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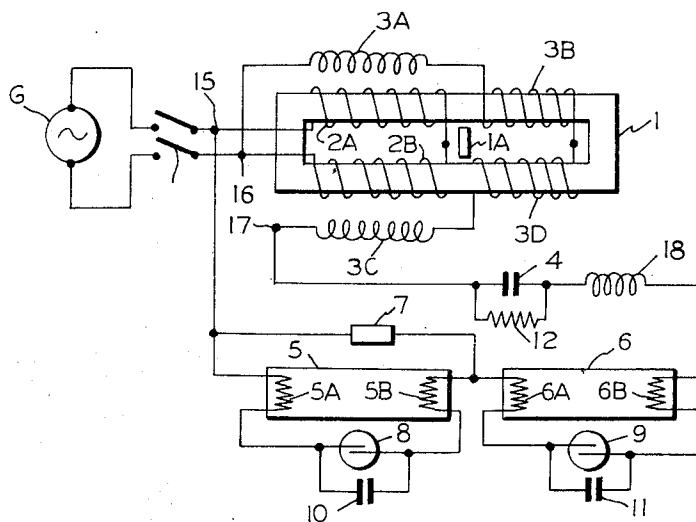
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[54] **PLURAL FLOURESCENT LAMP STARTING CIRCUIT USING AN UNIGNITED LAMP AS BALLAST AND A FLUX LEAKAGE TRANSFORMER AS TO OBTAIN SUITABLE CONTROL VOLTAGES**
3 Claims, 2 Drawing Figs.

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315/99, 315/254, 315/257, 315/278, 336/170
 [51] **Int. Cl.**..... **H05b**
41/18, H01z 27/28
 [50] **Field of Search**..... **315/94, 95,**
96, 98, 100, 105, 107, 185, 254, 157, 156, 178,
323; 336/170

ABSTRACT: A starting system for gaseous discharge devices, in which a transformer is used, comprising a magnetic core having two sections, a plurality of primary windings wound about one section, and a plurality of secondary windings, one portion wound about the one section commonly with the primary windings, and another portion wound about the other section, with suitable connections of the secondary windings to the discharge devices. The split secondary windings on different sections of the core, acts as a transformer and ballast choke.



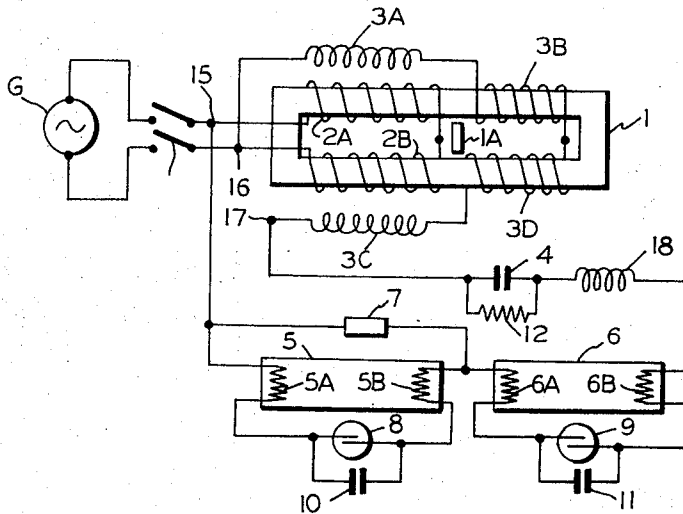


FIG. 1

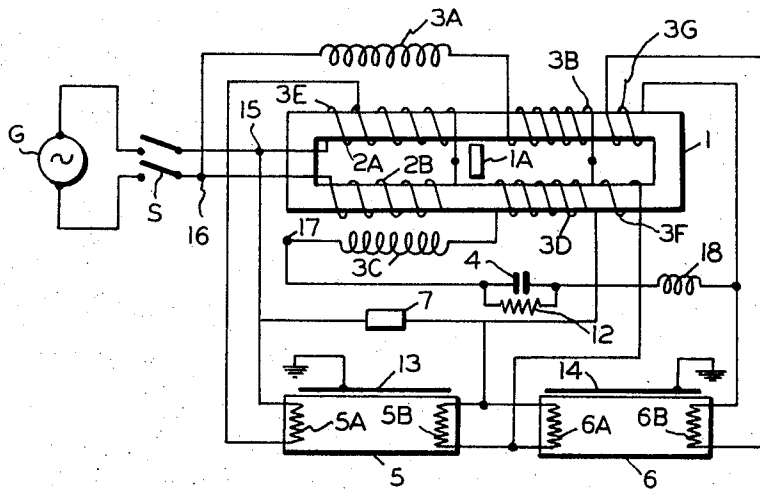


FIG. 2

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PLURAL FLOURESCENT LAMP STARTING CIRCUIT USING AN UNIGNITED LAMP AS BALLAST AND A FLUX LEAKAGE TRANSFORMER AS TO OBTAIN SUITABLE CONTROL VOLTAGES

DISCLOSURE

This invention relates to a system for operating gaseous discharge devices.

An object of the invention is to provide a starting and operating system for gaseous discharge devices, such as fluorescent lamps, which does not require the heavy duty inductive or impedance-type ballasts used in the prior art systems, and which system will improve current regulation.

The foregoing and other objects are attained in an illustrative embodiment of this invention which employs a transformer comprising a magnetic core having a first and a second section, a plurality of primary windings wound on the first section, and a plurality of secondary winding having a first portion wound about the first section commonly with the primary windings, and a second portion wound about the second section of the magnetic core. The secondary windings are connected to the filaments of one or more gaseous discharge devices.

The secondary windings wound about the second section of the magnetic core have a sufficient amount of flux leakage to cause the secondary windings to act as both transformer and ballast choke. Additional ballasts have been found to not be required with use of the transformer of this invention, in starting circuits for gaseous discharge device. Advantageously, economy of power, efficiency, greater current stability, and reduction in physical size result from use of this invention.

These and other objects, features and advantageous results of this invention will become more apparent from a consideration of the following detailed description taken in connection with the following drawing, in which:

FIG. 1, depicts an illustrative embodiment of this invention in connection with a pair of preheated-type (FL) fluorescent lamp, and

FIG. 2, depicts another illustrative embodiment of this invention in connection with a pair of rapid start-type (FLR) fluorescent lamps.

Turning now to the drawing, in FIG. 1, there is depicted a transformer comprising a magnetic core 1, primary windings 2A and 2B wound about one section of core 1, and secondary windings comprising portions 3A and 3C wound (although shown only symbolically) commonly about the same section of core 1 with the primary windings 2A and 2B. A flux leakage path is additionally provided by magnetic conductor 1A.

The primary windings 2A and 2B are connected via switch S to generator or power source G. Connected to terminal 17 of the secondary windings is capacitor 4, which is connected in shunt to static discharge resistor 12, filter inductor 18, and filament 6B of preheated-type (FL) fluorescent lamp 6. The other terminal 16 of the secondary windings is connected to primary winding 2B as depicted. Terminal 15 is connected to impedance 7 and filament 5A of preheated-type (FL) fluorescent lamp 5.

Lamps 5 and 6 are connected in series circuit to each other as depicted, with impedance 7 connected in parallel circuit across lamp 5. Also connected in parallel across lamp 5 is a shunt combination of glow starter switch 8 and noise suppressing capacitor 10. A similar combination of glow starter switch 9 and noise suppressing capacitor 11, is connected in shunt circuit across lamp 6.

In operation, when switch S is closed, current is applied through primary windings 2A and 2B to cause higher voltage out of secondary winding 3A, 3B, 3C and 3D, which higher voltage is applied to the series connected circuit. Since glow starter switches 8 and 9 are normally open, current will be shunted around lamp 5 through impedance 7, and be applied entirely to glow switch 9, which is then caused to glow and close. Substantially all of the current then is applied to filaments 6A and 6B, of sufficiently high voltage to cause lamp 6

to break down and ignite. Thereupon, since very little resistance exists in a lit gaseous discharge lamp, substantially all of the current will be applied to glow switch 8, thus causing it to glow and close. This causes substantial voltage to be applied to the filaments of lamp 5, thereby causing it to ignite. Flow switch 9 in the meantime has cooled and opened. The same occurring later with flow switch 8 after ignition of lamp 5.

Impedance 7 is of sufficient value to enable shunting of initial current around lamp 5 thus causing lamp 6 to ignite after glow switch 9 has closed, and also to enable glow switch 8 to operate after ignition of lamp 6. Impedance 7 also prevents any excess current from harming the circuit in the event of any element breakdown.

The filter inductor 18 is not necessary to the operation of the circuit, but may be used to obtain further current stability. Its size need not be large.

As depicted, the transformer comprises a magnetic core having two sections. On one section is wound primary windings 2A and 2B. Also wound on the same one section commonly with the primary windings 2A and 2B are secondary windings 3A and 3C. Wound about the other section of core 1 are windings (secondary) 3B and 3D. It has been discovered that the other section through flux leakage will act as a separate inductor in the circuit. Flux leakage device 1A, enables greater flux leakage. Although the ratio of commonly wound secondary windings 3A and 3C to the total number of secondary windings 3A, 3B, 3C and 3D, depends upon the other circuit elements used, it has been found that when this ratio is with in the range of from 10 to 80 percent, the circuit would be most effective. Advantageously, the windings 3B and 3D, act as both secondary winding of a transformer and also as a choke ballast. Thus, high voltage necessary for starting the lamps is obtainable without the use of heavy duty chokes, and ballast is provided to compensate for the surge of current resulting from the ignition of the lamps without use of heavy duty chokes.

Although the circuit of FIG. 1 is depicted as showing a pair of lamps, together with flow switches 8 and 9 connected in parallel therewith, the principles of this invention are applicable to one or more gaseous discharge devices without use of such glow switches.

In FIG. 2, there is depicted a circuit which does not use flow switches and uses another type of gaseous discharge devices, a pair of rapid start (FLR) fluorescent lamps 5 and 6. The elements which are common to FIGS. 1 and 2 are labeled with the same numerals and letters. Since their functions are similar, they will not be discussed or described again in connection with this figure. The difference between the two figures are the addition of additional third windings 3E, 3F, and 3G on magnetic core 1, to which windings are, respectively, connected filaments 5A, interconnected filaments 5B and 6A, and filament 6B. The rapid start fluorescent lamps 5 and 6, have grounded static shield 13 and 14 respectively.

The percentage of number of secondary windings 3A and 3C to the total number of secondary windings 3A, 3B, 3C and 3D ranges between 10 percent and 80 percent. In this case, when 80 watt rapid start-type (FLR-80) fluorescent lamps were used, the percentage was about 40 percent.

The high impedance element 7 is of such value as to not short circuit lamp 5, and to prevent the full current from flowing to lamp 6, yet enable flow of small initial trickle discharge current to lamp 6 when the starting voltage is initially applied thereto. One example of such an impedance is a capacitor of 0.2 microfarad capacity.

To operate this embodiment, switch S is closed. Sufficient starting voltage is induced in secondary windings 3A, 3B, 3C, 3D. The starting voltage will initially be applied to filament 5A, filament 6B, and filament 6A through impedance 7. None of the lamps will ignite instantaneously since insufficient voltage will be applied to any of them. However, small initial trickle discharge will occur first in lamp 5 when the starting voltage is initially applied. This would lower the resistance of lamp 6. An initial trickle discharge of lamp 5 will then occur

3

and cause decrease in the impedance of lamp 5, and increase the starting voltage applied thereto. This action in turn causes starting voltage to increase at lamp 6, thus further lowering its impedance, as the trickle discharge increases.

This differential stepwise ignition process is repeated until the total internal impedance of the two lamps 5 and 6 are sufficiently low to enable the starting voltage to pass current through the two lamps. Although lamp 6 is the first to start the initial trickle discharge, the starting of both lamps is substantially simultaneous, since they are both connected in series and impedance element 7 is of sufficient value to prevent initial flow of full lamp current to either.

In one example, the following elements were used in the circuit of FIG. 2: a pair of 80 watt rapid start-type fluorescent lamps (FLR-80), primary voltage of 100 volts at 50 cycles, rated starting voltage of 305 volts or 152.5 volts per lamp, rated lamp current of 0.90 amps, minimum starting voltage at the primary of 85 volts (equivalent to 260 volts or 130 volts per lamp at the secondary circuit). Tests were run on the circuit and the results are tabulated below.

Primary voltage, volts	Primary current, amps	No load secondary voltage, volts (start)	Lamp current, amps	Lamp voltage, volts
120	2.00	360	0.945	190
115	2.05	345	0.94	191
110	2.10	333	0.93	194
105	2.16	320	0.92	195
100	2.20	305	0.90	200
95	2.23	293	0.88	201
90	2.24	275	0.86	202
85	2.23	260	0.82	205
80	2.18	247	0.79	207
75	2.10	230	0.71	211
70	2.00	215	0.64	215

The stability of lamp current was found to be satisfactory when tests were run with primary voltage varying from 70 to 120 volts. It is understood that the foregoing is only illustrative of the principles of this invention and that numerous other changes and modification would be obvious to one skilled in the art without departing from the spirit and scope of this invention.

I claim:

1. In combination:

- 1. a pair of fluorescent lamps;
- 2. a first high impedance means connected in shunt circuit across one of said pair of fluorescent lamps;
- 3. a second impedance means comprising a capacitor and a

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high resistance connected in shunt circuit across said capacitor;

4. a voltage source;

5. a transformer comprising

a. closed magnetic core having four interconnected branches,

b. a pair of primary windings wound about a first pair of said branches,

c. two pairs of secondary windings, one of said two pairs wound about said first pair of said branches commonly with said primary windings, and the other of said two pairs wound about the other pair of said branches, said first pair having a number of turns comprising from 10 percent to 80 percent of the total number of turns of said two pairs of secondary windings, and,

d. flux leakage means disposed between said first pair and said second pair of said branches;

6. means for serially connecting said primary windings to each other;

7. switch means for connecting said series connected primary winding to said voltage source;

8. means for serially connecting said secondary windings to each other;

9. and means for connecting in series circuit said serially connected secondary windings, said serially connected fluorescent lamps and said second impedance, whereby operation of said switch means causes energization of said primary windings and generation of voltage in said secondary windings thereby to place voltage across both of said fluorescent lamps, with said first impedance means shunting substantially all of said voltage to the other of said pair of fluorescent lamps, thereby to cause ignition thereof, thereafter substantially of said voltage is placed across said one of said pair of fluorescent lamps thereby to cause ignition thereof, said leakage means thereupon causing lowering of voltage across both of said fluorescent lamps.

2. The combination of claim 1, wherein said fluorescent lamps comprise preheated-type fluorescent lamps, and a flow starter switch is connected in shunt circuit across each of said lamps.

3. The combination of claim 1, wherein said fluorescent lamps comprise rapid start-type fluorescent lamps, each having heating elements, and wherein said transformer has a plurality of third winding wound on said magnetic core, and means for connecting said third windings to said heating elements.

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