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STARTING AND OPERATING CIRCUITS AND DEVICES FOR ELECTRIC DISCHARGE DEVICES

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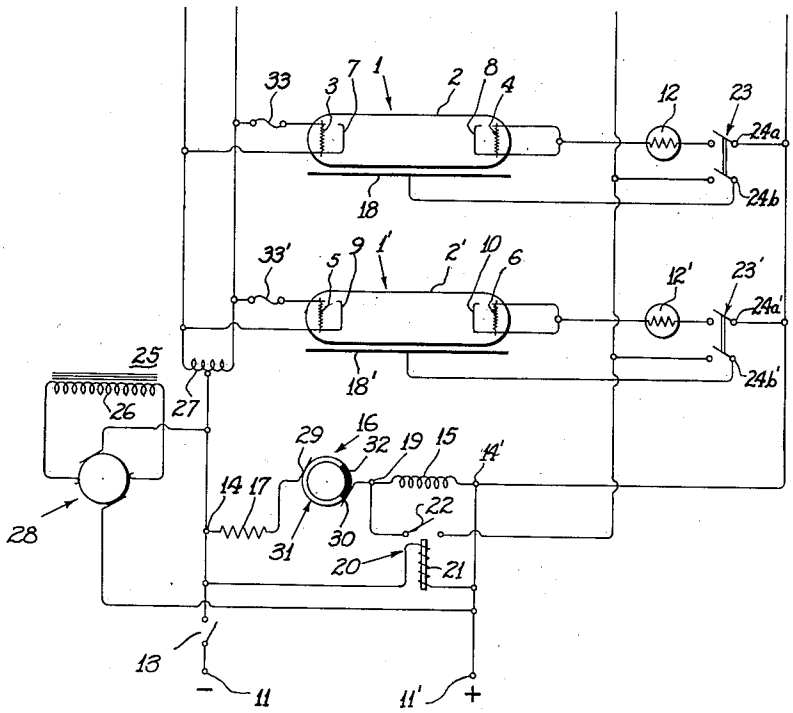

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STARTING AND OPERATING CIRCUITS AND DEVICES FOR ELECTRIC DISCHARGE DEVICES

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4 Claims. (Cl. 315—254)

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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 a new and improved starting and operating circuit for electric discharge lamps energized from a direct current source.

Another object of my invention is to provide a new and improved starting and operating circuit providing immediate lighting of luminous electric discharge devices or fluorescent lamps energized from a direct current source.

A feature of my invention is the provision of continuous voltage impulses to an auxiliary electrode for initiating a discharge between the main electrodes of the devices. Consequent upon this feature is the advantage of immediate starting of the lamp upon the closing of an individual control switch, since starting impulses are at all times available. A further feature of my invention is the utilization of alternating current derived from the direct current source for providing continuous heating of the filamentary electrodes.

My invention is of general applicability wherever it is desired to operate fluorescent lamps from a direct current supply. It has been found particularly useful in the illumination of vehicles and railroad cars having compartments or individual roomettes for the passengers. The feature of instantaneous starting of the individual fluorescent lamps is advantageous in such applications for meeting the separate requirements of the individual passengers. For a more complete discussion of various circuits which may be utilized in operating fluorescent lamps from a direct current supply, reference is made to my copending U. S. application No. 28,223, filed May 20, 1948. Other applications and improvements in such circuits are disclosed in my copending U. S. applications Nos. 28,224 and 28,226, filed May 20, 1948, and 33,385, 33,386, and 33,387, filed June 16, 1948. All of the above-mentioned applications are assigned to the same assignee as the present invention.

For a better understanding of my invention reference may be had to the following description taken in connection with the accompanying drawing and its scope will be pointed out in the appended claims. The drawing is a diagrammatic view of an electric discharge device and a starting and operating circuit therefor incorporating my invention.

In accordance with my invention, a continuous

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series of starting impulses is provided to an auxiliary electrode mounted adjacent an electric discharge device, in combination with continuous heating of the filamentary electrodes thereof. The electric discharge devices are connected in parallel across a direct current source of supply while at the same time an auxiliary source of alternating current is made available for the heating of filamentary electrodes used as cathodes.

This device, which is particularly applicable to the lighting of railroad car compartments, does not eliminate the flickering of lamps which have become defective; however, it offers the economic advantage of requiring only one time-delay relay for each railroad car.

When all the lamps of a carriage are to be lighted, the voltage impulses are applied to auxiliary electrodes mounted adjacent the lamps a few seconds after voltage has been applied to the entire group of lamps. This results in a deferred general illumination when the feeder switch controlling the lamp circuits of a whole carriage is first closed, but when a lamp in a compartment is to be lighted, the voltage impulses are applied at the same moment when the individual control switch is closed, so that the individual ignition is instantaneous.

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. 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. Metal cups 7, 8 and 9, 10 serve to intercept particles of emissive material sputtered from electrodes 3, 4 and

5, 6, respectively. These cups are usually connected, either outside or inside of the lamps, to the extremities of the electrodes. A number of advantages result from the connections between the electrodes and the corresponding cups, namely, utilization of the cups 8 and 10 as anodes and eliminating the disintegration by ionic bombardment of electrodes 4 and 6, utilization of lamps that are usually employed with alternating current discharge circuits, reduction of operating voltage, doubling the life of lamps by using successively the two filamentary electrodes, i. e., by turning the lamps around when one of the filaments becomes inoperative.

Devices 1, 1' are connected across a suitable direct current power supply circuit 11, 11' for supplying current thereto through stabilizing resistances 12, 12'. Resistances 12, 12', for example, may be iron or tungsten wire enclosed in hydrogen. A manual make-and-break control switch 13 may be used to connect devices 1, 1' to the power supply 11, 11'. A starting circuit 14, 14' is connected across the direct current supply 11, 11' and comprises an inductance 15, a switching means 16, and a resistance 17. Auxiliary electrodes 18, 18', mounted adjacent devices 1, 1', are connected to a common point 19 intermediate inductance 15 and switching means 16 through a time-delay relay or second switching means 20. Resistance 17 serves to regulate the value of the potential which the auxiliary electrodes 18, 18' assume. The time-delay relay or switching means 20 comprises a coil 21, which is connected across the terminals of the direct current supply 11, 11' through the manual make-and-break switch 13, and switch contacts 22, actuated by the coil 21 and located between point 19 and the wire which the auxiliary electrodes 18, 18' have in common. A pair of double-pole switches 23, 23' comprising contactors 24*a*, 24*b* and 24*a*' and 24*b*', respectively, are associated with devices 1, 1', respectively. Contactors 24*a*, 24*a*' are in series with the discharge circuits of devices 1, 1', respectively, and contactors 24*b*, 24*b*' are in series with the connections between junction point 19 and auxiliary electrodes 18—18', respectively, so that the starting voltage impulses are applied therethrough.

A transformer 25 comprising a primary winding section 26 and a center-tapped secondary winding section 27 is connected across an alternating current supply and serves to heat filamentary electrodes 3 and 5 and to continue to heat these electrodes as long as switch 13 remains closed. The center-tap of the secondary section 27 is connected to the negative terminal 11' of the direct current source of supply by means of switch 13.

The switching means 16 which serves to break the inductive starting circuit consists of a rotary switch which is mounted on the shaft of a converter 28 which supplies transformer 25 with an alternating current. Switching means 16 may comprise a rotary switch employing a pair of brushes each sliding on a ring. One of these rings may be entirely metallic; the other ring being half metallic and half insulating, and the metal parts of the two rings may be electrically interconnected. In the drawing, the rotary switch 16 consists of two brushes 29 and 30 which slide on one metal ring 31 comprising an insulating circular sector 32. A pair of fuses 33, 33' in the discharge circuits protect the elements of the heating transformer 25 in the case of a short circuit in the thermo-emissive filamentary electrodes 3 and 5.

The circuit and device indicated in the drawing operate as follows: In the rest position, the contactor 22 of relay 20 is open; as soon as the manual make-and-break switch 13 is closed the converter 28 starts, filamentary electrodes 3 and 5 serving as cathodes are heated, coil 21 of the time-delay relay 20 is energized and the rotary switch 16 sets up voltage impulses at the point 19. After one or several seconds, the time-delay relay 20 begins to operate and closes contactor 22. Switches 23, 23' in the discharge circuits of devices 1, 1' are normally closed and thus the voltage impulses are imparted to the corresponding auxiliary electrodes 18, 18' which causes devices 1, 1' to become conductive.

Inasmuch as the filamentary electrodes 3 and 5 of devices 1, 1', respectively, are continuously heated, switches 23, 23' may be opened and the devices 1, 1' instantaneously lighted again when these switches are again closed.

It is quite evident that the invention may be applied to other purposes besides the one which has been mentioned here, i. e., the lighting of railway carriages. It can be applied particularly well to the lighting of motion picture studios or of television studios, wherein it is desirable, under certain circumstances, to utilize direct current for fluorescent lighting rather than alternating current so as to eliminate the possibility of stroboscopic flickering. The appended claims are, therefore, intended to cover any modifications coming 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 main filamentary electrode and a cooperating main electrode, comprising: a unidirectional voltage source, a two contactor switch, a ballast resistance, and an auxiliary dependent source of alternating voltage; connections for continuously energizing said filamentary electrode from said alternating source; a discharge circuit including said device, said ballast resistance and one contactor of said switch connected in series across said unidirectional source; a starting circuit comprising a limiting resistance, automatic switching means, and an inductance, serially connected across said unidirectional source, said switching means continuously making and breaking said starting circuit to produce starting impulses; and an auxiliary starting electrode on said device, said auxiliary electrode being connected through a second contactor of said switch, to the junction of said switching means with said inductance, said device being thereby continuously supplied with said starting impulses upon the closing of said control switch.

2. Apparatus for operating a gaseous luminous electric discharge device of the type including a main filamentary electrode and a cooperating main electrode, comprising: a unidirectional voltage source, a two contactor control switch, a ballast resistance, and an auxiliary dependent source of alternating voltage; a transformer having a primary winding connected to said alternating source, and a secondary winding connected to said filamentary electrode for supplying heating current thereto, said secondary winding having a center tap; a discharge circuit including said device connected to one side of said unidirectional source through said center tap and to the other side of said unidirectional source through said ballast resistance and one contactor of a said

control switch; a starting circuit comprising a limiting resistance, switching means continuously making and breaking said starting circuit and an inductance serially connected across said unidirectional source; an auxiliary starting electrode mounted on said device intermediate the ends thereof; and a connection from said auxiliary electrode, through the other contactor of said control switch, to the junction of said inductance with said switching means for supplying starting impulses to said device upon the closing of said control switch.

3. Apparatus for operating a plurality of gaseous luminous electric discharge devices of the type including a main thermionic electrode and a cooperating main electrode, comprising: a unidirectional voltage source and an auxiliary dependent source of alternating voltage; a plurality of two contactor control switches and ballast resistors; a transformer having a primary winding connected to said alternating source, and a secondary winding connected to said thermionic electrodes in parallel for supplying heating current thereto, said secondary winding having a center tap; a plurality of discharge circuits including said devices connected to one side of said unidirectional source through said center tap, and to the other side of said unidirectional source through individual ones of said ballast resistors and the first contactors of said control switches; a starting circuit comprising a limiting resistance, continuously operative switching means for making and breaking said starting circuit, and an inductance serially connected across said unidirectional source; auxiliary starting electrodes mounted on said devices intermediate the ends thereof; and connections from said auxiliary electrodes, through the second contactors of said control switches, to the junction point of said inductance with said switching means for supplying starting impulses to said devices upon the closing of their associated control switches.

4. Apparatus for operating a plurality of gaseous luminous electric discharge devices, of the type including a main filamentary electrode and a cooperating main electrode, comprising: a principal source of unidirectional voltage, an auxiliary

dependent source of alternating voltage in the form of a rotary converter energized from said unidirectional source; a plurality of ballast resistors and two contactor control switches; a transformer having a primary winding connected to said converter and a secondary winding connected to said filamentary electrodes in parallel for supplying heating current thereto, said secondary winding having a center tap; a plurality of discharge circuits including said devices connected to one side of said unidirectional source through said center tap, and to the other side of said unidirectional source through individual ones of said ballast resistors and first contactors of said control switches; a starting circuit comprising a limiting resistance, a rotary switch mechanically coupled to said converter for making and breaking said starting circuit, and an inductance, serially connected across said unidirectional source; auxiliary starting electrodes mounted on said devices intermediate the ends thereof; and connections from said auxiliary electrodes, through the other contactors of said control switches, to the junction point of said inductance with said rotary switch for supplying starting impulses to said devices upon the closing of their associated control switches.

PHILIPPE WAGUET.

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