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(54) **Electronic starters for discharge lamps.**

(57) An electronic starter circuit for a discharge lamp is provided. The lamp (8) has preheatable electrodes (10, 12), a pair of terminals of which electrodes are connectable to a pair of input terminals (2, 4) of an AC voltage source. The starter comprises a thyristor switch (16) connected in series to another pair of terminals of the lamp electrodes and an ignition circuit connected to the thyristor switch. The thyristor switch is controllable by the ignition circuit, which ignition circuit, upon actuation of the starter, repeatedly, for a predetermined number of cycles calculated by the characteristics and values of the ignition circuit elements to ensure a definite ignition of the lamp (8) under standard conditions, renders the thyristor switch (16) conductive. The ignition circuit cuts off the conduction of the thyristor switch upon the ignition of the lamp (8) or the termination of the predetermined number of cycles.

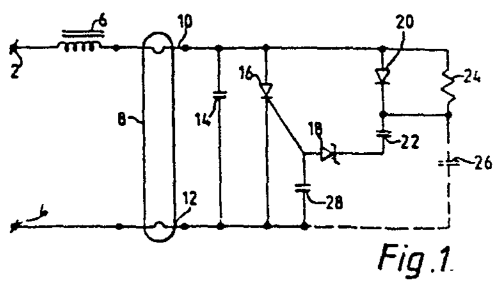

Fig.1

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ELECTRONIC STARTERS FOR DISCHARGE LAMPS

The present invention relates to electronic starters for igniting discharge lamps and in particular the invention relates to starters for providing rapid ignition of discharge lamps having preheatable electrodes, the electrodes having a pair of terminals connectable to a pair of input terminals of an AC voltage source.

The main disadvantages of the more advanced known electronic starters include: a) the dependence of the starting operation on the voltage of the mains as well as on the lamps built-in parameters which results in the instability of the starting operation and which dependence prevents the provision of a universal starter suitable for a wide range of lamps; b) the radio interferences caused during the starting operation of the lamp due to the repeated interruption of the igniting circuit whenever the lamp is conducting or whenever the conduction is instable which, in turn, also shortens the lamp's lifetime; and c) whenever the

the lamp itself is out of order in these types of starters, a starting current will constantly flow which, of course, brings about the waste of costly energy.

In contradistinction to the known electronic starters operating on the principle of the voltage level which is applied across the lamp, the starter of the present invention essentially operates on the principle of ignition time, resulting in a safe, flickerless and a more rapid fluorescent-lamp starting system.

Essentially, the electronic starter of the present invention includes a controlled switch which is constituted by a thyristor and an ignition circuit. The term thyristor used herein is meant to refer to the electronic solid state components, such as, a silicon controlled rectifier (SCR), Diac, a Triac and their equivalents.

The actuation of said controlled switch, i.e., the rendering of said thyristor into its conduction state in order to pass current therethrough for igniting the lamp, is repeatedly effected for a predetermined period of time by means of properly chosen values of the components of the igniting circuit. This predetermined period of time is chosen or adjusted to be of a duration which is always at least equal to, and preferably greater than the longest duration required for a positive sure ignition of a lamp under the commonly acceptable conditions for igniting the kind of lamps for which the proposed starter is intended. With the starter according to the present invention, in case when the lamp did not ignite during said predetermined period of time due to a malfunction, the starter circuit ceases to conduct after said period of time as the thyristor is switched back to its non-conductive state.

This independence of the ignition time of the proposed starter from the actual starting process, as opposed to the case in many other known prior art electronic starters, the operation of which is based on the change of the voltage level applied to the lamp during the ignition period, facilitates the provision of a novel universal starter suitable for igniting a wide range of discharge lamps of various operating potentials and output powers.

While the invention will now be described in connection with certain preferred embodiments with reference to the accompanying drawings in the following description, it will be understood that it is not intended to limit the invention to these particular embodiments. On the contrary, it is intended to cover all alternatives, modifications and equivalent arrangements as may be included within the scope of the invention as defined by the appended claims.

In the drawings:

Fig. 1 shows a circuit diagram of a starter according to the invention;

Fig. 2 are waveforms of voltages and currents appearing in the circuit of Fig. 1 ploted against time;

Fig. 3 shows a circuit diagram of another embodiment of a starter according to the invention.

In Fig. 1 there are shown input terminals 2 and 4 of the starter, according to the invention, which are intended to be connected to a standard AC supply source. The terminals 2 and 4 are shunted by a series arrangement of an inductance (choke) 6 and a discharge lamp 8. The lamp 8 is provided with preheatable electrodes 10 and 12. The terminals of the electrodes which are remote from the terminals 2 and 4 are respectively connected across an ignition circuit including a capacitor 14 and a SCR 16, which capacitor is adapted to protect the SCR against pulses of high voltage from the mains.

The remaining components of the ignition circuit include a zener diode 18, connected between the gate of the SCR 16 and a capacitor 22, a diode 20 and a discharge resistor 24 in parallel therewith. Advantageously, there is also provided a capacitor 28 which protects the gate of the SCR 16 against impulses of high voltage which may appear in the circuit.

The operation of the starter will now be described with reference also to Fig. 2.

Upon the actuation of the starter, a voltage Vst of an AC voltage source is applied across the terminals 2 and 4. As long as the potential across the zener diode 18 does not exceed its breakdown value, capacitor 22 does not charge and there is no current flow through the capacitor (see V_{c22} and I_{c22} in Fig. 2).

When the potential across the zener diode 18 reaches the diodes breakdown value V_{z18}, capacitor 22 starts to charge and the charging current passes through the diode 20. The gate of the thyristor 16 will render the latter conductive and the thyristor will fire, when the potential across it will reach its firing voltage V_{th}. At the current zero-crossing point (which is after the voltage zero-crossing due to the phase shift introduced by the choke 6), the thyristor will close and there will be formed an instant high voltage pulse for igniting the lamp. The capacitor 14 and the choke 6 effectively act to widen the igniting pulse.

If the lamp 8 is not ignited, in the following cycle capacitor 22 receives an additional charge V as is seen in Fig. 2. When the capacitor 22 becomes fully charged, after the predetermined number of cycles, the thyristor 16 will no longer fire and the heating of the lamps electrodes will cease. On the other hand, when the lamp 8 will fire, the voltage across the lamp will become lower and the stabilizing zener diode 18 in combination with the capacitor 22 will no longer be capable to fire the thyristor.

Only when the starter is deactuated, the potential accumulated on capacitor 22 will be discharged through the resistor 24.

As can be further seen in Fig. 1, advantageously, there may be provided a second capacitor 26, connected in parallel with the capacitor 22. The combined values of the two capacitors will determine the period of time (or the number of cycles) in which the ignition circuit repeatedly renders the thyristor conductive to ignite the lamp. The addition of this second capacitor 26 facilitates to substantially decrease the values of the capacitor 22 and of the discharge resistor 24. Also, this added capacitor will cause the current, which passes through the zener diode 18 and the thyristor 16, to be advantageously smaller.

When the second capacitor is in circuit, upon the actuation of the starter, capacitor 26 is first charged through the diode 20. Until the potential across the capacitor 26 does not reach the breakdown voltage of the zener diode 18, there will not be a current flow through capacitor 22. During the heating of the lamp's electrodes, capacitor 26 discharges through the resistor 24 and since the potential across the capacitor 26 is higher than the potential across the capacitor 22, the latter capacitor does not discharge.

A typical example of the values chosen for the starter of Fig. 1 adapted to ignite a 40 W lamp operating from a 220 V AC source, is as follows:

SCR 16 - 400 V, 1A

Zener diode 18 - 170 - 200 V

Capacitor 14 - 5000 - 15,000 PF
Capacitor 22 - 0.2 - 1uF
Capacitor 26 - 0.o4 - 0.2uF
Capacitor 28 - 0.1 - 0.3uF
Resistor 24 - 560 K

In Fig. 3 there is shown a modification of the circuit of Fig. 1 in which the discharging resistor 24 is connected in parallel with the second capacitor 26. Also, instead of the protecting capacitor 28 of Fig. 1 there is provided a protecting resistor together with the zener diode 18, determines the potential in which the thyristor is ignited or conducts. The added diode 32 serves to provide additional protection to the circuit from high voltage impulses originating at the AC source or form impulses which are formed during the ignition process. Otherwise, the operation of this circuit is similar to the operation of the circuit of Fig. 1.

Finally, it should be mentioned that if it is desired to increase the heating time of the lamp's electrodes without changing the values of the capacitors 24 and/or 26, it is possible to connect between said capacitors (as shown by the hatched lines in Fig.3) a diode 34, instead of the lead 36 connecting said capacitors. This increase in the heating time will facilitate the use of the same starter for a larger range of lamps having different values of heating times.

While particular embodiments of the invention have been described, it will be evident to those skilled in the art that the present invention may be embodied in other specific forms without departing from the essential characteristics thereof. The present embodiments are, therefore, to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are, therefore, intended to be embraced therein.

CLAIMS:

1. An electronic starter circuit for a discharge lamp (8) having preheatable electrodes (10, 12), the electrodes having a pair of terminals connectable to a pair of input terminals (2, 4) of an AC voltage source, characterised in that the starter circuit comprises a thyristor switch (16) connected in series to another pair of terminals of the lamp electrodes and an ignition circuit connected to said thyristor switch, the thyristor switch being controlled by said ignition circuit, the ignition circuit, upon actuation of the starter, repeatedly, for a predetermined number of cycles calculated by the characteristics and values of the ignition circuit elements to ensure a definite ignition of the lamp under standard conditions, renders said thyristor switch conductive, and wherein said ignition circuit cuts off the conduction of said thyristor switch upon the ignition of said lamp or the termination of said predetermined number of cycles.

2. A starter as claimed in claim 1 wherein said ignition circuit comprises at least one capacitor (22) connected between the anode and the gate of

said thyristor (16) for determining the period of time in which said ignition circuit repeatedly renders said thyristor switch conductive.

3. A starter as claimed in claim 2 wherein said ignition circuit comprises a rectifying element (20) for completely charging said capacitor (22) during said predetermined period of time, which time period is equal to or greater than the selected predetermined maximal period of time for igniting said lamp under standard operating conditions.

4. A starter as claimed in claim 2 or claim 3 wherein said ignition circuit comprises a resistor (24) connected in series with said capacitor (28), which resistor constitutes a discharge path for said capacitor.

5. A starter as claimed in any one of claims 2 and 4 and, further comprising a second capacitor (26) connected in parallel with said first capacitor (22) across at least a part of the ignition circuit, wherein the combined values of said capacitors determine the period of time in which said ignition

circuit repeatedly renders said thyristor switch conductive.

6. A starter as claim in claim 5 and further comprising a resistor (24, Fig. 3) connected in parallel with said second capacitor (26, Fig.3) and constituting a discharge path for said second capacitor.

7. A starter as claimed in claim 5 or claim 6 and further comprising a diode (34) connected in circuit between said first and second capacitors (22, 26).

8. A starter as claimed in any one of claims 1 to 7 wherein said ignition circuit comprises a voltage stabilizing element (18) connected in series with the gate of said thyristor, which element conducts whenever the voltage thereacross reaches a predetermined value.

9. A starter as claimed in claim 8 wherein said voltage stabilizing element is a zener diode (18).

10. A starter as claimed in any one of claims 1 to 9 and further comprising a diode (32) connected in

the ignition circuit between the thyristor's anode of the thyristor and said lamp to protect the circuit against high voltage impulses.

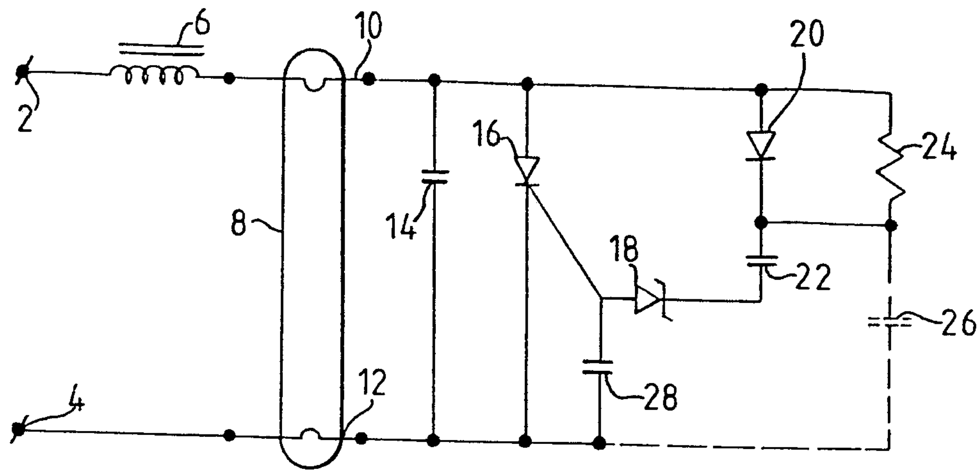

Fig.1.

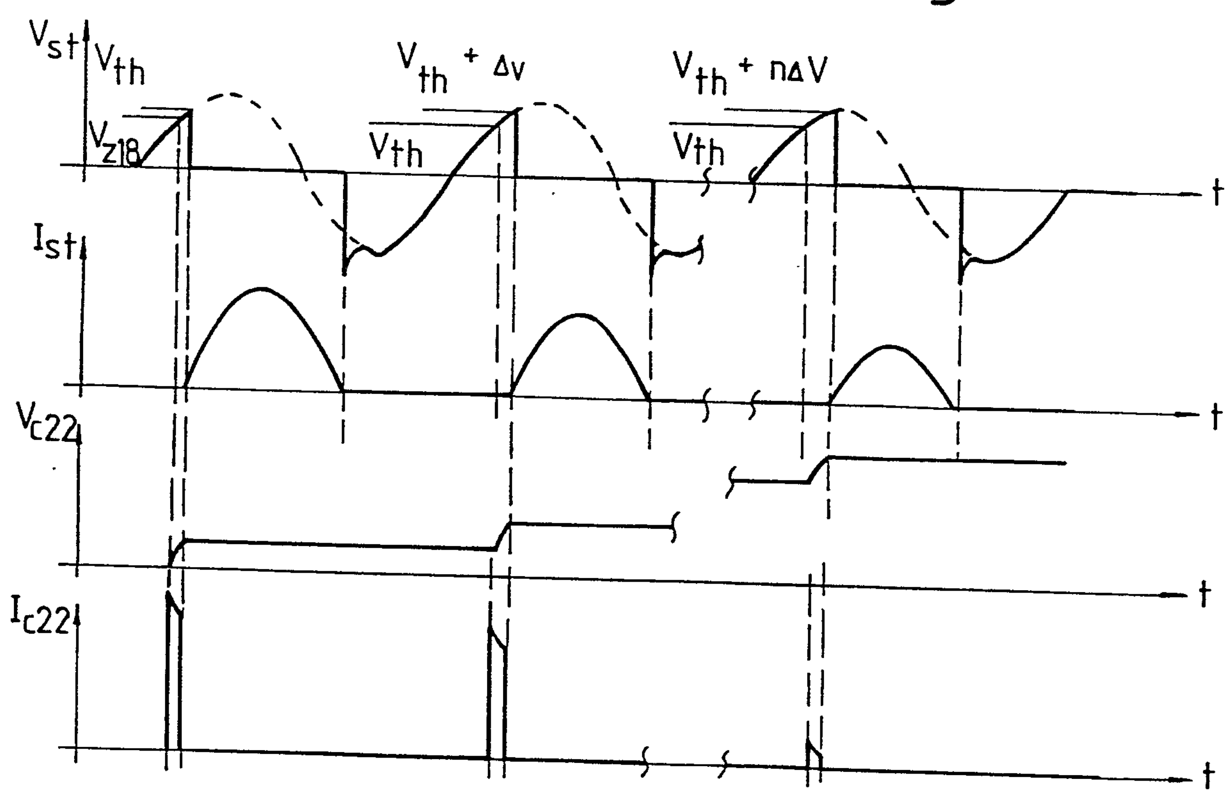

Fig.2.

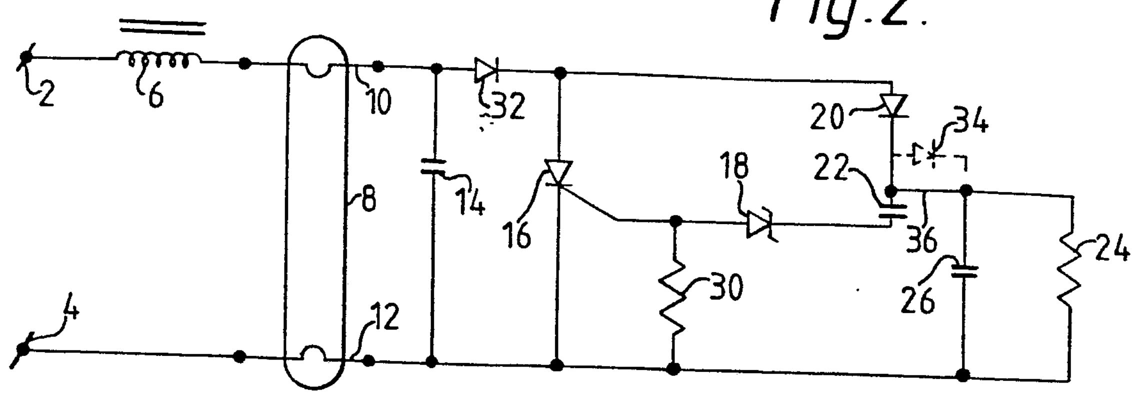

Fig.3.

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Application number

European Patent Office

EUROPEAN SEARCH REPORT

EP 79 30 2368

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
	FR - A - 2 041 024 (N.V. AUCO) * Page 2, lines 25-38; figure 2 * --	1-4
	FR - A - 2 104 522 (NOVANEX AUTOMATION) * Page 3, lines 3-30; figure 4 * --	1,5
	FR - A - 2 277 493 (GENERAL ELECTRIC) * Page 3, lines 17-36; figure 1 * ----	1,8,9

CLASSIFICATION OF THE APPLICATION (Int. Cl.[3])

H 05 B 41/04
H 01 J 61/70

TECHNICAL FIELDS SEARCHED (Int.Cl.[3])

H 05 B 41/04

CATEGORY OF CITED DOCUMENTS

X: particularly relevant
A: technological background
O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention
E: conflicting application
D: document cited in the application
L: citation for other reasons

&: member of the same patent family, corresponding document

✓ The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	19-02-1980	DUCHEYNE

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