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54 **Electronic starter circuit for lamps.**

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FR-A-2 488 095
US-A-4 306 177

**S. T. Henerson and A. M. Marsden "Lamps and
Lighting", second edition, 1972, section 18.3.1,
pp. 333-334**

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Courier Press, Leamington Spa, England.

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Description

This invention relates to electronic starter circuits for discharge lamps and it relates especially, though not exclusively, to such circuits for krypton filled fluorescent lamps. Some such lamps, especially those which are slimmer than conventional fluorescent lamps (e.g. 25 mm diameter as opposed to 38 mm diameter), tend to be rather difficult to start and this invention provides an electronic starter circuit which is capable of overcoming that difficulty.

A starter circuit which is used in practice for conventional fluorescent lamps is the progressive starter circuit such as that described and claimed in US—A—4165475 the disclosure of which is incorporated herein by reference. This circuit employs progressive triggering such that triggering pulses are generated in successive cycles or half cycles of mains voltage in response to the mains voltage exceeding a threshold level which increases steadily cycle by cycle. This progression continues until the threshold level reaches a predetermined value, preferably greater than the supply voltage. At each triggering pulse cathode heating current flows until the predetermined value is reached at which time the starter is inactivated and attempts at starting cease. This invention consists in supplementing that circuit by connecting an ignitor circuit, in parallel therewith, across the lamp. The ignitor circuit is one in which the supply negative swing is rectified to charge a capacitor to around peak mains and on the positive swing a thyristor fires to complete an HF resonant series circuit (ballast and charged capacitor) which executes approximately one cycle and terminates with current attempting to reverse through the thyristor. The basic ignitor circuit is well known of itself and a reference to ignitors may be found in "Lamps and Lighting" (Second Edition 1972, Editors: S. T. Henderson and A. M. Marsden Pub. Arnold) Section 18.3.1, pp. 333—334. There is, however, a special and advantageous interaction between the two known circuits as will become clear hereinafter.

According to the invention there is provided a discharge lamp starter circuit having two starter input terminals for connection to the cathodes of a discharge lamp, for receiving a cyclically varying voltage supplied through the lamp cathodes and a choke ballast, the circuit comprising, connected in parallel between said terminals, a progressive starter circuit capable of providing to said cathodes a succession of preheat current pulses, of progressively diminishing magnitude in response to a progressively rising threshold and an ignitor circuit capable of providing to said lamp, high voltage ignition pulses in response to a fixed threshold, the arrangement in combination being such that the progressive starter circuit provides the progressively decreasing preheat current pulses until the threshold of the ignitor is exceeded, the ignitor initiates high voltage ignition pulses there-

after, the ignition pulses being terminated prematurely by interaction with the progressive starter circuit which provides substantially constant magnitude preheat pulses until the progressive threshold reaches a preset maximum value whereupon the ignitor circuit provides a full ignition pulse.

In order that that invention may be clearly understood and readily carried into effect, one embodiment thereof will now be described with reference to the accompanying drawings, of which

Figure 1, illustrates a starter circuit in accordance with one example of the invention and

Figure 2 illustrates a development of the starter of Figure 1 capable of starting two lamps.

Referring now to Figure 1, the components of the progressive starter circuit, of the kind described and claimed in the aforementioned patent, are disposed to the right of the vertical dashed line, to the left of which are shown the components of the ignitor circuit, and the lamp L itself. In order to avoid undue repetition, the progressive starter circuit will be referred to hereinafter as "circuit A" and the ignitor circuit as "circuit B".

The operation of both circuits A and B independently is well known and thus will not be further described herein. However, with the following component types and values incorporated by way of example, the two circuits interact in a particularly advantageous way, as will be described.

Resistors R1 and R7	2k2 ($\frac{1}{2}$ Watt)
Resistors R2 and R3	1k0 ($\frac{1}{4}$ Watt)
Resistor R4	3M3 ($\frac{1}{4}$ Watt)
Resistors R5 and R6	10M0 ($\frac{1}{2}$ Watt)
Capacitor C1	0.047 F
Capacitor C2	0.047 F
Capacitor C3	0.047 F
Diode D1	1N4007 GP
Diode D2	1N4007 GP
Diode D3, D4	DA 1/83760A (Zener)
Diode D6	IR 60096
Diode D7	BYX 10
Thyristor TH1	TIC 106M
Thyristor TH2	TIC 106N

The connection of circuits A and B in parallel with each other, and with the lamp L, is effective initially (i.e. for the first few cycles of mains voltage applied to the lamp) so that circuit A only operates, circuit B being arranged to be energised only when the voltage applied thereto exceeds a fixed threshold level. The progressive threshold of circuit A (increasing with each cycle of mains voltage applied to the lamp) permits, in known manner, preheat current pulses of steadily decreasing magnitude to be applied to the lamp electrodes. Once the aforementioned few cycles of mains voltage have been applied to the lamp, with circuit A being operative to preheat the lamp electrodes but circuit B not being energised at all

due to its fixed operational threshold exceeding that of circuit A, the variable threshold of circuit A has been increased to a level which exceeds the fixed threshold of circuit B. When this occurs, circuit B is energised and attempts, in the usual manner for such an ignitor circuit, to develop a high voltage ignition pulse for the lamp, the voltage consisting of a high frequency oscillation determined by a series resonant circuit governed by the capacitor C1 and the inductance of a lamp choke ballast LB. In consequence, the circuit B develops the expected high frequency pulse which first swings negative, limiting at maximum negative mains voltage, and then attempts to swing to a substantially higher positive voltage. This attempt however is frustrated by the pulse triggering circuit A into operation, thus precluding the positive swing of the pulse generated by circuit B exceeding the threshold level of the circuit A for that cycle of mains operation. The triggering of circuit A provides another current pulse to the electrodes of the lamp. This state of affairs continues for several cycles of mains voltage, with the positive swing of the voltage pulse generated by circuit B being permitted to increase for each cycle by the increasing threshold of circuit A. Eventually, after, say, twenty cycles of mains operation, the threshold of circuit A has risen high enough for the positive swing of the pulse generated by circuit B to be able to reach its maximum positive value without triggering circuit A into operation. It is then able to ignite the lamp. Once ignition occurs, the low running voltage across the lamp is insufficient to trigger either of circuits A and B into operation and thus these circuits remain quiescent during normal running. It will be understood that preheating of the lamp electrodes ceases when the threshold of circuit A has increased sufficiently to allow the pulse generated by circuit B to attain its maximum positive value. It will also be appreciated that, during those cycles of mains operation when circuit B is triggered first and subsequently triggers circuit A, the preheating current pulses generated by circuit A remain of substantially constant magnitude, despite the steadily increasing threshold value of circuit A, because of the fixed threshold of circuit B and the high frequency nature of the voltage pulses generated thereby, since these pulses determine the instant of energisation of circuit A during the successive cycles of mains voltage.

In some circumstances, such as where there is little possibility that circuit B will be triggered by the normal running waveform applied to the lamps, the resistors R1 and R7 and the diode D2 can be omitted from the circuit.

A refinement that can be made, if desired, to the circuit shown in the drawing without departing from the scope of the invention, involves the series connection of a capacitor and a diode across the lamp, and thus in parallel with circuits A and B, the anode of the diode being connected to the junction line of R1, TH1, R2, TH2, R3, R6 and

C3 and the capacitor being connected to the junction of C1 and D7. In addition a resistor is connected from the junction of the capacitor and the diode thus added to the junction of D6, R4 and C2. This refinement permits the preheating current pulses supplied to the lamp electrodes by circuit A to be adjusted in magnitude to allow for the effect of mains voltage variation. The added components are effective to rectify the mains voltage to provide a bias current to capacitor C2, which component established the progressive threshold of operation for circuit A. The bias current provides a non-linear progression of the threshold such that if the mains voltage is high, the ultimate cessation of production of current pulses by circuit A occurs sooner than it would have done if linear progression had been used, and vice-versa.

If it is desired to utilise a starter arrangement to ignite two lamps instead of one, as thus far described, it is possible, using the principles described in EP—A—34401, to utilise one ignitor circuit of the form of circuit B for each lamp and to have these two ignitor circuits share a common progressive starter circuit of the form of circuit A. This is shown in Figure 2 in which the ignitor components of a circuit B' to start a second lamp L' are given the same reference numerals as those of circuit B with the addition of a prime. In addition there are provided two rectifier elements D8 and D8' which serve to isolate the respective ignitors and lamps from each other. The use of two ignitor circuits of the form of circuit B permits independent operation of the two lamps in case of failure of one of them.

In certain circumstances, whether used for one-lamp or two lamp operation, it can be advantageous to connect a resistor in series with TH2.

Claims

1. A discharge lamp starter circuit having two starter input terminals for connection to the cathodes of a discharge lamp (L), for receiving a cyclically varying voltage supplied through the lamp cathodes and a choke ballast (LB), the circuit comprising, connected in parallel between said terminals, a progressive starter circuit (A) capable of providing to said cathodes a succession of preheat current pulses, of progressively diminishing magnitude in response to a progressively rising threshold and an ignitor circuit (B) capable of providing to said lamp (L), high voltage ignition pulses in response to a fixed threshold the arrangement in combination being such that the progressive starter circuit (A) provides the progressively decreasing preheat current pulses until the threshold of the ignitor (B) is exceeded, the ignitor (B) initiates high voltage ignition pulses thereafter, the ignition pulses being terminated prematurely by interaction with the progressive starter circuit (A) which provides substantially constant magnitude preheat pulses until the progressive threshold reaches a preset

maximum value whereupon the ignitor circuit provides a full ignition pulse.

2. A discharge lamp starter circuit according to claim 1, adapted to start two discharge lamps (L, L') having, connected in parallel with said progressive starter circuit (A), a second substantially identical ignitor circuit (B') with two further starter input terminals for connection to the cathodes of a second of said two lamps (L'), and two rectifier elements (D8, D8') each connected to isolate an ignitor circuit (B or B') and its respective pair of starter input terminals from the other ignitor circuit (B' or B) and its respective pair of starter input terminals.

3. A discharge lamp starter circuit according to claim 1 or 2, in which the progressive starter circuit (A) includes means providing a threshold which progressively rises in a non-linear progression so that a predetermined maximum value at which the progression terminates is reached more quickly in response to higher mains supply voltage.

Patentansprüche

1. Entladungslampen - Starterschaltung mit zwei Starter - Eingangsklemmen für den Anschluß an die Kathoden einer Entladungslampe (L), zum Empfang einer sich zyklisch ändernden Spannung, die über die Lampenkathoden und eine Ballastdrossel (LB) zugeführt wird, wobei die Schaltung umfaßt: eine parallel zwischen den genannten Klemmen geschaltete progressive Starterschaltung (A), die in der Lage ist, die genannten Kathoden mit einer Folge von Vorheiz - Stromimpulsen zu versehen, deren Größe progressiv in Abhängigkeit von einer progressiv ansteigenden Schwelle abnimmt, und eine Zündschaltung (B), die in der Lage ist, die genannte Lampe (L) mit Hochspannungs - Zündimpulsen in Abhängigkeit von einer festen Schwelle zu versehen, wobei die Anordnung in Kombination so ist, daß die progressive Starterschaltung (A) die progressiv abnehmenden Vorheiz - Stromimpulse liefert, bis die Schwelle des Zünders (B) überschritten wird, wobei der Zünder (B) danach Hochspannungs - Zündimpulse auslöst, wobei die Zündimpulse vorzeitig durch Zusammenwirken mit der progressiven Starterschaltung (A) beendet werden, die Vorheizimpulse mit im Wesentlichen konstanter Größe erzeugt, bis die progressive Schwelle einen vorgegebenen Maximumwert erreicht, worauf die Zündschaltung einen vollen Zündimpuls erzeugt.

2. Entladungslampen - Starterschaltung nach Anspruch 1, die geeignet ist, zwei Entladungslampen (L, L') zu starten, die in Parallelschaltung mit der genannten progressiven Starterschaltung (A) eine zweite im wesentlichen identische Zündschaltung (B') mit zwei weiteren Starter - Eingangsklemmen zum Anschluß an die Kathoden einer zweiten von den beiden Lampen (L') aufweist, wobei zwei Gleichrichterelemente (D8,

D8') jeweils so angeschlossen sind, daß sie eine Zündschaltung (B oder B') und ihr entsprechendes Paar von Starter - Eingangsklemmen von der anderen Zündschaltung (B' oder B) und ihrem entsprechenden Paar von Starter - Eingangsklemmen isolieren.

3. Entladungslampen - Starterschaltung nach Anspruch 1 oder 2, bei der die progressive Starterschaltung (A) Mittel einschließt, die eine Schwelle vorsehen, die progressiv in nichtlinearer Progression ansteigt, so daß ein vorgegebener Maximumwert, bei dem die Progression endet, schneller in Abhängigkeit von einer höheren Netzspannung erreicht wird.

Revendications

1. Circuit d'amorçage pour une lampe à décharge, comportant deux bornes d'entrée d'amorçage destinées à être raccordées aux cathodes d'une lampe à décharge (L), pour la réception d'une tension variant de façon cyclique délivrée par l'intermédiaire des cathodes de la lampe et d'un ballast en forme de bobine d'arrêt (LB), et comportant, branché en parallèle entre lesdites bornes, un circuit (A) d'amorçage progressif apte à alimenter lesdites cathodes avec une succession d'impulsions de courant de préchauffage, possédant une amplitude diminuant progressivement en réponse à un seuil s'accroissant progressivement, et un circuit d'allumage (B) apte à envoyer à ladite lampe (L), des impulsions d'allumage à haute tension en réponse à un seuil fixe, l'agencement en combinaison étant tel que le circuit d'amorçage progressif (A) produit les impulsions de courant de préchauffage, qui diminuent progressivement, jusqu'à ce que le seuil du circuit d'allumage (B) soit dépassé, que le circuit d'allumage (B) produit ensuite des impulsions d'allumage à haute tension, ces impulsions d'allumage se terminant prématurément par suite de l'interaction avec le circuit (A) d'amorçage progressif, qui délivre des impulsions de préchauffage d'amplitude sensiblement constante jusqu'à ce que le seuil progressif atteigne une valeur maximale pré-réglée, à la suite de quoi le circuit d'allumage délivre une impulsion complète d'allumage.

2. Circuit d'amorçage pour une lampe à décharge selon la revendication 1, apte à amorcer deux lampes à décharge (L, L') comportant, selon un branchement en parallèle avec ledit circuit d'amorçage progressif (A), un second circuit d'allumage (B') essentiellement identique, comportant deux bornes d'entrée supplémentaires d'amorçage pour le raccordement aux cathodes d'une seconde desdites deux lampes (L'), et deux éléments redresseurs (D8, D8') raccordés chacun de manière à isoler un circuit d'allumage (B ou B') et son couple respectif de bornes d'entrée d'amorçage par rapport à l'autre circuit d'allumage (B' ou B) et à son couple respectif de bornes d'entrée d'amorçage.

3. Circuit d'amorçage pour lampe à décharge selon la revendication 1 ou 2, dans lequel le circuit

d'amorçage progressif (A) comprend des moyens fournissant un seuil qui augmente progressivement, selon une progression non linéaire, de sorte qu'une valeur maximale prédéterminée,

pour laquelle la progression s'arrête, est atteinte plus rapidement en réponse à une tension supérieure d'alimentation du réseau.

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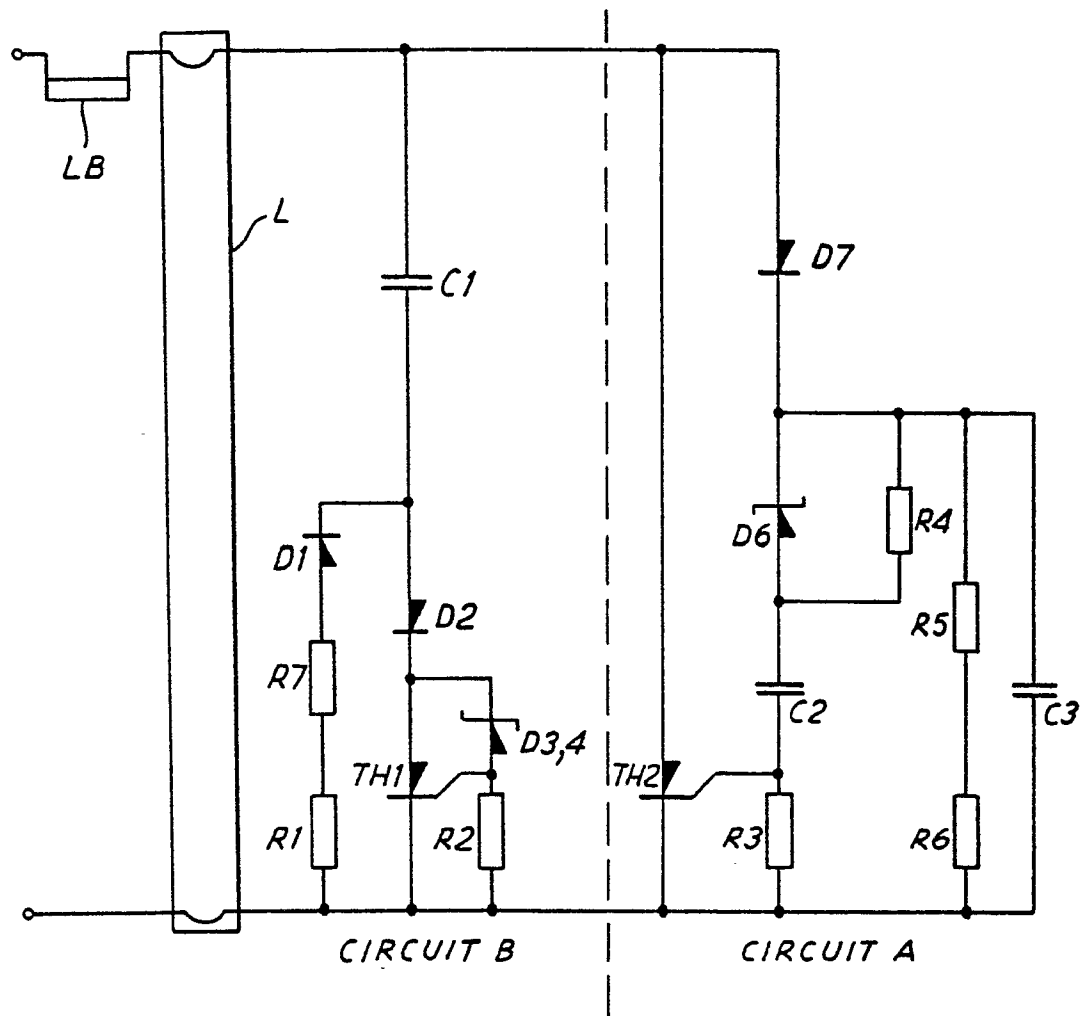


FIG. 1

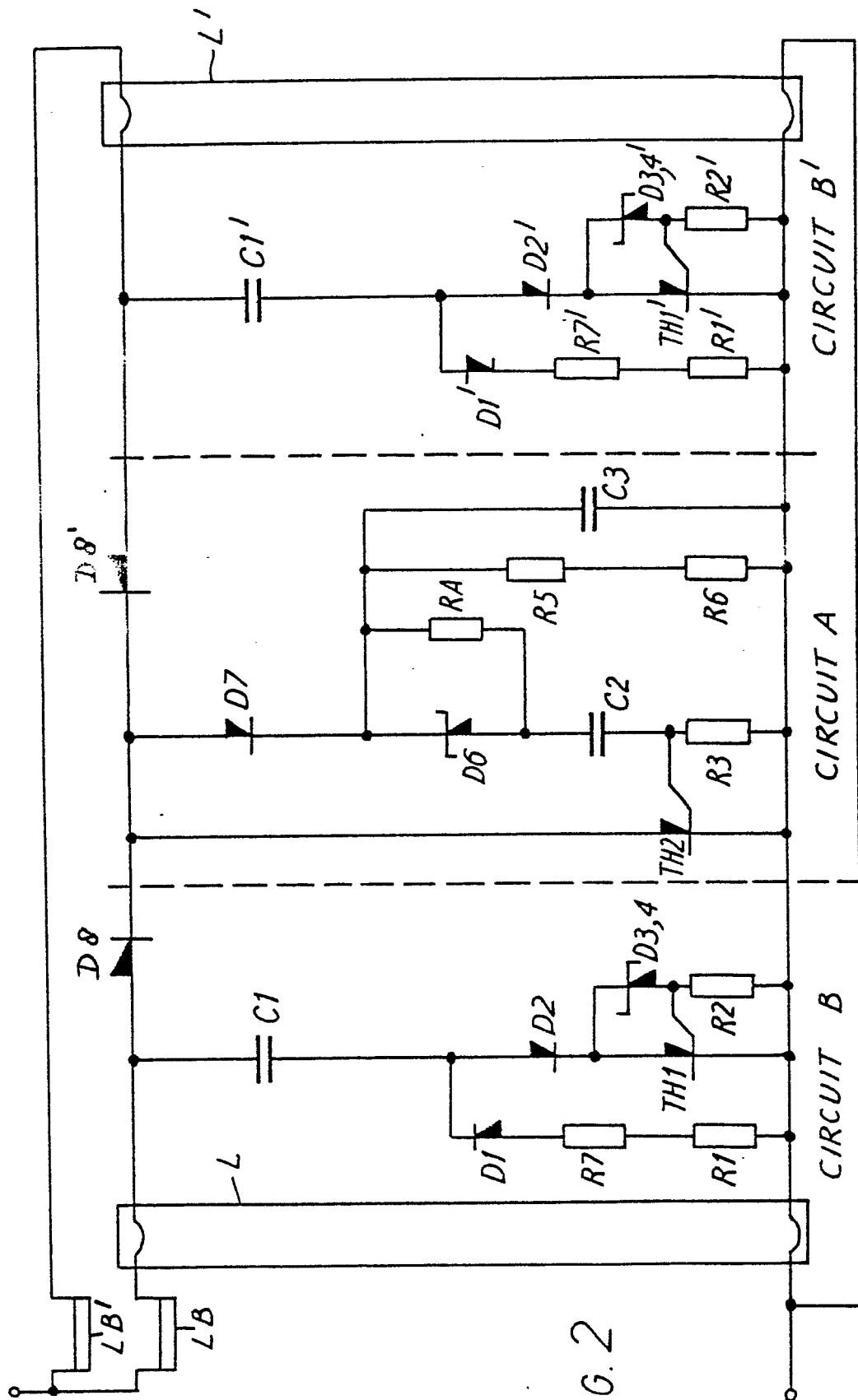


FIG. 2