

Nov. 28, 1944.

W. J. KARASH

2,363,868

APPARATUS FOR STARTING AND CONTROLLING DISCHARGE DEVICES

Filed April 21, 1942

Fig. 1.

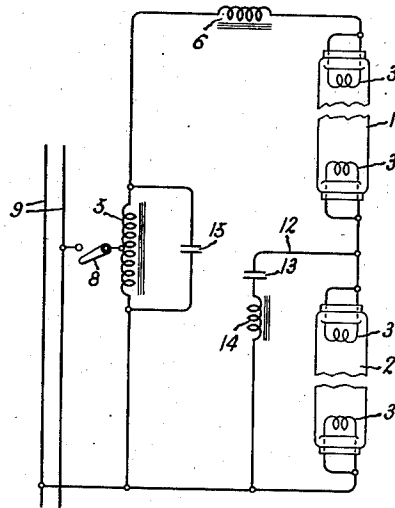
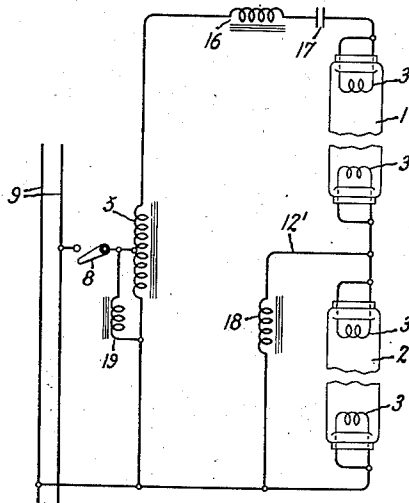


Fig. 2.



Inventor:
Walter J. Karash,
by *Harry E. Dunham*
His Attorney.

UNITED STATES PATENT OFFICE

2,363,868

APPARATUS FOR STARTING AND CONTROLLING DISCHARGE DEVICES

Walter J. Karash, Annapolis, Md., assignor to
General Electric Company, a corporation of
New York

Application April 21, 1942, Serial No. 439,819

6 Claims. (Cl. 315—188)

My invention relates to apparatus for starting and controlling electric discharge devices such as discharge lamps of the fluorescent type which are now coming into common use. It relates particularly to apparatus for starting a plurality of similar electric discharge devices connected to be operated in series from a source of current supply. As at present constructed, a lamp of that type comprises a long transparent tubular envelope containing mercury vapor at a low pressure and having its side walls coated with a suitable phosphor which under the influence of an electric discharge through the mercury vapor produces fluorescence. The lamp electrodes which are mounted in the ends of the envelope are filamentary in form and are coated with a suitable electron emissive material. Such a lamp requires for its starting the application of a voltage or electric impulse considerably higher than the voltage necessary to keep the lamp in operation after it has been started, the starting voltage required being materially less if one or both of the lamp electrodes are heated to an electron emitting temperature prior to the application thereof. A preheating of the electrodes of such lamps as they have been constructed heretofore, moreover, has been essential in order to avoid excessive damage to the electrodes by the starting voltage and the attendant blackening of the lamp walls in the vicinity of the electrodes by the material knocked off them. By reason of recent developments made in such lamps particularly in the construction of their electrodes prior heating of the electrodes is not as essential to the prevention of injury to the lamp as heretofore. Because of the desire to avoid the time delay occasioned by electrode preheating, notwithstanding the fact that lamps as heretofore constructed were known to be seriously injured by being continually started without electrode preheating, apparatus has been used which would produce a voltage peak or impulse sufficiently high to make the lamp break down immediately upon its application thereto.

It is an object of my invention to provide improved apparatus for starting a plurality of similar electric discharge devices connected to be operated in series from a source of current supply whose voltage is less than the sum of the starting voltages of said devices but is greater than the starting voltage of one of the devices.

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, Figs. 1 and 2 are cir-

cuit diagrams illustrating two embodiments of my invention.

In Fig. 1 two long tubular similar discharge devices which, for example may be 40 watt fluorescent lamps are shown diagrammatically at 1 and 2 each provided with filamentary electrodes 3 which may or may not be short circuited as shown by the drawing. The lamps 1 and 2 when started without any preheating of their electrodes may each require from 400 to 450 volts to start depending upon various conditions such as the geometry of the envelope and the temperature of the ambient. The envelopes of the lamps contain mercury vapor at low pressure and the side walls thereof have a phosphor thereon which when excited by a discharge through the mercury vapor produces fluorescence. The two lamps are connected to be operated in series from the secondary of the auto-transformer 5, the connection including the ballast reactor 6. The voltage of the secondary may, for example, be 600 volts and the reactance of the ballast may be 1140 ohms. The transformer 5 has its primary connected through the control switch 8 with the source 9 of alternating current supply which, for example, may be a 115 volt, 60 cycle lighting circuit.

Inasmuch as the combined starting voltage of the two lamps in series is considerably higher than the secondary voltage of the transformer 5 it will be seen that the lamps when connected in series with the transformer as shown will not start without the aid of other apparatus but after having been started they will continue to operate in series. To effect the starting of the lamps, I have provided the circuit 12 shunting the lamp 2 and comprising the capacitor 13 and the reactor 14 whose reactive impedances may be 5300 and 1240 ohms respectively. The net reactance of the shunt circuit therefore is capacitive and the net reactive voltage of that circuit is opposite in character to the reactive voltage of the ballast 6. By reason of this shunt circuit substantially the full voltage of the transformer 5 is initially applied to the lamp 1 and is sufficient to cause a discharge to start therein. Since the combined reactance of the capacitor 13 and the reactor 14 considered as a unit is capacitive when current passes through them after the lamp 1 has started and as the reactive voltage of that unit is opposite in character to the reactive voltage of the ballast 6 a voltage appears across the unit which is higher than the starting voltage of the lamp 2. It will be understood that from the values given above of the relative reactive impedances of the reactors 6 and 14 and capacitor 13 that this combination will be in the

condition of partial resonance so that the resonant effect of the reactor and reactor circuit which comprises the capacitor 13 and reactor 14 produces a starting voltage across the other lamp 2 which may be in the range of equal to or greater than the voltage of the source, depending upon the degree of resonant effect, as the amount of resonant effect needed is, of course, governed by the relative values of the potential of the source and the starting voltage of the lamp.

When the switch 8 is closed to operate the lamps the lamp 1 immediately starts and the current taken thereby traverses the ballast reactor 6 and the shunt circuit comprising the capacitor 13 and the reactor 14. The voltage then applied to the lamp 2 by the shunt circuit causes that lamp also to start after which the current traversing the shunt circuit drops to a low value. The two lamps 1 and 2 thereafter continue to operate connected in series across the secondary of the transformer 5 and since the ballast 6 is inductive the lamp current is lagging. If it is desired that the energy taken from the source 9 shall be at approximately unity power factor one may connect a suitable capacitor represented at 15, across the secondary of the transformer.

In Fig. 2 the lamps 1 and 2 and the transformer 5 are similar to the above-described corresponding parts of Fig. 1, but in this case the lamps operate with a leading current. The lamp ballast in Fig. 2 comprises the reactor 16 and the capacitor 17, the reactive impedances of which may for example be 784 and 2150 ohms respectively, and since the impedance of the capacitor is greater than that of the reactor the lamp circuit is capacitive. To effect the starting of the lamps I have provided the circuit 12' which is connected in shunt with the lamp 2 and comprises the reactor 18, whose reactance may for example be 4350 ohms. As this reactor is the only reactive element in the shunt circuit, it will be seen that the reactive voltage of the shunt circuit is opposite in character to that of the lamp ballast. As in Fig. 1 the voltage of the transformer is sufficient to start the lamp 1 and after it starts, the voltage appearing across the shunt circuit 12' is sufficient to cause the lamp 2 to start. If in this form of my invention it is desired that the energy taken from the source 9 shall be at approximately unity power factor one may connect a suitable reactor, as indicated at 19, across the primary of the transformer 5 or, if preferred, he may construct the core of the transformer with an air gap therein thereby to increase the exciting current of the transformer.

When the switch 8 is closed, lamp 1 immediately starts and the current taken by it flows through the ballast 16, 17, and the shunt circuit 12' including the reactor 18. The resulting voltage appearing across the ends of the shunt circuit is sufficient to cause the lamp 2 to start after which both lamps 1 and 2 continue to operate with capacitive ballast and hence with a leading current.

In either of the above-described forms of my invention if it is desired that the currents taken by the two lamps be more nearly equal during their operation and also if greater stability of the lamps be desired one may build into the reactor employed in the shunt circuit 12 or 12' somewhat more resistance than would otherwise be employed or, if preferred, he may insert a separate small resistor in that circuit.

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

1. In combination, a plurality of electric discharge devices, means having reactive impedance for connecting said devices to be operated in series from a source of alternating current whose voltage is less than the sum of the starting voltages of said devices but greater than the starting voltage of one of said devices, and a reactive circuit connected across another of said devices, the reactive voltage of said circuit being opposite in character to the reactive voltage of said impedance, whereby after said one device is started the resonant effect of said impedance and said reactive circuit produces a starting voltage across said other device which is substantially equal to or higher than the voltage of said source.

2. In combination, a plurality of electric discharge devices, a reactor for connecting said devices to be operated in series from a source of alternating current whose voltage is less than the sum of the starting voltages of said devices but greater than the starting voltage of one of said devices, and a reactive circuit whose reactance is predominantly capacitive connected across another of said devices, whereby after said one device is started the resonant effect of said reactor and said reactive circuit produces a starting voltage across said other device which is substantially equal to or higher than the voltage of said source.

3. In combination, a plurality of electric discharge devices, reactive means whose reactance is predominantly capacitive for connecting said devices to be operated in series from a source of alternating current whose voltage is less than the sum of the starting voltages of said devices but greater than the starting voltage of one of said devices, and a reactive circuit whose reactance is predominantly inductive connected across another of said devices, whereby after said one device is started the resonant effect of said reactive means and said reactive circuit produces a starting voltage across said other device which is substantially equal to or higher than the voltage of said source.

4. In combination, a plurality of electric discharge devices, a step-up transformer the voltage of the secondary of which is less than the sum of the starting voltages of said devices but greater than the starting voltage of one of said devices, means comprising a reactor connecting said devices in series across the secondary of said transformer, and a capacitive circuit comprising a reactor and a capacitor connected across another of said devices, whereby after said one device is started the resonant effect of said means and said capacitive circuit produces a starting voltage across said other device which is substantially equal to or higher than the voltage of said source.

5. In combination, a plurality of electric discharge devices, a step-up transformer the voltage of the secondary of which is less than the sum of the starting voltages of said devices but greater than the starting voltage of one of said devices, means comprising a reactor and a capacitor, the reactance of the later being greater than that of the former, connecting said devices in series across the secondary of said transformer, and a reactor connected across another of said devices, whereby after said one device is started the resonant effect of said means and said last mentioned reactor produces a starting

voltage across said other device which is substantially equal to or higher than the voltage of said source.

6. In combination, a plurality of electric discharge lamps having spaced electrodes, means including a reactive ballast for supplying from a source of supply operating current to said lamps in series and voltage for starting one of them, said means including reactive means con-

5 nected across the other of said lamps and having a reactive voltage opposite in character to the reactive voltage of said ballast, whereby after said one lamp has started the resonant effect of said ballast and said reactive means produces a starting voltage across said other lamp which is substantially equal to or higher than the voltage of said source.

WALTER J. KARASH.