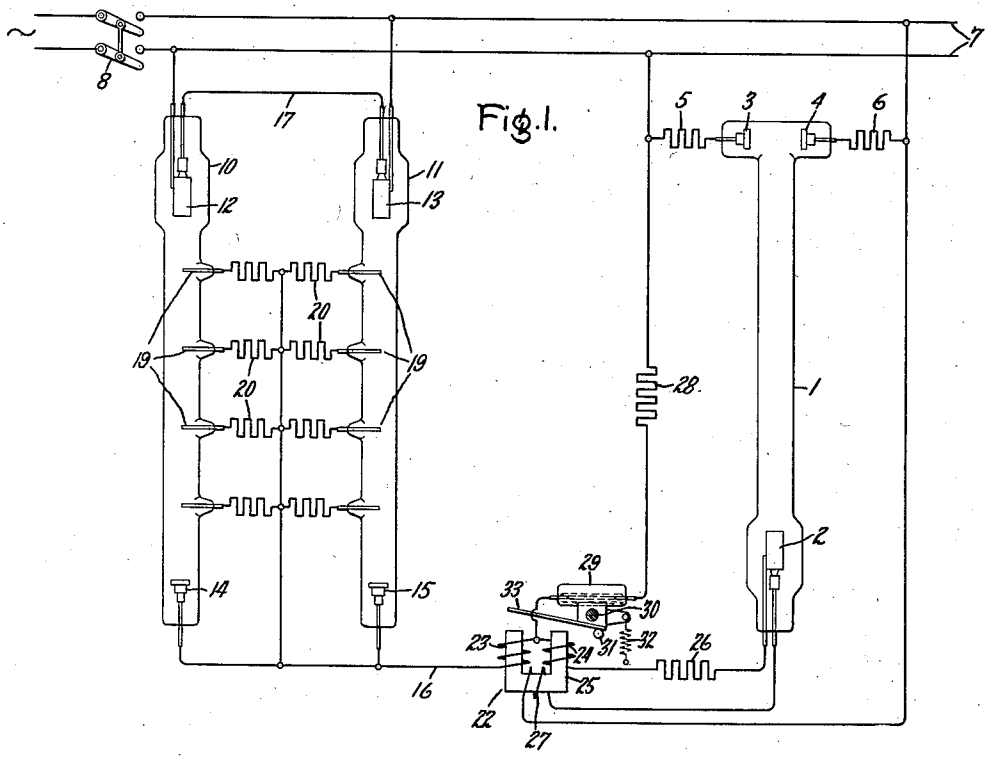
Jan. 2, 1934. W. F. WESTENDORP 1,942,078

ELECTRIC ILLUMINATING APPARATUS

Filed June 26, 1931



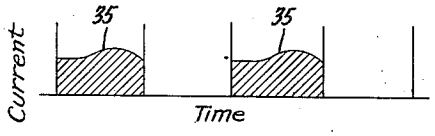


Fig. 2.

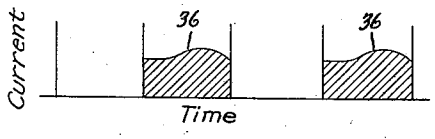


Fig. 3.

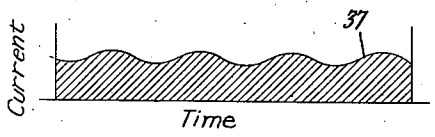


Fig. 4.

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ELECTRIC ILLUMINATING APPARATUS

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14 Claims. (Cl. 176—124)

My invention relates to electric illuminating apparatus. More particularly it relates to electric discharge illuminating apparatus operable from a single phase source of alternating current. One object of my invention is the provision of improved illuminating apparatus of this character which will operate without producing visible flicker. Another object is the provision of such apparatus the illumination produced by which gives the impression of daylight.

My invention will be better understood from the following description taken in connection with the accompanying drawing, and its scope will be pointed out in the appended claims.

Referring to the drawing, Fig. 1 is a diagram illustrating an embodiment of my invention; Figs. 2, 3 and 4 are time-current curves showing the current values in various parts of the apparatus.

In the embodiment of my invention illustrated by Fig. 1, I have shown the positive column discharge lamp 1 provided with the hot cathode 2 and main anodes 3 and 4. The lamp comprises a suitable envelope of glass or quartz containing a gas or vapor or a suitable gaseous mixture which becomes luminous when subjected to an electric discharge. Various gases and vapors may be used depending largely upon the particular kind of light which it is desired the lamp shall produce; for example, the gas or vapor may be argon, neon, helium, krypton, xenon, mercury or sodium.

The main anodes 3 and 4 connect through the controlling resistances 5 and 6 with opposite sides of the alternating current supply circuit 7, which, for example, may have a voltage of 110 volts or 220 volts and a frequency of 60 cycles the circuit being controlled by the switch 8.

At 10 and 11 are two other positive column discharge lamps having hot cathodes 12 and 13 respectively connected to opposite sides of the supply circuit 7 and having main anodes 14 and 15 respectively connected by conductor 16 and a reactance to be described later with the cathode 2 of lamp 1. Cathodes 12 and 13 connect with opposite sides of the source 7 and have heaters which by the conductor 17 are connected in series across the supply circuit 7. Lamps 10 and 11 comprise suitable envelopes of glass or quartz and contain gases or vapors, such, for example, as those mentioned above, the particular gas, vapor or mixture depending upon the quality of light which it is desired the lamps shall give. Both lamps are provided with a series of auxiliary starting electrodes 19 the current to which is controlled by the resistances 20 whose value may, for example, be 2000 ohms, 1000 ohms, 500 ohms and 250 ohms respectively, these values being named in order from the cathode to the anode of each lamp. A positive column discharge lamp having auxiliary starting anodes such as illustrated in this figure has been described and claimed in a copending application by Clifton G. Found and myself, Serial No. 529,710, filed April 13, 1931 and assigned to the same assignee as the present invention. The two main anodes 14 and 15 of lamps 10 and 11 connect through the inductance 22 with the cathode 2 of lamp 1.

For the starting of the discharge in the lamp 1 I have provided means now to be described by which the heating circuit of the lamp cathode is interrupted to produce an inductive kick the voltage of which is sufficient to start the discharge in the lamp. In the circuit connecting anodes 14 and 15 with cathode 2 is the reactance 22 shown comprising coils 23 and 24 wound in opposite directions upon two legs of a U-shaped core structure 25, coil 24 being connected with the cathode 2 through resistance 26. Included in the heating circuit of cathode 2 is a third coil 27 on the core 25 which coil is connected to produce a flux in the core opposing that produced by coil 24. Arranged also in the heating circuit of cathode 2 is the resistance 28 and the mercury switch 29 which switch is mounted to oscillate about the pivot 30, being retained in the closed circuit position against stop 31 by the spring 32. For tipping the mercury switch to open circuit position it is provided with the armature 33 arranged adjacent the ends of the core 25 so that when a flux in the core reaches a predetermined value the switch is tilted and the heating circuit is opened.

To start the lamps shown in Fig. 1, the main switch 8 is closed whereupon the cathodes 12 and 13 of lamps 10 and 11 begin to heat by reason of their direct connection across the circuit 7. Cathode 2 of lamp 1 also begins to heat since the circuit thereof is completed from one side of the supply circuit through resistance 28, mercury switch 29, coil 24, resistance 26, heater of cathode 2 and coil 27 back to the other side of the supply circuit. Since coils 24 and 27 on core 25 are arranged to oppose each other the resulting flux in the core is insufficient to operate the mercury switch. When cathodes 12 and 13 become sufficiently heated, the lamps become operative by the discharge rapidly progressing from one auxiliary anode 19 to the next finally reaching the main anodes. As soon as either or both lamps 10 and 11 become operative the discharge current thereof in flowing through the coil 23 on core

25 destroys the balance and produces a sufficient flux in the core to operate the mercury switch. The sudden opening of the heating circuit thereby in conjunction with the inductance in the circuit produces a sufficient inductive kick to start the discharge in lamp 1. If the lamp fails to start at the first operation of the mercury switch, the switch may operate a second or third time to insure starting of the lamp. After lamp 1 has started, the mercury switch remains in open circuit position the heating element of cathode 2 being then supplied by the rectified current received from lamp 10 and from anode 3 through lamp 1, the circuit being completed through coil 27.

Since lamps 1, 10 and 11 all are rectifying in their operation, it will be seen that the current which traverses the inductance 22 comprising coils 23 and 24 will be unidirectional. As a result of this arrangement the current waves which pass through lamps 10 and 11 have a general rectangular form, there being no apparent interval between the termination of the current wave through one lamp and the beginning of the current wave through the other lamp. This is illustrated by the curves comprising Figs. 2 and 3 where the hatched portions 35 of Fig. 2 represent the current waves passing through one lamp and hatched portions 36 of Fig. 3 represent the current waves passing thruogh the other lamp. Since the illumination produced by a discharge lamp varies with the discharge current thereof it will be seen that the two lamps taken together as a unit produce with the exception of a slight ripple a substantially uniform illumination which is free from visible flicker.

In Fig. 4 the hatched portion 37 represents the current waves in lamp 1; hence the illumination produced by lamp 1 which illumination is with the exception of a slight ripple substantially uniform and without flicker. While I have shown lamp 1 as comprising a single envelope having therein a cathode and a plurality of main anodes, the lamp obviously may comprise two seperate envelopes each containing a suitable gas or vapor and each having a cathode and a single main anode.

As mentioned above, the lamps 1, 10 and 11 may contain various gases or vapors in accordance with the kind of light which it is desired the lamps shall produce. For the purpose of providing illumination which shall give the sensation of daylight I prefer to employ in lamp 1 mercury vapor, and in lamps 10 and 11 neon. All three lamps taken together as a unit will therefore provide a combination of blue and red rays and the illumination resulting from such a unit gives to a person a sensation which is substantially the same as that produced by daylight.

I have chosen the particular embodiment described above as illustrative of my invention and it will be apparent that various other modifications may be made without departing from the spirit and scope of my invention which modifications I aim to cover by the appended claims.

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

1. Electric discharge apparatus for producing illumination without visible flicker from a single phase alternating current supply, comprising a discharge lamp having cathode means and a plurality of anodes, means for connecting each anode with a different side of said supply, an inductance connected with said cathode means and rectifying means connecting the inductance with both sides of said supply.

2. Electric discharge apparatus for producing illumination without visible flicker from a single phase alternating current supply comprising a positive column discharge lamp having a cathode and a plurality of anodes, a connection between each anode and a different side of said supply, a resistance in each connection, rectifying means connected with both sides of said supply and an inductance connected between said rectifying means and said cathode.

3. Electric discharge apparatus for producing illumination without visible flicker from a single phase alternating current supply, comprising a positive column discharge lamp having a cathode and a plurality of main anodes, each anode being connected with a different side of said supply, a resistance in each connection, a plurality of rectifying devices each connected with a different side of said supply and an inductance connected between said rectifying devices and said cathode.

4. Electric discharge apparatus for producing illumination without visible flicker from a single phase alternating current supply comprising a plurality of discharge lamps each having a cathode and an anode, means for connecting each cathode with a different side of said supply, an inductance in circuit with said anodes and means connecting said inductance with both sides of said supply for limiting the current flow to one direction through the inductance.

5. Electric discharge appartus for producing illumination without visible flicker from a single phase alternating current supply comprising a plurality of positive column discharge lamps each having a cathode, a main anode and an auxiliary starting anode, means for connecting said cathodes each with a different side of said supply, an inductance connected with said main anodes and rectifying means connecting the inductance with both sides of said supply.

6. Electric discharge illuminating apparatus adapted to give the impression of daylight and operable from a single phase alternating current supply without flicker, comprising electric discharge means containing mercury, electric discharge means containing neon, an inductance connected between said means and means for connecting each of said discharge means with both sides of said source.

7. Electric discharge illuminating apparatus adapted to give the impression of daylight and operable from a single phase alternating current supply without visible flicker, comprising a mercury vapor discharge lamp having a cathode and having anodes each connected with a different side of said supply, a plurality of discharge lamps containing neon each having an anode and a cathode, said cathodes each connected with a different side of said supply and means including an inductance connecting the cathode of the mercury lamp with the anodes of the neon lamps.

8. Electric discharge illuminating apparatus adapted to give the impression of daylight and operable from a single phase alternating current supply without visible flicker, comprising a mercury vapor discharge lamp having a single cathode and a plurality of anodes, means for connecting each anode with a different side of said supply, a plurality of discharge lamps containing neon and each having an anode and a cathode, means connecting the cathodes each with a different side of said supply, and an in-

ductance connected between the cathode of said mercury lamp and the anodes of said neon lamps.

9. Electric discharge illuminating apparatus adapted to give the impression of daylight and operable from a single phase alternating current supply without visible flicker comprising a mercury vapor discharge lamp having a single cathode and a plurality of anodes, means including resistances for connecting the anodes each with a different side of said supply, a plurality of discharge lamps containing neon each having a main anode, a cathode and an auxiliary starting anode, means for connecting the cathodes of the neon lamps each with a different side of said supply, and an inductance connected at one end with the cathode of said mercury lamp and at the other end with the main and auxiliary anodes of said neon lamps.

10. In combination, a source of single phase alternating current, a positive column discharge lamp having a hot cathode and having anodes each connected with a different side of said source, a plurality of positive column discharge devices having hot cathodes each connected with a different side of said source and having anodes connected with the hot cathode of said lamp and means responsive to current flow in said connection for producing an inductive starting impulse in said lamp.

11. Electric discharge apparatus for producing illumination without visible flicker from a single phase alternating current supply circuit comprising an inductance, a discharge lamp having a plurality of anodes and arranged to connect one end of the inductance with both sides of the supply circuit and rectifying means arranged to connect the other end of the inductance with both sides of said circuit.

12. Electric discharge apparatus for producing illumination without visible flicker from an alternating current supply circuit comprising a plurality of discharge lamps each having an anode and a cathode, means connecting each cathode with a different side of said circuit, an inductance in circuit with said anodes, and means connecting the inductance with both sides of said circuit.

13. Electric discharge apparatus for producing illumination without visible flicker from an alternating current supply circuit comprising a plurality of discharge lamps each having an anode and a cathode, each cathode being connected with a different side of said circuit, an electric discharge device having a plurality of anodes each connected with a different side of said circuit and having a cathode, and an inductance connected between the cathode of said device and the anodes of said lamps.

14. Electric discharge apparatus for producing illumination without visible flicker from an alternating current supply circuit comprising a plurality of discharge lamps each having an anode and a cathode, each cathode being connected with a different side of said circuit, an electric discharge device having a single cathode connected with the said anodes and having a plurality of anodes each connected with a different side of said circuit and an inductance in the connection of the lamp anodes with said single cathode.

WILLEM F. WESTENDORP.