Aug. 26, 1969 S. C. PEEK 3,463,965

GAS DISCHARGE LAMP STARTING CIRCUIT WITH A PISE GENERATOR CONTROL

Filed June 29, 1967 2 Sheets-Sheet 1

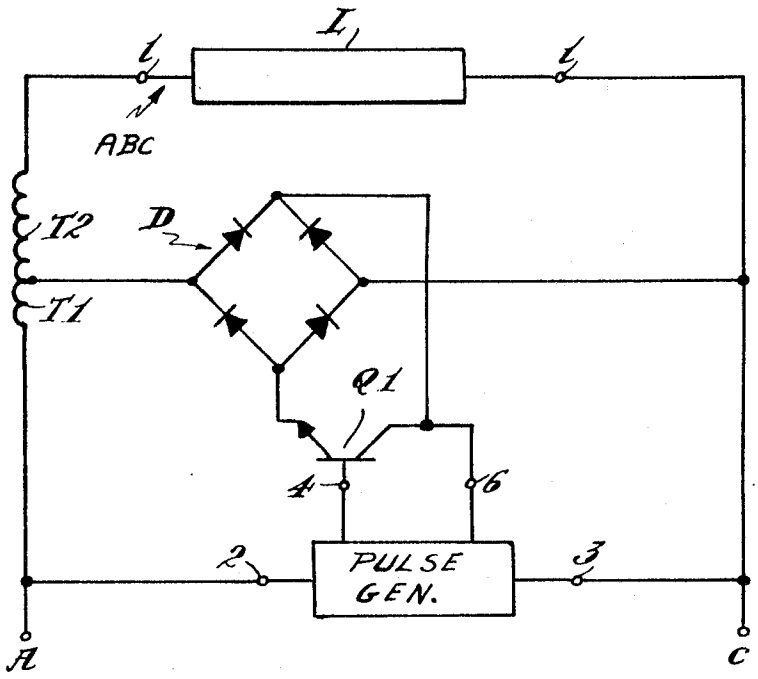


Fig. 1

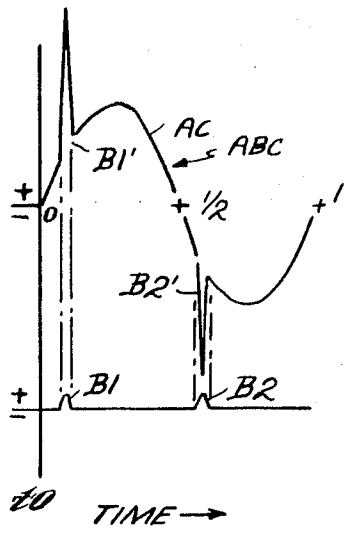


Fig. 2

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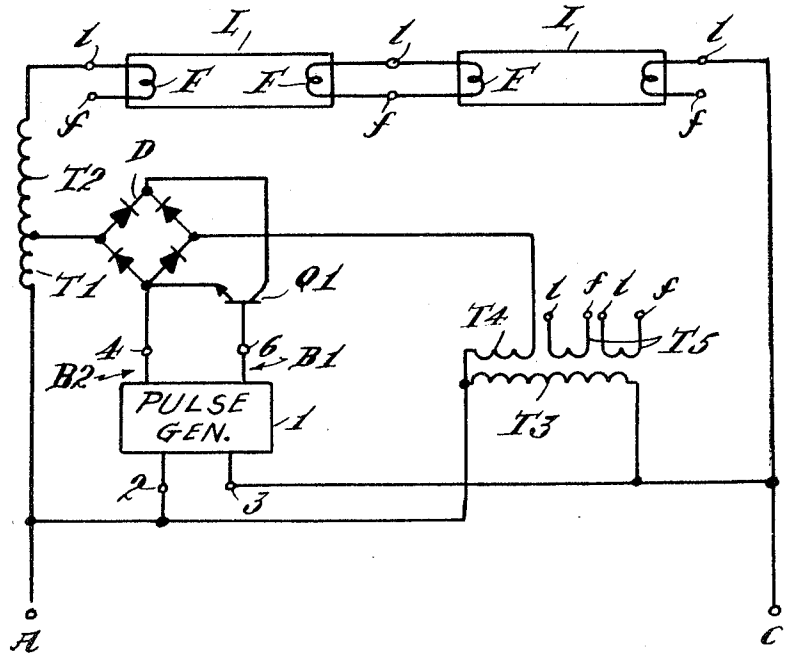


Fig. 3

United States Patent Office 3,463,965 Patented Aug. 26, 1969

3,463,965

GAS DISCHARGE LAMP STARTING CIRCUIT WITH A PISE GENERATOR CONTROL

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Filed June 29, 1967, Ser. No. 650,008
Int. Cl. H05b 41/16, 41/24
U.S. Cl. 315—272 2 Claims

ABSTRACT OF THE DISCLOSURE

A control circuit for a fluorescent lamp wherein alternating current is supplied to the lamp through the primary and secondary of an autotransformer and a pulse generating current supplies a voltage pulse to the autotransformer primary to step up the voltage pulse and ionize the lamp for a half of the AC cycle. The pulse generating circuit includes a bidirectional gate shut off, semi-conductor device connected to the primary and controlled by a pulse generator connected to the AC line.

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 reactively 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. Usually such circuits include a sizeable and expensive storage capacitor whose discharge allows the switching device to shut off.

The object of the present invention is to provide an arc discharge lamp control circuit which eliminates the heavy ballast of conventional circuits and the expensive storage capacitor of prior semiconductor circuits and yet which efficiently ionizes the lamp and limits current drawn by the lamp.

According to the invention an arc discharge lamp control circuit comprises discharge terminals for connection to a lamp, power terminals for connection to a supply of alternating current, transformer means including a primary and secondary, a power circuit connecting said power terminals to said discharge terminals and including the secondary of said transformer, controllable bidirectional electronic gate valve means directly connected to said primary, and a pulse generator connected to said power terminals and responsive to each half-cycle of said alternating current to generate a control pulse of substantially shorter duration than said half-cycle, said generator being connected to said gate device to open said valve for the duration of said pulse and gate, said voltage pulse through said primary, thereby to cause said transformer to step up said voltage pulse and apply it to the lamp, whereby the lamp is ionized sufficiently to support substantially one half-cycle of discharge. By voltage pulse is meant to include a single pulse or a series of pulses as in a burst of RF energy.

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

FIG. 1 is a schematic diagram of one form of fluorescent lamp control circuit;

FIG. 2 is a graph of voltages in the circuit of FIG. 1; and

FIG. 3 is an alternate form of control circuit.

The control circuit of FIG. 1 comprises a fluorescent lamp L, typically an 8 foot VHO lamp connected in the circuit at discharge terminals *l*. The discharge terminals *l*

are connected directly to a 115 volt, 60 cycle alternating current power terminal C in one case, and through the primary T1 and secondary T2 of a 1 to 3 step-up autotransformer to the other power terminal A, in the other case. The autotransformer is of relatively small inductance compared to a conventional ballast.

Connected between one power terminal C and the autotransformer primary T1 is an electronic valving subcircuit including a bridge rectifier D and a semiconductor device Q1 (Delco type 2N3079) rated for, that is, capable of impeding, 200 volts, substantially higher than the peak line voltage, about 160 volts, available at the power terminals A and C. The semiconductor Q1 has a control electrode or base *b* at which a signal of approximately 0.5 to 1 volt with respect to its emitter *e* will cause conduction between the collector *c* and emitter *e*. This current will be abruptly shut off when the base to emitter voltage drops below 0.5 volt. It will be noted that the bridge and semiconductor circuit are connected directly to the primary T1 without any intervening capacitor.

A pulse generator 1 has input terminals 2 and 3 respectively connected to the line terminals A and C, and output terminals 4 and 6 respectively connected to the base *b* and collector *c*. The pulse generator, which may be of conventional design, responds to alternate half-cycles of the line current applied to terminals 2 and 3 to produce positive pulses of 1 volt positive across its output terminals 4 and 6. As shown in FIG. 2, positive pulse B1 at terminal 6 appears early in the positive half-cycle of the line voltage AC, pulse B2 appearing early in the negative half-cycle. As each of these pulses, typically of 100 microseconds duration, is applied to the base *b*, the valve Q1 conducts line voltage in a voltage pulse to the autotransformer primary T1. A pulse B1′ or B2′, stepped up by the autotransformer, is superimposed on the AC half-cycle of the same polarity and applied to the lamp terminals *l* as part of a composite voltage ABC.

If, early in each half AC cycle, the lamp L is virtually non-conducting, the open circuit voltage of pulse B1′ or B2′ is in the order of 250–350 volts peak. Application of such a voltage for 100 microseconds produces sufficient ionization in the lamp to sustain arc discharge through the lamp for about one half-cycle. At the end of approximately one half-cycle following the pulse, the AC voltage is close to zero and the lamp tends to extinguish. But shortly after the half-cycle a succeeding pulse B1 or B2 causes reionization and conduction.

In FIG. 3 is shown a control circuit for two 4 foot VHO rapid-start fluorescent lamps having filaments F. A bridge D and semiconductor device Q2 (RCA type 2N5036) are connected between the primary T1 of the autotransformer and the secondary T4 of a transformer T3–T5 whose primary T3 is connected between line terminals A and C. The transformer steps down the AC voltage to about 50 volts below that which the transistor and bridge are rated, namely 70 volts. Secondaries T5 supply heating current to filament terminals *l* and *f* of the lamps. As in the circuit of FIG. 1 a pulse generator 1 produces voltage pulses B1 and B2 which cause the bridge and semiconductor to gate pulses through the autotransformer primary T1 so as to ionize the lamps L sufficiently for about one half-cycle of conduction.

During the interval between the pulses B1 and B2 the valve Q1 or Q2 is cut off and draws virtually no power. The autotransformer T1, T2 is of negligible inductance, and the low voltage pulse generator has minimal power consumption. Thus the present lamp control circuit eliminates the previous high-loss ballasts and high-cost capacitors while providing quick-starting and precise control of lamp discharge. The lamp circuit has a fraction

of the weight and bulk of prior ballasts and control circuits, and consumes and dissipates much less power.

While one desirable embodiment of the invention has 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.

I claim:

1. An arc discharge lamp circuit comprising:

discharge terminals for connection to a lamp,

power terminals for connection to a supply of alternating current,

transformer means including a primary and secondary,

an uninterrupted power circuit continuously connecting said power terminals to said discharge terminals and including the secondary of said transformer,

controllable bidirectional electronic gate valve means directly connected to said primary in parallel with the lamp, and having a control electrode capable of starting and terminating discharge of the valve means, and

a pulse generator connected to said power terminals and responsive to each half-cycle of said alternating current to generate a control pulse of substantially shorter duration than said half-cycle, said generator being connected to said gate valve to start discharge by said valve for the duration of said pulse and thereafter terminate discharge so as to gate said voltage pulse through said primary,

thereby to cause said transformer to step up said voltage pulse and apply it to the lamp superimposed on the alternating current;

whereby the lamp is ionized sufficiently to support substantially one-half-cycle of discharge.

2. An arc discharge lamp circuit according to claim 1 wherein the connection between said power terminals and said primary contains only the impedance of said valve means.

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U.S. Cl. X.R.

315—205, 274, 280, 289