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STARTING AND OPERATING CIRCUIT FOR ELECTRIC DISCHARGE DEVICES

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Fig. 1

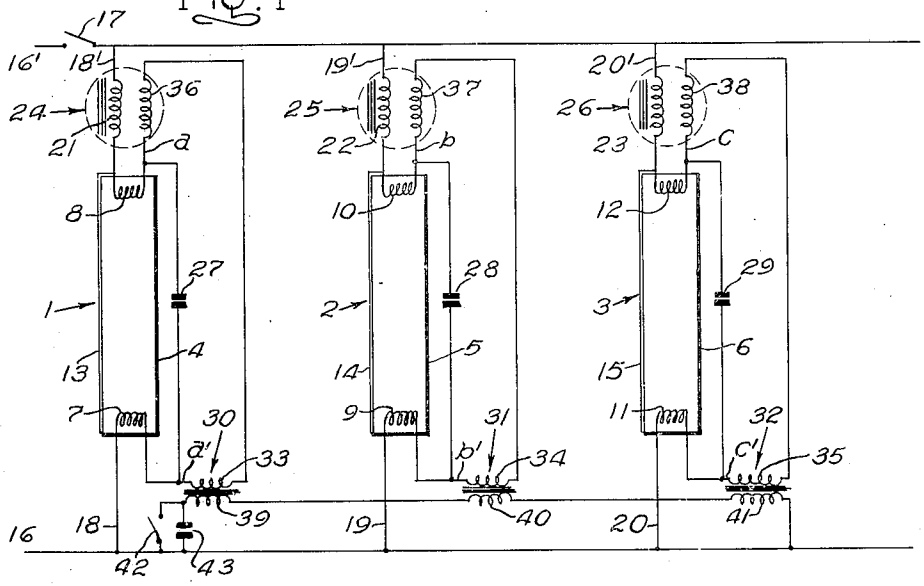
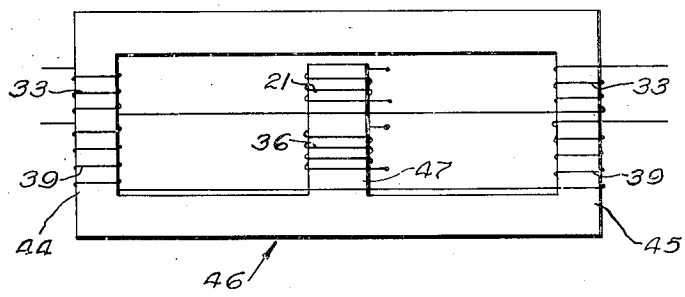


Fig. 2



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STARTING AND OPERATING CIRCUIT FOR ELECTRIC DISCHARGE DEVICES

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6 Claims. (Cl. 315—278)

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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 improvements in the circuits and apparatus used with fluorescent lamps utilizing filamentary electrodes.

Circuits now in wide use with fluorescent lamps are provided with means for heating the filamentary electrodes and for impressing a high voltage for a short duration across the electrodes for starting an electrical discharge therebetween. Some of these arrangements are provided to delay the application of the high voltage until the electrodes have reached the desired electron emitting temperature.

One method of starting fluorescent electric discharge lamps is by so-called resonance-starting, namely involving the energization of the lamp with alternating current in a resonant circuit which includes a stabilizing inductance in series with the lamp and capacitance in shunt with the lamp; in the case of lamps having filamentary electrodes, one terminal of each of the filaments are connected together through a capacitor, while their other terminals are connected to the alternating current supply circuit through stabilizing inductance.

Resonance-starting involves no difficulty where the supply is derived from a motor generator set which can be started up from rest each time the lamp or lamps may be required to be started, inasmuch as, during the speeding up of the set, the current in the lamp circuit will gradually rise and so cause the filaments to be heated before the voltage across the capacitor becomes sufficient to initiate the discharge. In circumstances where it is not possible, or is otherwise inconvenient, to supply the lamp or lamps from a motor generator set which can be started each time a lamp is required, other facilities must be available for affecting pre-heating of the lamp filaments before initiation of the discharge.

It has heretofore been proposed with reference to fluorescent lighting systems that the filamentary discharge electrodes of a fluorescent lamp may be arranged with one terminal of each of the filaments connected together through a capacitor, while the other terminals are connected with an alternating current supply circuit, either or both through stabilizing inductance, and to provide an electric switch arranged, when closed, for completing a local circuit across the capacitor. Thus, when current is circulated through the filamentary electrodes for heating them, the voltage applied across the gap between them is

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insufficient to support an arc discharge therebetween, whereas, when the switch is opened the local circuit is interrupted and the voltage between the filamentary electrodes increases sufficiently to initiate the arc discharge.

In one form of this arrangement the local circuit may include current limiting means for controlling the value of the current taken by the lamp during the heating period. These limiting means may be small choke coils or auxiliary windings or a choke coil having a main winding connected for providing stabilizing inductance in series with the lamp.

While such arrangement enables the starting of individual lamps very effectively, it is not particularly suited to conditions in which it is desired to start a plurality of lamps simultaneously.

An object of my invention is to provide a new and improved circuit for starting and operating electric discharge devices employing filamentary electrodes.

Another object of my invention is to provide a new and improved starting means for electric discharge devices which is particularly adapted for use in controlling a plurality of lamps.

A further object of my invention is to provide a new and improved means of controlling a plurality of lamps by means of a single switch.

Further features and advantages of my invention will appear from the following 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 drawing and its scope will be pointed out in the appended claims. Fig. 1 is a diagrammatic view of a plurality of electric discharge devices and a starting and operating circuit therefore incorporating my invention. Fig. 2 illustrates diagrammatically the transformer illustrated in Fig. 1 and incorporates therewith certain aspects of my invention.

Referring to Fig. 1, I have there illustrated one embodiment of my invention as applied to electric discharge devices 1, 2, and 3. The electric discharge devices 1, 2, and 3, such as fluorescent lamps, therein illustrated comprise elongated tubular or cylindrical envelopes 4, 5, and 6, respectively, having sealed into the ends thereof filamentary electrodes 7, 8 and 9, 10, and 11, 12, respectively, each herein illustrated as comprising a coil, preferably in the form of a coiled coil of tungsten wire activated with oxides of alkalin earth metals such as a mixture of barium or

strontium oxides. The envelopes 4, 5, and 6 contain gaseous atmospheres such as 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. The devices 1, 2, and 3 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. For ease of starting stripes or strips 13, 14, and 15 of conductive material which, for example, may be a metallic paint or graphite mixed with potassium silicate, may be applied to the surface of devices 1, 2, and 3, respectively.

In accordance with my invention devices 1, 2, and 3 are connected across a suitable power supply circuit 16, 16' which, for example, may be a 115 volt, 60 cycle source, for supplying current thereto. A manual make-and-break control switch 17 may be used to connect devices 1, 2, and 3 to the power supply. Starting and operating circuits 18, 18' and 19, 19' and 20, 20' for devices 1, 2, and 3, respectively, each comprises a parallel circuit including two branches in series with the electrodes of devices 1, 2, and 3, and stabilizing inductances or inductive ballasts 21, 22, and 23, respectively, across the source of power 16, 16'. Inductive ballasts 21, 22, and 23 may form a part of double wound coils 24, 25, and 26. The filaments of devices 1, 2, and 3 are bridged by capacitances 27, 28, and 29, respectively, forming one of the parallel branches of the starting and operating circuits 18, 18' and 19, 19' and 20, 20'. The other parallel branch of the various starting and operating circuits 18, 18' and 19, 19', and 20, 20' called preheating circuits *a*, *a'* and *b*, *b'* and *c*, *c'* comprises inductive devices which, for example, may be transformers 30, 31, and 32 having primary windings 33, 34, and 35, respectively in series with choke coils 36, 37, and 38 of the double wound coils 24, 25, and 26, respectively, and shunting the capacitances 27, 28, and 29, respectively. Secondary windings 39, 40, and 41 of transformers 30, 31, and 32 respectively, are connected in series through a control means or switch 42, shunted by a capacitor 43 and connected to one side of the source of power.

When the entire installation is energized by closing the manual make-and-break switch 17, current may flow through filamentary electrode 7, primary winding 33 of transformer 30, choke coil 36 of the double wound coil 24, filamentary electrode 8, and stabilizing inductor or ballast 21 of the double wound coil 24. Current may flow through each of the other starting and operating circuits for devices 2 and 3 in a similar and corresponding manner. This current by the proper design of the double wound coils and the transformers may be limited to a very low value. Upon closing control switch 42, the secondary windings 39, 40, and 41 of transformers 30, 31, and 32, respectively, are short-circuited. In such an arrangement when the secondary windings are short-circuited, the primary winding's reactance is reduced from a high or maximum value to a value low enough to enable the requisite heating current to flow through the filamentary electrodes. When control switch 42 is re-opened and the secondary windings of the transformers are substantially open-circuited, the reactance of the primary windings rises and enables the voltage across the condenser to rise sufficiently to initiate arc discharges between the electrodes of the various devices. The peak voltage across the condenser shunting the electrodes of the devices may occur at that point after re-opening switch 42 when the impedance of the preheating circuit is a maximum. Thus, at the point where the impedances of the preheating circuits are maximum resonant conditions exist between capacitances and inductive impedances in the starting and operating circuits for the devices and simultaneously with the decrease in current in the preheating circuits arc discharges occur in the devices by virtue of the ionization produced by the heated electrodes.

As mentioned above the primary windings of the transformers are each connected with a current limiting choke coil across the condenser shunting the electrodes of the various devices. Alternatively, the primary windings of the respective transformers may be connected directly across the condensers shunting the electrodes of the various devices and arranged to provide sufficient leakage reactance between the two transformer windings to limit the lamp heating current when the secondary windings are short-circuited by the switch, thus eliminating choke coils 36, 37, and 38.

If desired the double choke coil and the transformer in each discharge lamp circuit may be combined in a single unit. For example, the windings of the transformer as indicated in Fig. 2 may be arranged on outer legs 44 and 45 of a core 46 having a center leg 47, half the primary and secondary windings being arranged together on each outer leg, while the current limiting choke coil and the stabilizing choke coil being arranged on the center leg which is provided with an air gap. Since the windings of the transformer are on the outer legs, which present a closed iron path without air gaps, flux from the choke coils will be prevented from linking with the windings of the transformers and vice versa; or in other words, the arrangement is such that the mutual inductance between the transformer windings and the choke coils is zero.

Although, I have disclosed my invention with reference to a plurality of discharge lamps, my invention is not so restricted, but may readily be used with a starting and operating circuit for a single discharge lamp.

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

1. In combination, an alternating current supply circuit, an electric discharge device of the type employing an ionizable medium and comprising a plurality of electrodes at least one of which is of a filamentary type, an inductive ballast connected in series relation with one terminal of said source and one of said electrodes, and a preheating circuit connected between said one electrode and the other electrode and comprising an inductive means inductively associated with said ballast and a transforming means comprising a primary winding means connected in series relation therein and a secondary winding means for controlling the effective impedance of said preheating circuit to increase the preheating current and subsequently decrease the preheating current and for producing simultaneously with the decrease in preheating current a starting voltage across said electrodes by virtue of the change of current in the preheating circuit.

2. In combination, an alternating current supply circuit, a plurality of parallel connected electric discharge devices of the type employing an ionizable medium and each comprising a plurality of electrodes at least one of which is of a filamentary type, a plurality of inductive ballasts each connected to one terminal of said circuit and to an electrode of different devices, a plurality of preheating circuits shunting said devices and each comprising an inductive means inductively connected with the associated ballast and a second inductive device, and a means for controlling the effective impedance of all preheating circuits to control the preheating current and simultaneously produce starting voltages across said electrodes by virtue of the change of current in the preheating circuits.

3. In combination, an alternating current supply circuit, an electric discharge device of the type employing an ionizable medium and comprising a plurality of electrodes at least one of which is of a filamentary type, an inductive ballast connected in series relation with one terminal of said source and one of said electrodes, a variable impedance preheating circuit connected between said one electrode and the other electrode and comprising an inductive means inductively associated with said ballast and a second inductive device connected in series relation therein, a capacitance connected across said electrodes constituting with the inductance of said ballast a resonant circuit when the impedance of said preheating circuit is maximum, and means for controlling said second inductive device to increase the preheating current and subsequently decrease the preheating current and for producing simultaneously with the decrease in current an arc discharge in said device by virtue of the ionization produced by the heated electrodes.

4. In combination, an alternating current supply circuit, an electric discharge device of the type employing an ionizable medium and comprising a plurality of electrodes at least one of which is of a filamentary type, an inductive ballast connected in series relation with one terminal of said source and one of said electrodes, a variable impedance preheating circuit connected between said one electrode and the other electrode and comprising an inductive means inductively associated with said ballast and a transforming means comprising a primary winding means connected in series relation therein and a secondary winding means, a capacitance connected across said electrodes constituting with the inductance of said ballast a resonant circuit when the impedance of said preheating circuit is maximum, said secondary winding means controlling the effective impedance of said preheating circuit to increase the preheating current and subsequently decrease the preheating current and

for producing simultaneously with the decrease in preheating current a starting voltage impulse across said electrodes by virtue of the change of current in the preheating circuit.

5. In combination, an alternating current supply circuit, a plurality of parallel connected electric discharge devices of the type employing an ionizable medium and each comprising a plurality of electrodes at least one of which is of a filamentary type, a plurality of inductive ballasts each connected to one terminal of said circuit and to an electrode of one of said devices, a plurality of preheating circuits shunting said devices and each comprising an inductive means inductively connected with the associated ballast and a transforming means comprising a primary winding means connected in series relation therein and a secondary winding means, a capacitance connected across said electrodes constituting with the inductance of said ballast a resonant circuit when the impedance of said preheating circuit is maximum, said secondary winding means controlling the effective impedance of said preheating circuit to increase the preheating current and subsequently decrease the preheating current and for producing simultaneously with the decrease in preheating current a starting voltage impulse across said electrodes by virtue of the change of current in the preheating circuit.

6. In combination, a source of alternating current supply, an electric discharge device of the type employing an ionizable medium and comprising a plurality of electrodes of a filamentary type, connections between one end of each of said electrodes and said source, an inductive ballast in one of said connections, a capacitance connecting the other ends of said electrodes, a transformer comprising a primary winding connected in shunt with said capacitance, and switching means arranged to short-circuit or open-circuit the secondary winding of said transformer whereby when the secondary winding is short-circuited the primary reactance of the transformer is low enough to enable the requisite heating current to flow through the filament whereas when the secondary winding is open-circuited the primary reactance is high enough to enable the voltage across the capacitance to rise sufficiently to initiate a discharge between the electrodes.

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