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GASEOUS DISCHARGE LAMP CIRCUIT EMPLOYING A PULSER AND A SATURABLE REACTOR

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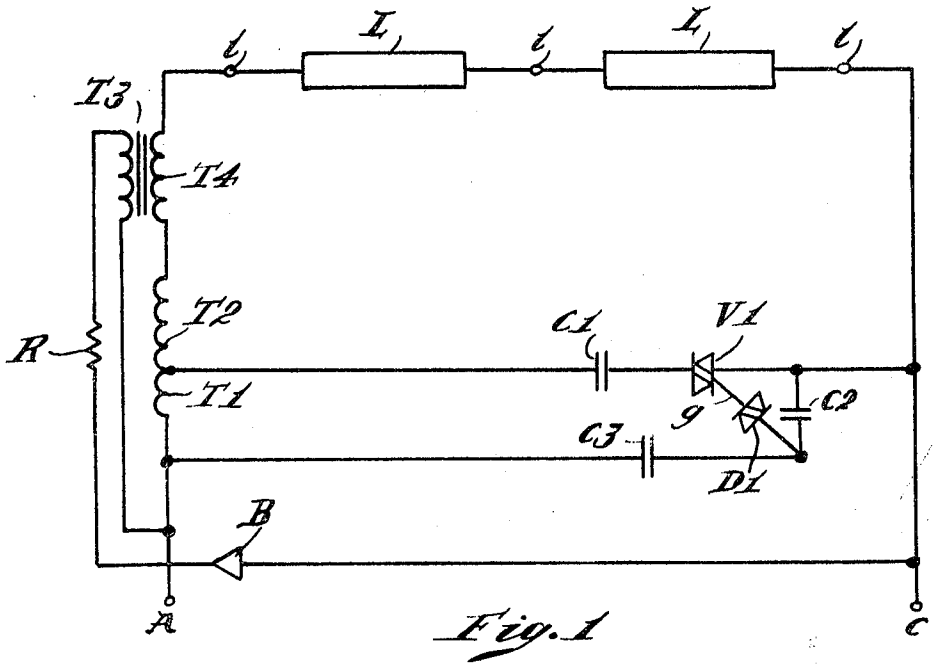


Fig. 1

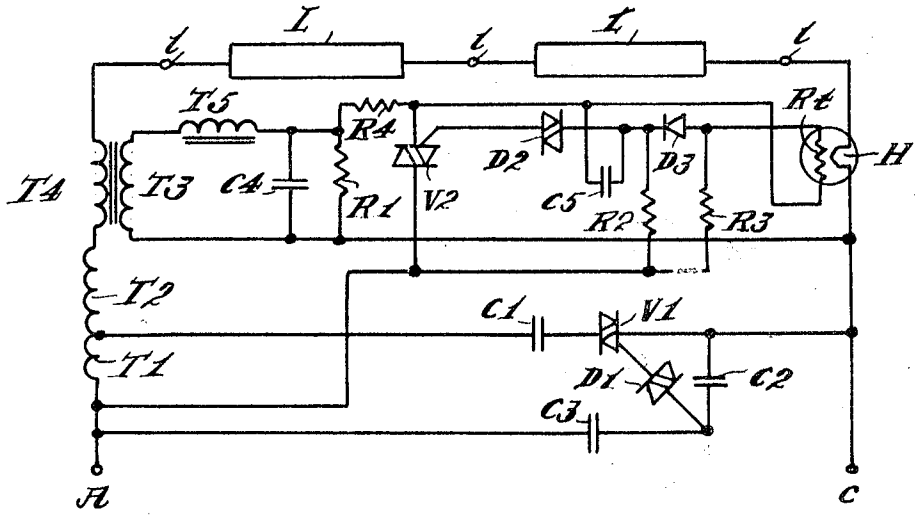


Fig. 2

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GASEOUS DISCHARGE LAMP CIRCUIT EMPLOYING A PULSER AND A SATURABLE REACTOR

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ABSTRACT OF THE DISCLOSURE

An electronic circuit having a semiconductor pulse generating circuit for applying ionizing pulses to a fluorescent lamp, and an amplifier or thermistor for sensing voltage or current applied to or drawn by the lamp and limiting the amplitude of the ionizing pulses inversely dependent on the current.

Conventional fluorescent lamp starting and operating circuits have comprised a ballast for applying a high starting voltage to the lamp to ionize it and start discharge and for inductively limiting current through the ionized lamp. Because of the weight and bulk of the ballast and its high expense, heating and noise, control circuits have been proposed which start and control the lamp discharge by various electronic switching circuits. Some of the advanced electronically valved circuits comprise pulse generating or gating means for periodically applying a voltage pulse to the lamp thereby ionizing the lamp sufficiently to support an arc discharge for a limited period, usually a half-cycle or less of the alternating current supply. If the amplitude and duration of the pulse is very precisely controlled the lamp will tend to extinguish after each pulse application, rather than draw increasingly greater, run-away current as its negative resistance characteristic would otherwise allow.

Despite the above described inherent current control of electronic pulse applying circuits, it is desirable in some instances to employ further current limiting, and it is the object of the present invention to provide a circuit which cooperates with advantageous electronic pulse applying circuits positively to limit current drawn by a fluorescent lamp.

According to the invention a fluorescent lamp regulating circuit comprises discharge terminals for connection to a lamp, power terminals for connection to a supply of alternating current, a power circuit connecting said power terminals to said discharge terminals including means for applying periodic voltage pulses to said discharge terminals thereby to start an arc discharge by ionization in the lamp and to draw current from said alternating current supply dependent on the amount of ionization, a transformer having a secondary in said power circuit conducting said voltage pulses to said discharge terminals, said transformer having a primary, means for sensing the amplitude of voltage or current in said power circuit, and means interconnecting said sensing means and transformer primary and responsive to said current amplitude to apply to said primary a direct current thereby changing the inductive reactance or an alternating current inducing in the secondary a voltage opposed to said voltage pulse, thereby to control ionization and limit current drawn by said lamp.

For the purpose of illustration typical embodiments of the invention are shown in the accompanying drawing, in which—

FIGS. 1 and 2 are schematic diagrams of two forms of fluorescent lamp regulating circuits.

The regulating circuit of FIG. 1 comprises discharge

terminals *l* between which are connected two four-foot HO lamps L which may be considered as one lamp. Power for the lamps is supplied from 115 volt, 60 cycle alternating current line terminals A and C, terminal C being directly connected to one lamp terminal *l* and terminal A being connected to another terminal *l* through an autotransformer primary T1 and secondary T2, and the secondary T4 of a core transformer having a primary T3. The autotransformer is of very small reactance, e.g. 47 to 80 ohms at 60 cycles, compared to a conventional ballast.

A voltage pulse discharging circuit includes a triac V1 (G.E. type SC45B), a diac D1 (G.E. type ST2), a primary voltage pulse storage capacitor C1 (6 microfarads) a secondary storage capacitor C2 (0.33 microfarad) and a coupling capacitor C3 (0.07 microfarad). The primary storage capacitor C1 and triac V1 are connected in series between the power terminals A and C through the autotransformer primary T1, so that during each half-cycle of alternating current the primary storage capacitor C1 charges, through the triac V1. In the succeeding half-cycle the voltage across the secondary capacitor C2 rises toward the breakdown voltage of the diac D1. When this breakdown voltage is exceeded the diac D1 conducts allowing the secondary capacitor C2 to discharge to the gate electrode *g* of the triac and trigger the triac into avalanche conduction. The primary capacitor then discharges through the triac and autotransformer primary and reverses its charge. The discharge voltage is stepped up by the 1 to 3 ratio of primary to secondary, and the stepped up voltage (e.g. 400 volts peak) is applied to the lamp terminals *l*. At this instant a limited number of ions are established in the lamps L, and the lamp fully ignites and conducts line current for part or all of the half-cycle. About when the line voltage passes through zero the arc tends to extinguish depending on the amplitude and duration of the ionizing pulse. If the pulse becomes too high in amplitude or too long in duration, as by a power surge at terminals A and C, the lamp, because of its negative resistance characteristic would tend to draw increasingly greater current and reach run-away condition causing failure of the lamp or some part of the lamp circuit or supply.

According to the present invention, run-away conduction is prevented by sensing the current in the circuit or the voltage applied to the circuit and controlling the ionizing voltage pulse inversely dependent on the amplitude of the lamp current. In FIG. 1 the sensing means comprises a conventional alternating current amplifier B of approximately 10 to 15 db gain connected between the power terminals A and C in series with the primary T3 of the core transformer and a resistor R (10,000 ohms). Under normal line voltage conditions during each half-cycle, the amplifier causes the primary T3 to apply to the core transformer a flux such as to somewhat oppose the ionizing voltage pulse. If a surge of line voltage at the power terminals tends to increase the amplitude of the voltage pulse the voltage through the primary is increased opposing the pulse amplitude increase, thereby compensating for the line voltage surge.

In FIG. 2 the sensing means comprises a known photoresistor or thermistor R*t* with an integral lamp or heater H, the heater H being connected in series with the lamps L. An increase in current drawn by the arc discharge lamp L ohmically increases the temperature of the heater H causing increased heat or light output and lowers the resistance of the photoresistor of thermistor R*t*. The resistor R*t* is coupled to a saturable reactor with windings T3 and T4, winding T4 being in series with the lamps L, and controlling lamp current.

In the circuit of FIG. 2 the components have the same values as the like components in FIG. 1 and are as follows:

R1	10,000 ohms.
R2	500,000 ohms.
R3	15,000 ohms.
R4	5,000 ohms.
C4	10 microfarads.
C5	0.33 microfarad.
D2	G.E. type ST2.
D3	1N456.
V2	G.E. type SC45B.
T3	5,000 turns #42 wire.
T4	300 turns #22 wire.
T5	6 henries at 50 ma.

Resistor R*t* is in one arm of a voltage divider that sets the pedestal height of a ramp and pedestal control circuit R3, D3, R2, C5, D2, V2, R4 and R1. Capacitor C5 charges at a certain rate from the line voltage through resistor R2. This is the ramp portion of the circuit. At each half-cycle the ramp voltage is boosted to a variable degree from the pedestal circuit R2, R*t* and D3. That is, the pedestal voltage at the junction of resistors R3 and R*t* is the starting point for the steady ramp voltage that charges capacitor C5. The pedestal voltage at the junction of resistors R3 and R*t* depends on the value of resistor R*t*. When the voltage at the junction of diac D2 and capacitor C5 reaches the firing level of diac D2 it conducts and fires triac V2. V2 is thus fired later in the cycle if the pedestal voltage is smaller. The pedestal voltage is smaller if resistor R*t* is low in resistance. Thus if lamp current increases, R*t* decreases and triac V2 is fired later in the cycle.

Firing triac V2 later in the cycle passes a smaller quantity of charge per cycle to capacitor C4 through voltage divider resistors R1, R4. Capacitor C4 stores charge and assumes an equilibrium voltage between the bleed-off of charge by resistor R1 and windings T3 and T5, and the addition of charge through resistor R4. Thus the DC level applied to winding T3 is under control of R*t*. An inductive reactance T5 prevents alternating current in the secondary T4 from being coupled into the controlling circuit. Thus, as lamp current tends to increase, the DC voltage in the winding T3 decreases and the inductive reactance of winding T4 increases and opposes the ionizing voltage pulse and limits the conduction of the lamp L.

While two desirable embodiments of the invention have herein been disclosed by way of example, it is to be understood that the invention is broadly inclusive of any and all modifications falling within the terms of the appended claims.

We claim:

1. A fluorescent lamp regulating circuit comprising:
discharge terminals for connection to a lamp,
power terminals for connection to a supply of alternating current,
a power circuit connecting said power terminals to said discharge terminals including means for applying periodic voltage pulses to said discharge terminals thereby to support an arc discharge by ionization in the lamp and to draw current from said alternating current supply dependent on the amount of ionization,
an inductance having a secondary in said power circuit conducting said voltage pulses to said discharge terminals, said inductance having a primary,
means for sensing the amplitude of current in said power circuit,
and means interconnecting said sensing means and inductance primary and responsive to said current amplitude to oppose said voltage pulse in the secondary,
thereby to control ionization and limit current drawn by said lamp.

2. A circuit according to claim 1 wherein said sensing means is connected directly to said power terminals to sense the voltage applied thereto.

3. A circuit according to claim 1 wherein said sensing means comprises means connected to a lamp terminal for sensing the current drawn by the lamp.

4. A circuit according to claim 1 wherein said pulse generating means, transformer secondary and lamp terminals are connected in a closed loop.

No references cited.

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