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A. CLAUDE

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CIRCUIT FOR ELECTRIC DISCHARGE APPARATUS

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Fig. 1

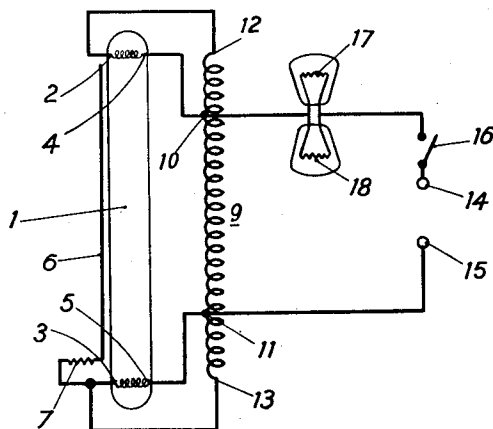
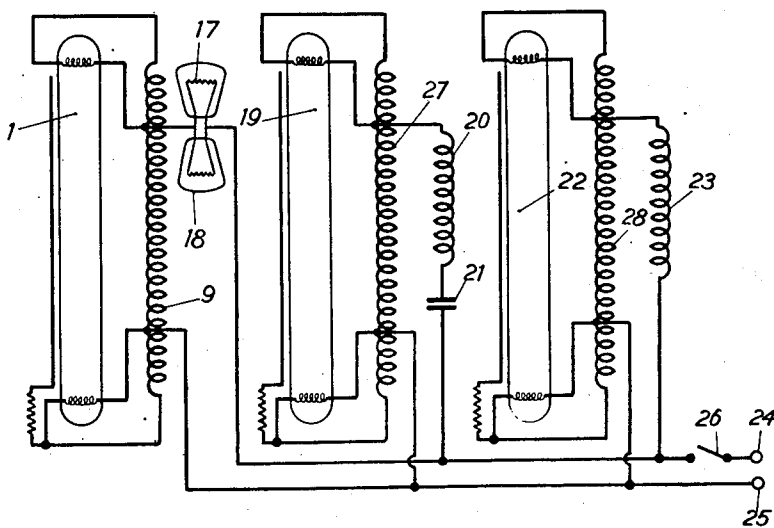


Fig. 2



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CIRCUIT FOR ELECTRIC DISCHARGE APPARATUS

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1 Claim. (Cl. 315—97)

1

This invention relates to devices for the power supply, from an alternating current source, of an electrical discharge apparatus with bipolar electrodes, and for the starting of said apparatus by preheating its electrodes, said devices being of the kind having, for the stabilization of the discharge, a resistance in series with the current source and discharge apparatus and, for the preheating of each one of the electrodes of the apparatus, a transformer, the primary of which is supplied from the current source through said resistance and the secondary of which is in series with said one electrode. The two secondaries, intended to preheat the two electrodes of the discharge apparatus, may have the same primary.

One object of the invention is to provide a power supply and starting device in which the stabilizing resistance transforms into luminous energy a substantial portion of the electric energy consumed in said resistance.

Another object of the invention is to provide a device for supplying power to, and starting, a discharge apparatus with electrodes preheated before starting, in which the ballasting means emit a substantial quantity of light, and which allows the starting and working of the apparatus when a portion of this means is out of use.

A feature of the invention is that said resistance is constituted by at least a group of at least two incandescent electric lamps with metallic filament, connected in parallel and each one being designed to work, during the normal working of the electric discharge apparatus, substantially at its conventional rated load.

What is named here the "conventional rated load" of a lamp is the current intensity of this lamp when it is used in a conventional manner for the lighting by means of incandescent lamps.

Contrarily to what would be believed a priori, experiments show that if, for instance, the stabilizing resistance is constituted by two incandescent lamps of the same type connected in parallel, and if one of these lamps is damaged and no longer passes electric current, the discharge apparatus keeps on operating. If used for lighting, the light flux of the discharge apparatus is now only about half its normal flux but it is not extinguished, which is a safety feature, since there is ample time for replacing the faulty lamp. It is found, further, that the starting of the discharge apparatus, although the stabilization resistance thus has twice its normal value, is effected almost as easily as if the two lamps were in service; it is also established that the life of the

2

remaining lamp is materially lengthened, which proves that such operation does not overstrain this lamp. If the power supply and starting device did not comprise a transformer for heating the electrodes and if the stabilizing resistance were constituted by two incandescent lamps, starting the discharge apparatus would be impossible when one of these lamps would be out of use; even if, in order to avoid overstraining the incandescent lamps during the starting stage, the shunting of said lamps by a resistance during this stage was provided for, it would be impossible for the discharge apparatus to start when one of these lamps would be out of use. Indeed, even in the latter case, the pre-heating current would be insufficient for heating the electrodes suitably and, besides, for operating the relay which effects the necessary changes in the connections at the end of the pre-heating period.

It is generally advantageous to use, for these stabilizing lamps, lamps the atmosphere of which consists mainly of krypton and/or xenon. If such lamps are designed to work at the load which gives them the usual mean life of the vacuum or of the argon lamps, a better luminous efficiency than with the latter is obtained, as well as a light the color of which is whiter and nearer that of the usual fluorescent lamps. If the filaments of these lamps are caused to work in the same conditions as if they were in vacuum or in argon, which is also a customary method of using such lamps, the same luminous efficiency is obtained as with vacuum or argon lamps, but the life of these lamps is materially lengthened and becomes of the same order as that of the discharge apparatus they are used with.

For a better understanding of the invention and to show how the same may be carried into effect, several constructional forms thereof will now be described in greater detail with reference to the accompanying drawings, in which:

Figure 1 shows a circuit comprising a discharge apparatus stabilized by two incandescent lamps mounted in parallel.

Figure 2 shows the power supply and starting circuit for a lighting fixture having a very low stroboscopic effect and comprising three fluorescent lamps.

In Figure 1, the outer surface of the envelope of the discharge apparatus 1 is provided with a conducting strip 6, with a graphite base, for instance, connected to one of its electrodes through a high resistance 7. The ends 2, 4 and 3, 5 of the electrodes of this apparatus are connected with the ends 12, 10 and 13, 11 respective-

ly of the secondaries of a heating transformer 9 having small magnetic leakage and a single primary. The end 10 of said primary is connected with a terminal 14 of the current source, through a group of two incandescent lamps 17, 18, connected in parallel, and through an interrupter 16; the other end 11 is connected directly with the other terminal 15 of said source. The latter may be, for instance, a distribution network for alternating current of a suitable voltage.

By way of example, if the discharge apparatus 1 is a fluorescent lamp of the so-called "40 watt" type, 120 cm. long and about 38 mm. in diameter, for which the terminal voltage, the discharge current and the pre-heating current are respectively: 109 volts, 0.45 amp. and 0.5 amp., the following power supply circuit may be used:

Voltage of the current source 14, 15: 220 volts.

Lamp 17, 18 with an atmosphere of krypton, each of the usual 31 watts type, normal voltage 115 volts.

Open circuit transformation ratio of the heating transformer 9: $\frac{1}{10}$ for each one of the secondaries.

The pre-heating current of lamp 1 should be, if this pre-heating were controlled by a "beating" relay, equal to 1.5 times 0.450 amp. i. e. 0.675 amp.; it is obvious that this current would rapidly damage the incandescent lamps 17 and 18, the rated current of each of which is only 0.27 amp. The transformer 9, on the other hand, supplies during the whole pre-heating period, and through each one of its secondaries, a current of 0.5 amp. which is amply sufficient for heating the electrodes, since it is uninterrupted. During this period, the current in the primary of the transformer 9, which is the current flowing through the group of the lamps 17 and 18, has a value of 0.136 amp., which is much too low to cause a fatigue of these lamps. During normal operation of the discharge lamp 1, the current through each of the incandescent lamps is about 0.28 amp. when the voltage of the current source is 220 volts. This current slightly overloads the lamps 17, 18 on which the voltage is 118 volts during such operation; this overloading can be avoided by using lamps 17, 18, designed for operating at a slightly higher voltage, 120 volts, for instance.

It will be noted that the voltage of the current source is slightly different from the sum of the operating voltages for the lamps 1 and 17 or 18; this anomaly is due to the fact that the variation, in time, of the current through the lamp 1 is not sinusoidal.

The discharge current in lamp 1 is 0.485 amp.; if one of the two lamps, 17 or 18, is burnt out or missing, this current becomes 0.200 amp., but the electrode heating current, before starting, which is 0.5 amp. with two lamps in service, then drops only to 0.46 amp., a value which is quite sufficient for starting. During operation, the electrodes are not damaged by the insufficient heating caused by the discharge, as this heating is supplemented by the heating due to the circulation, in the electrodes, of the current delivered by the heating transformer 9, a current which is approximately 0.1 amp. per electrode. A discharge apparatus with no heating transformer but with a heating controlled by a glow type interrupter, supplied in a similar manner through only one of the two incandescent lamps provided for its stabilization, would not start, as its pre-heating current would be too low.

The value of resistance 7 is about 0.2 megohm. The connected strip 6 decreases the starting voltage for the lamp and allows its starting even when the voltage of the source drops to 190 volts, although the operating voltage of the lamp 1 is 109 volts. This latter voltage makes it possible to design the incandescent lamps 17, 18 for 115 volts (or 120 or even 125 volts if it is desired to increase their life), so that they may be procured in the trade, and so that they operate in conditions similar to those for which they are designed. The same 40 watt fluorescent lamp, but with the conducting strip not connected, cannot start if the voltage of the current source drops substantially below 220 volts. If a lamp of the same design were used, but comprising no conducting strip or equivalent device, its starting voltage with the power supply circuit shown, would be higher than 220 volts. One would then be led to using a discharge lamp with a lower starting voltage; the operating voltage of this new lamp would also be lower and, in order that the incandescent lamps operate in the conditions for which they were designed, their rated voltage would have to be substantially higher than 115 volts, for instance 140 volts, which is not usual.

Figure 2 shows the power supply and starting circuit for the three lamps 1, 19, 22 of a lighting fixture having a very low stroboscopic effect. Lamp 1 is supplied from the source 24, 25, through the incandescent stabilizing lamps 17 and 18, connected in parallel, and its electrodes are heated by the secondaries of the transformer 9 as described in connection with Figure 1. Lamps 19 and 22 are mounted close to the lamp 1 and are of the same type as lamp 1. They are, like lamp 1, provided with a conducting strip connected to one electrode, and their electrodes are heated by heating transformers 27 or 28, of the same type as 9. On the other hand, the stabilization of lamp 19 is effected by an inductance 20 and a condenser 21, mounted in series, and the stabilization of lamp 22 by an inductance 23. The values of the inductances 20 and 23 are close to each other and the reactance of each one of them, at the current source frequency, is, in absolute value, of the order of one half of that of the condenser 21, at the same frequency. If, for instance, lamps 1, 19, 22, are of the same type as lamp 1 described in connection with Figure 1 and if the current source 24, 25 is a 220 volts network, at 50 cycles per second, one may use:

For lamps 17, 18, incandescent lamps with a metal filament, designed for 115 volts, 31 watts.

For inductance 20 a 1 henry coil and for condenser 21 a 4.5 microfarad condenser.

For inductance 23 a 1 henry coil.

It is found, experimentally, that the instantaneous value of the light intensity delivered by this group of three lamps varies only by 5 to 6% above or below its mean value, the frequency of the current source being 50 cycles per second.

It is obvious that if the voltage of the electric current source 24, 25, is not suitable for the feeding and the starting of the fluorescent lamps 1, 19, 22, this voltage may be changed by transformers; it is then advisable that the transformers which thus energize lamps 19 and 22 have substantial magnetic leakages, giving them a reactance which allows to dispense with the reactance coils 20 and 23.

Numerous modifications may be made in the above described circuits. For instance, the conducting strip for facilitating the starting may be omitted and other means be, or not, used for

facilitating the starting. The secondary windings which furnish the heating current to the electrodes of one and same lamp may be wound on separate magnetic circuits, each having its own primary winding. The current source may consist of a transformer, the primary of which is supplied from a current distributing network, at a voltage of 110 volts for instance, the transformer delivering 220 volts, or else, through a vibrating interrupter, from a battery of primary cells or storage batteries. As usual for similar devices comprising more than one electrode discharge apparatus, each lamp and the corresponding heating transformer may, in the embodiment comprising three lamps be energized by a transformer, part of which may be common with the transformer of at least one of the other lamps. The heating transformer may also fulfill the function of modifying the voltage available for the discharge. Other modifications, may also be used within the scope of the present invention.

What I claim:

A circuit for energizing three electric discharge apparatus provided with filamentary electrodes, of the type in which the starting of the discharge apparatus comprises preheating the electrodes of said apparatus, comprising, a source of alternating current, a first, a second and a third step-down transformer, each having a primary and two secondary windings, a first, a second and a third electric discharge apparatus with filamentary electrodes, said apparatus having similar electric characteristics and being energized by said source of current through separate stabilizing means, the primary windings of said

step-down transformers being respectively energized from said source through said stabilizing means and the secondary windings of said transformers being connected respectively to the filamentary electrodes of that discharge apparatus which is energized through that ballasting means through which is energized the primary winding of the corresponding transformer, the stabilizing means for the first discharge apparatus being a reactance coil, the stabilizing means for the second discharge apparatus comprising a reactance coil and a condenser connected in series, the impedances of these two reactance coils being approximately equal, each of said impedances being, at the frequency of the source of current, approximately equal in absolute value to half that of said condenser, and the ballasting means for the third discharge apparatus being a group of at least two incandescent electric lamps of the type having a metallic filament, connected in parallel, each of said incandescent lamps being designed to work, during the normal working of the electric discharge apparatus, substantially at its conventional rated load.

ANDRÉ CLAUDE.

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