heating transformers 11, 11', respectively, are energized and the thermo-emissive filamentary electrodes 3, 4 and 5, 6 are heated. After a few seconds, the time-delay relay 20 operates and contactor 21 disconnects the auxiliary wire 10 from the current supply. This disconnection stops the heating of the filamentary electrodes. Contactor 19 in turn connects the neutral wire 29 to the wire 18 which the auxiliary electrodes 17, 17' have in common, thus lighting the lamps of circuit A and those of circuit B whose double-throw switches 16 are in the contact-closed position. The lamp of circuit B, whose double-throw switch 16 is in the contact-open position, has its filamentary electrodes permanently heated as soon as the three-pole supply switch contactors 34 are closed. Placing this double-throw switch in the contact-closed position does away with the heating of the filament and produces the instantaneous ignition of this lamp. The small night light 28 is lighted when the double-throw switch 16 is in the contact-open position.

In Figure 3 the auxiliary electrode of each lamp is connected to one of the wires of the current supply, the neutral wire in the case of a polyphase system. The ignition is obtained either by means of a time-delay relay or by means of a reversing switch which, according to my invention, supplants the heating current and then applies the potential of the source between the filamentary electrodes.

In Figure 3, wherein the elements which are the same as in Figure 1 carry the same reference characters, the auxiliary electrodes 17 and 17' are connected to the wire 8 of the distribution system. A time-delay relay 35 replaces relay 20 of Figure 1 and comprises a coil 36 connected across the direct current supply 23 and a contactor 37 which, when in its rest position, as represented in the drawing, connects the auxiliary wire 10 to the alternating current supply and, in its operating position, connects conductor 10 to the alternating current supply and thereby applies potential to the lamp electrodes.

The operation of the circuit illustrated in Fig-

ure 3 is as follows: On closing of the starting switch 24 the coil 27, which controls the source switch or contactor 26, and the coil 36 of the time-delay relay 35 are connected across the terminals of the storage battery 23. The source or control contactor 26 closes, the primary winding section 12, 12' of the heating transformers 11, 11', respectively, are energized and the thermionic filamentary electrodes 3, 4 and 5, 6 are heated. After a few seconds the time-delay relay 35 functions, the contactor 37 is actuated and moves from position *a* to position *b* and thus supplants the heating of the filamentary electrodes and places the lamps across the potential of the alternating current supply. This produces the ignition of the lamps at circuit A and those at circuit B where the reversing switch 16 is in its contact-closed position. The lamps in circuit B, whose reversing switch is in the contact-open position, have their filamentary electrodes heated permanently by the operation of the time-delay relay 35. The moving of the reversing switch 16 into its closed-contact position suppresses the heating of the filaments and produces the instantaneous starting of the lamps. A small night light 28 is energized when the reversing switch 16 is in its contact-open position.

The delayed operation of contactors 19 and 21 of relay 20 in Figures 1 and 2 or contactor 36 of relay 35 in Figure 3 may be effected either by means of a mechanism actuated by coils 22 and 36 which causes the tilting of two glass bulbs containing mercury whose flow, suitably retarded by a capillary tube, serves to make or break the contact, or it may be brought about by a condenser of suitable capacitance in parallel with the terminals of coils 22 and 36 and charged through a resistance of appropriate value.

When the energizing of the circuit illustrated in Figure 3 is done by a triphase current, the relay 35 carries four contacts, one serving the heating filaments and the other three applying the potential to the lamps. In its rest position, the first contact is then closed and the other three open; in its operating position the first is open and the other three closed.

While certain specific embodiments have been shown and described, it will, of course, be understood that various modifications may be made without departing from the invention. Thus, an alternating current supply of different frequency may be used; and, likewise, a different voltage source than the battery shown for controlling the relays in the circuit may be utilized. The appended claims are, therefore, intended to cover any such modifications falling within the true spirit and scope of the invention.

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

1. Apparatus for operating a gaseous luminous electric discharge device of the type including a pair of filamentary thermionic electrodes and an auxiliary starting electrode mounted intermediate the ends thereof, comprising: said device, an alternating voltage source, and a transformer having a primary winding and a pair of secondary windings connected to said filamentary electrodes to provide heating current thereto; a time-delay relay having a control coil and a contactor capable of shifting from a first position to a second position at a predetermined time interval after the energizing of said coil; a circuit for energizing said primary winding, constituted by connecting said winding across said source through the first position of said contactor; a main discharge circuit including said device and

a ballast impedance serially connected across said source; and a circuit for applying a starting voltage to said auxiliary electrode constituted by connecting said electrode, in series with the second position of said contactor, to one side of said source.

2. Apparatus for operating a fluorescent lamp of the type including a pair of filamentary electrodes and an auxiliary starting electrode located intermediate the ends thereof, comprising: said lamp, an alternating voltage source, and a transformer having a primary winding and a pair of secondary windings connected to said filamentary electrodes to provide heating current thereto; a time-delay relay having a control coil and a contactor movable from a first to a second contact at a predetermined time interval after the energizing of said coil; a circuit for energizing said transformer constituted by connecting said primary winding, in series with the first contact of said relay, across said source; a main discharge circuit including said device and a ballast impedance serially connected through said second contact across said source; a connection from said starting electrode to one side of said source; and a circuit for energizing said control coil and thereby causing said contactor to move from said first to said second contact at a predetermined time interval after said energizing.

3. Apparatus for operating a plurality of fluorescent lamps, of the type including a pair of filamentary electrodes and an auxiliary starting electrode located intermediate the ends thereof, comprising: said lamps, an alternating voltage source, and a plurality of transformers, each having a primary winding and a pair of secondary windings separately connected to said filamentary electrodes to provide heating current thereto; a time-delay relay having a control coil and a contactor movable from a first to a second contact at a predetermined time interval after the energizing of said coil; circuits for energizing said transformers, constituted by connecting said primary windings, through said first contact, across said source; a plurality of discharge circuits each including one of said lamps and a ballast impedance serially connected through said second contact across said source; and a connection in each lamp from said auxiliary electrode to one of said filamentary electrodes, heating current being continually supplied to said electrodes during said time interval after energizing said relay, and heating current being discontinued to said lamps and voltage supplied across the electrodes thereto after said time interval.

4. Apparatus for operating a plurality of fluorescent lamps, of the type including a pair of filamentary electrodes and an auxiliary starting electrode located intermediate the ends thereof, with unit control of a first group and individual control of a second group of said lamps, comprising: said lamps, an alternating voltage source, and a plurality of transformers, each having a primary winding and a pair of secondary windings separately connected to said filamentary electrodes to provide heating current thereto; a time-delay relay having a control coil and a contactor movable from a first to a second contact at a predetermined time interval after the energizing of said coil; a plurality of double-pole double-throw control switches having an "on" position and an "off" position; circuits for energizing the transformers in said first group, constituted by connecting their primary windings,

in series with said first contact, across said source, and for energizing those in said second group, constituted by connecting their primary windings, each in series with one pole of said switches in their "off" position, across said source; discharge circuits, including said lamps, and ballast impedances serially connected through said second contact for said first group, and serially connected through the other poles of said switches in their "on" positions for said second group, across said source; a connection in each lamp from its auxiliary electrode to one of its filamentary electrodes; and a circuit for energizing said control coil, whereby heating current is continually supplied, after said time interval, to the electrodes of the lamps whose respective control switches are in the "off" position, and heating current is discontinued to said lamps and voltage supplied across the electrodes thereof when the control switches associated therewith are moved from the "off" to the "on" position.

PHILIPPE WAGUET.

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