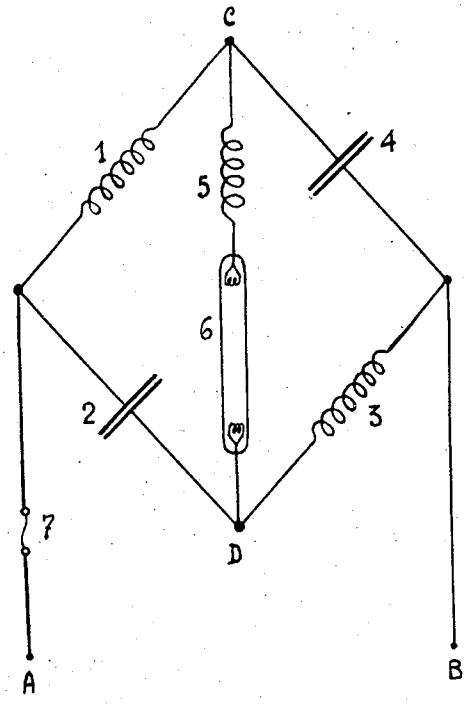
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DEVICE FOR STARTING AND FEEDING ELECTRIC DISCHARGE TUBES UNDER LOW PRESSURE

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DEVICE FOR STARTING AND FEEDING ELECTRIC DISCHARGE TUBES UNDER LOW PRESSURE

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There are known so-called constant voltage-constant current circuits which are formed of combinations of tuned inductance and capacitance elements and which, when they are supplied from a constant voltage source at their input terminals, should theoretically deliver a constant current from their output terminals. This uniform distribution system feeds current to a receiving circuit. These arrangements have, in particular, the advantage that when they are applied to the feed of electric discharge tubes they permit the automatic starting and operation of the tube without requiring any modification.

This invention relates to the establishment of special conditions for the application of these systems, hereinafter called "feed systems," to the operation of low voltage electric discharge tubes. These tubes are fitted with thermo-emitting electrodes heated by the discharge from a constant voltage alternating source, for instance one of the usual low tension sources (110 or 220 volts). Only those voltages are permitted in a receiving circuit which do not exceed the limit authorized by the regulations for usual distributions. Furthermore, the device according to the invention, which does not work with a uniform intensity, occupies a minimum of space, consumes very little energy, and has a high power factor, without reducing the life of the tube employed.

The accompanying drawing shows merely by way of example an embodiment of the invention, comprising a constant voltage-constant current circuit of the Wheatstone bridge type.

In this drawing, A and B designate the terminals of the constant voltage source of distribution. C and D are the terminals of the receiving circuit. 1 and 3 are the inductors, and 2 and 4 are the capacitors of the feed system, these elements being respectively equal to each other. 5 is the stabilizing inductance coil in series with the luminescent discharge 6. The fuse is indicated at 7.

According to the present invention, when the tube is connected in series with an inductance coil in the receiving circuit, the following conditions are simultaneously complied with:

(*a*) The stabilizing impedance has such a value that it would secure the stability of the tube when the tube with its impedance is supplied with a constant voltage, this voltage actually being lower than twice the voltage across the tube under working conditions;

(*b*) The open circuit voltage is higher than the tube starting voltage, but it is lower than three times the constant input voltage and at most equal to the maximum voltage permitted by the regulations concerning low voltage systems (for instance 250 volts in France);

(*c*) The circuit leading to the terminals of the source of distribution includes a device for automatically cutting off the current (fuse or circuit-breaking relay) adjusted to operate at the open circuit current.

The stabilizing impedance such as defined above prevents any rapid deterioration of the electrodes during the starting of the tube and its operation. Its value is very much higher than it would be advantageous to use with a tube having cold electrodes. It is important to note that the value of this impedance is independent of the supply circuit and of the value of the elements thereof, although these elements intervene for the stabilization of the tube.

Stabilization with the constant voltage supply considered at *a* above is to be considered as secured when a change of current in the tube between 30 and 18% corresponds to an incidental change of 10% in the normal supply voltage. In the present invention, owing to the influence of the feed system elements, the stabilization obtained for the entire device will of course be still better.

The open circuit voltage defined in *b* above is obtained by suitably dimensioning the elements of the feed system. These dimensions are chosen in such manner that, when the tube is in operation, its normal working current flows therethrough.

The low value chosen for the open circuit voltage prevents the production of a dangerous overvoltage at the terminals of said circuit, if the tube is brought out of action, and permits a reduction of the space occupied by the elements of the feed system. This effect is further accentuated by the provision of a current cutting means, which allows these elements to be dimensioned only as far as necessary for the flow of a current equal to that which passes therethrough when the tube is being started, during the period for bringing it into normal operating conditions. It has been found that the starting time, despite the low overvoltage employed for this starting, is sufficiently short to allow a material reduction in the size of the system. The size is very small compared with that which would be necessary in the absence of the circuit-breaking means, if the elements had been chosen in such manner as to support the current flowing therethrough in case the tube was brought out of service.

The automatic circuit breaking means may be a delayed action fuse, adjusted to operate after the elapsing of the time required for starting the tube, provided the tube has not actually been started. This fuse comprises for instance an electric heating coil, which may be made of a metal the resistance of which increases considerably when the temperature rises, surrounding a mass of fusible alloy, for instance Lipowitz alloy (26.3% of lead, 13.3% of tin, 50% of bismuth, 10% of cadmium, melting point 70° C.) with which it is in series. The fuse may be terminated by a spring under tension with one of its ends embedded in the fusible mass. But it has been found that in most cases it is sufficient to employ an automatic current circuit breaking means acting without delay, for instance an ordinary fuse. The same is true when the interval between the open circuit current and the starting current is rendered sufficient to permit the starting of the tube without operating the circuit breaking means. The starting input current can be reduced with respect to the open circuit current in a suitably proportioned plant (as to the voltage delivered by the supply network, the starting voltage and the characteristics of the tube). The open circuit current is in fact larger than the starting current as the following two ratios are larger, first—the ratio of the starting voltage to the working voltage at the output, and second—the ratio of the open circuit current to the working current at the input. The inductance coil in series with the tube is preferably proportioned so that the induction therein developed by the starting current is sufficiently low to avoid saturation by the temporary current peaks, such as occur during the starting. This induction is chosen, for instance, to range from 6000 to 7500 Gauss.

What I claim is:

1. A circuit arrangement for supplying an electric discharge lamp with current from a low voltage source comprising, a ballast impedance in series with said lamp, the value of said impedance being such that an incidental change of 10% in the voltage applied to the lamp and its impedance will cause a change of less than 30% in the current in the lamp when said voltage is lower than approximately twice the voltage across the lamp under working conditions, a network of the constant voltage-constant current type including two sets of inductances and capacitances, each of said sets comprising one inductance and one capacitance connected across said discharge tube and its impedance, the inductances and capacitances being respectively equal to each other, said network having its input and output sides connected to said low voltage source and said circuit respectively and being so proportioned as to yield at its output side an open circuit voltage lower than a predetermined value below approximately three times the constant input voltage and a working output as required by said circuit, a circuit breaker in the input connections of said network which will withstand the input current and maintain the circuit closed during the starting of the tube but which will break the circuit at open circuit current of the network; the elements of the circuit being of smaller size than that which would be required under a steady open circuit operation of the network.

2. A circuit arrangement for supplying an electric discharge lamp with current from a low voltage source comprising, a ballast inductance in series with the lamp, said ballast inductance being so proportioned as not to be saturated by the current peaks occurring in the network during the starting of the lamp and having such a value that an incidental change of 10% in the voltage applied to the lamp and its impedance will cause a change of less than 30% in the current in the lamp when said voltage is approximately lower than twice the voltage across the lamp under working conditions, a network of the constant voltage-constant current type including two sets of inductances and capacitances, each of said sets comprising one inductance and one capacitance connected across said discharge tube and its impedance, the inductances and capacitances being respectively equal to each other, said network having its input and output sides connected to said low voltage source and said circuit respectively and being so proportioned as to yield at its output side an open circuit voltage lower than a predetermined value below approximately three times the constant input voltage and a working output as required by said circuit, a circuit breaker in the input connections of said network which will withstand the input current and maintain the circuit closed during the starting of the tube but which will break the circuit at open circuit current of the network; the elements of the circuit being of smaller size than that which would be required under a steady open circuit operation of the network.

3. A circuit arrangement for supplying an electric discharge lamp with current from a low voltage source comprising, a ballast impedance in series with said lamp, the value of said impedance being such that an incidental change of 10% in the voltage applied to the lamp and its impedance will cause a change of less than 30% in the current in the lamp when said voltage is approximately lower than twice the voltage across the lamp under working conditions, a network of the constant voltage-constant current type including two sets of inductances and capacitances, each of said sets comprising one inductance and one capacitance connected across said discharge tube and its impedance, the inductances and capacitances being respectively equal to each other, said network having its input and output sides connected to said low voltage source and said circuit respectively and being so proportioned as to yield at its output side an open circuit voltage lower than a predetermined value below approximately three times the constant input voltage and a working output as required by said circuit, a circuit breaker of the delayed action type in the input connections of said network which will delay over the time required for starting the tube and maintain the circuit closed but which will break the circuit at open circuit current of the network; the elements of the circuit being of smaller size than that which would be required under a steady open circuit operation of the network.

4. A circuit arrangement for supplying an electric discharge lamp with current from a low voltage source comprising, a ballast impedance in series with said lamp, the value of said impedance being such that an incidental change of 10% in the voltage applied to the lamp and its impedance will cause a change of less than 30% in the current in the lamp when said voltage is approximately lower than twice the voltage across the lamp under working conditions, a network of the constant voltage-constant current type including two sets of inductances and capacitances, each of said sets comprising one inductance and one ca-

pacitance connected across said discharge tube and its impedance, the inductances and capacitances being respectively equal to each other, said network having its input and output sides connected to said low voltage source and said circuit respectively and being so proportioned as to yield at its output side an open circuit voltage lower than a predetermined value below approximately three times the constant input voltage and a working output as required by said circuit, and which, during the starting of the lamp, will take an input current substantially lower than the open circuit input current, a circuit breaker in the input connections of said network which will withstand the input current and maintain the circuit closed during the starting of the tube but which will break the circuit at open circuit current of the network; the elements of the circuit being of smaller size than that which would be required under a steady open circuit operation of the network.

5. A circuit arrangement for supplying an electric discharge lamp with current from a low voltage source comprising a ballast impedance in series with said lamp, the value of said impedance being such that an incidental change of 10% in the voltage applied to the lamp and its impedance will cause a change of less than 30% in the current in the lamp when said voltage is approximately lower than twice the voltage across the lamp under working conditions, a network of the constant voltage-constant current type including two sets of inductances and capacitances, each of said sets comprising one inductance and one capacitance connected across said discharge tube and its impedance, the inductances and capacitances being respectively equal to each other, said network having its input connected to said low voltage source and its output connected to the lamp and its impedance and being so proportioned as to yield at its output side an open circuit voltage lower than a predetermined value below approximately three times the constant input voltage and yielding a working voltage as required by said lamp, an automatic circuit breaker of the delayed action type in the input connections of said network, said circuit breaker being adjusted to operate upon failure of the lamp to start, after a time interval normally required to start the lamp, the elements of the circuit being of smaller size than that which would be required under a steady open circuit operation of the network.

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