

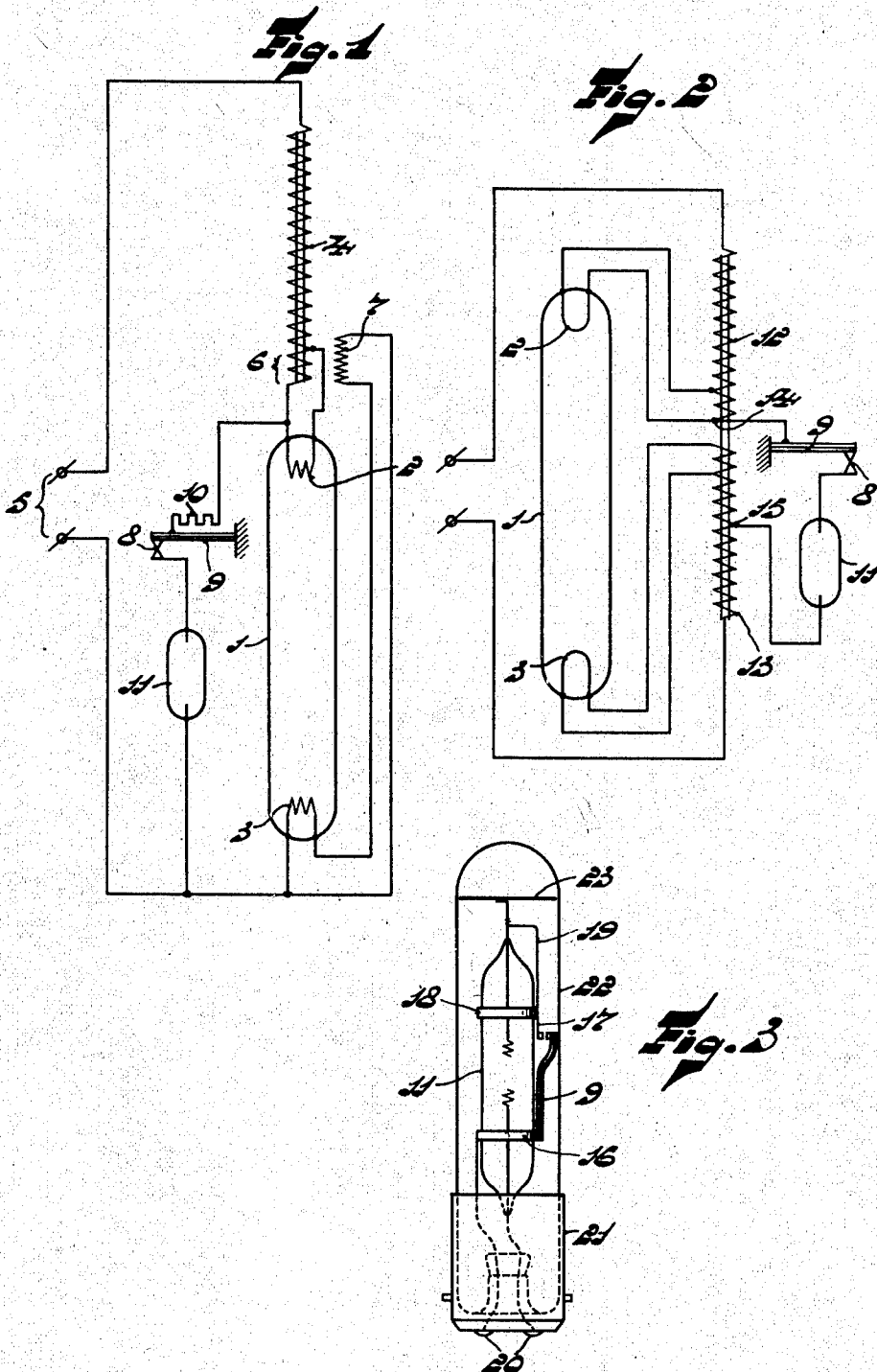
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GASEOUS ELECTRIC DISCHARGE APPARATUS

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GASEOUS ELECTRIC DISCHARGE
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This invention relates to a circuit arrangement comprising a gasfilled electric incandescent electrode discharge tube, an auxiliary branch circuit connected in parallel with this tube and comprising a thermally operated switch which is opened to ignite the tube, and an inductance connected in series with the tube and the auxiliary branch circuit.

It has previously been proposed to short-circuit the discharge tube to be ignited by means of a switch. When this short-circuiting switch is opened, a strong voltage impulse occurs in an inductance connected in series with the discharge tube. In order to avoid the drawback involved in the manual operation of this switch it has already been suggested to employ a thermally operated switch, e. g. a bimetallic switch. With this thermally operated switch the opening of the switch is effected only after a certain period, since the contact members are only separated from one another after a certain amount of heat is supplied. The delay in ignition thus involved has the advantage, particularly with incandescent electrode discharge tubes, that the incandescent electrodes may be heated prior to the ignition of the tube which naturally favourably affects its life and brings about a lower igniting voltage than in the cold state of the electrodes.

After the tube has ignited, the contacts of the thermally operated switch, by which the tube is bridged, must remain open which requires the supply of a certain amount of energy also during normal operation of the discharge tube. This uselessly supplied energy entails another drawback. In fact, when the voltage supplied to the circuit arrangement is for some reason interrupted for a short time and the discharge extinguishes, the thermally operated switch due to its thermal delay needs a certain time until its switching contacts make contact again. Consequently in such cases the switch for initiating the ignition is not ready for use.

The invention has for its purpose to avoid the abovementioned drawbacks. According to the invention, the heating element of the thermally operated switch is inserted in the auxiliary branch circuit in series with the switch. Furthermore an auxiliary discharge tube connected in series with the switch and the heating element is inserted in this auxiliary branch circuit, in which tube an arc discharge may occur. This tube is so constructed and dimensioned that its igniting voltage is lower than the voltage supplied to its electrodes prior to ignition of the

main discharge tube and higher than the voltage supplied to its electrodes after ignition of the main discharge tube when the thermally operated switch is closed again.

5 Since the heating element of the thermally operated switch constitutes a series-element of the auxiliary branch circuit, no energy is supplied any more to the heating element after the switch is opened. In the absence of a supply of energy the switching contacts very rapidly contact again, however; also in this case no current flows through the auxiliary branch circuit when the main discharge tube has ignited, since the auxiliary discharge tube provided in this circuit prevents the passage of current in the auxiliary branch circuit due to the low working voltage of the main discharge tube during operation. The heating element of the switch therefore consumes no energy during operation of the tube, while the arrangement exhibits an immediate readiness for ignition. Since the auxiliary discharge tube exhibits an arc discharge, a strong current flows through the auxiliary branch circuit when the main discharge tube is to be ignited, which current upon opening of the switch leads to the production of a very strong voltage impulse in the pre-connected inductance. This permits also a more satisfactory and more rigid construction of the thermal interruptor, since abundant energy may be supplied to the heating element prior to the ignition of the main discharge tube and thus the time of interruption may be reduced to about 1 to 2 seconds, a time in which generally also a sufficient pre-heating of the incandescent electrodes is obtained. Since the energy required for opening the interruptor does not play a part in normal operation of the discharge tube and may be given a high value, it is possible to give the switch also a high contact pressure so that a better interruption, better life of the contacts and a more favourable condition of ignition for the tube is ensured.

It will be appreciated that the auxiliary branch circuit need not be connected directly between the electrodes of the main discharge tube, but may be connected in parallel with this tube and part of the pre-connected impedance. The points of connection of the auxiliary branch circuit need only be such that the voltage supplied to the electrodes of the auxiliary discharge tube shall be sufficient for the ignition of the auxiliary discharge tube prior to the ignition of the main discharge tube, but shall be insufficient therefor during operation of the main discharge tube.

The thermal switch employed may advantageously comprise a bimetallic switch so constructed and dimensioned that its metallic parts themselves act as a heating element. An advantageous construction is obtained when the heat developed by the auxiliary discharge tube is utilised to help the heating of the bimetallic element. To this end the bimetallic strip may be fastened to the tube by means of a metallic strip so that the heat developed in the auxiliary discharge tube is transmitted to the bimetallic strip by conduction or also by radiation and thus helps the heating of the latter.

The thermally operated switch and the auxiliary discharge tube may advantageously be combined to form a unit so that an igniting device is obtained which can be easily applied and connected.

The incandescent electrodes of the main discharge tube or, if desired, the heating bodies of these electrodes may advantageously be supplied with heating current from some turns of the inductance so that a special source of heating current is superfluous. The heating elements (with directly heated electrodes these are the core wires of the electrodes and with indirectly heated electrodes the special heating bodies) of the incandescent electrodes may be directly connected to these turns, or they may be connected to a separated winding which is inductively coupled with the preconnected impedance. Since a strong current flows through the auxiliary branch circuit during ignition, the turns feeding the incandescent electrodes are also strongly loaded so that the incandescent electrodes are rapidly heated.

The invention will be explained more fully hereinafter with reference to the accompanying drawing, in which the Figs. 1 and 2 are two embodiments of the circuit arrangement according to the invention and Fig. 3 represents the constructional assembly of the auxiliary discharge tube with the bimetallic switch.

In Fig. 1, 1 denotes a gasfilled discharge tube which, for example, may be a low-pressure mercury vapour discharge lamp provided, if desired, with a luminescent coating on the glass wall. The tube comprises two incandescent electrodes 2 and 3 and is connected to the source of alternating current 5 through the choke 4. The electrode 2 is supplied with heating current by being connected across the end turns 6 of the choke coil 4 while the electrode 3 is supplied with heating current by being connected across the winding 7 which is magnetically coupled with the choke coil.

An auxiliary branch circuit comprising the bimetallic switch 8 is connected in parallel with the discharge tube 1. The bimetallic strip of this switch is designated by 9 and the heating element of this bimetallic strip by 10. Furthermore the auxiliary branch circuit comprises an auxiliary discharge tube 11 in which occurs an independent arc discharge. The switch 8, the heating element 10 and the auxiliary discharge tube 11 are connected in series with one another and by reason of the operating characteristics of the tube 11 constitute a non-linear circuit.

Since in the position of rest the switch 8 is closed and the auxiliary discharge tube 11 is so dimensioned as to be ignited when the supply voltage is applied and before a discharge starts in the tube 1, a current starts to flow through the auxiliary branch circuit connected in parallel with the tube. Heat produced in the element 10

then heats the bimetallic strip 9. After sufficient heating the bimetallic strip becomes curved with the result that the switch 8 is opened. Due to this interruption of the circuit a voltage impulse is produced in the choke 4 which brings about the ignition of the discharge tube. The ignition of this tube is facilitated by the fact that the incandescent electrodes 2 and 3 during the passage of current through the auxiliary branch circuit are supplied with heating current from the turns 6 and 7 and consequently receive a high temperature.

After the switch 8 is opened, no current flows through the heating element 10 so that the bimetallic strip 9 cools down and the switch 8 is closed again after some time. When the discharge tube 1 is ignited in the meantime, the voltage supplied to the auxiliary branch circuit has become lower than the voltage conducted to this branch circuit before the discharge tube 1 was ignited. In fact the voltage set up between the ends of the auxiliary branch circuit and consequently between the electrodes of the auxiliary discharge tube 11 has become equivalent to the working voltage of the discharge tube 1. The auxiliary discharge tube 11 is so dimensioned that it will not continue to ignite with this voltage. Consequently after the main discharge tube 1 has been ignited no current flows through the auxiliary branch circuit connected in parallel with the discharge tube 1 even when the switch 8 is closed again. Thus it is ensured that this auxiliary branch circuit does not consume any current during normal operation of the discharge tube 1 and the current which flows upon ignition through this branch circuit may be given whatever high value is desirable to obtain the operation of the bimetallic switch. Also one obtains the advantage that the switch 8 is immediately ready to initiate the ignition again when the discharge in the tube becomes extinguished for any reason.

In the circuit arrangement according to Fig. 2 the preconnected choke coil of the discharge tube 1 comprises two parts 12 and 13 which are connected at each end of the tube 1. The incandescent electrode 2 is connected to some of the turns of the part 12 and the incandescent electrode 3 is connected to some of the turns of the part 13 of the pre-connected impedance. The auxiliary branch circuit comprising the bimetallic switch 8 and the auxiliary discharge tube 11 is not directly connected between the electrodes of the discharge tube 1, but between the end 14 of the part 12 and the point 15 of the part 13. The auxiliary branch circuit therefore is connected in parallel with the discharge tube 1 and the upper part of the choke coil 13. The point of connection 15 is so chosen that the voltage supplied to the auxiliary branch circuit after the discharge tube 1 has ignited is not sufficient to ignite the auxiliary discharge tube 11. The connection of the auxiliary branch circuit to point 15 has the advantage that not the whole pre-connected impedance of the discharge tube 1 is pre-connected with respect to the auxiliary branch circuit so that a stronger auxiliary current occurs than in the event of the auxiliary branch circuit being connected directly to the electrodes of the discharge tube.

As appears from Fig. 2, the auxiliary current flows through the bimetallic strip 9 so that the latter constitutes at the same time the heating element for the bimetallic switch. In this case it is very desirable to help the heating of the

bimetallic strip by means of the heat produced in the discharge tube 11. For this purpose the discharge tube 11 is so arranged that the heat produced therein is transmitted to the bimetallic strip 9. This may be ensured in the manner illustrated in Fig. 3.

In this figure, 11 denotes the auxiliary discharge tube. The bimetallic strip is also in this case denoted by 9. One end of this strip is secured to the tube 11 by means of the metal strip 16, whilst the contact piece 17 of the switch is secured to the tube 11 by means of the metal strip 18. Since the bimetallic strip 9 is arranged along the discharge tube 11 a portion of the heat produced in the tube 11 when a current flows is transmitted to the strip 9 so that the heating of the bimetallic strip is helped to a great extent. The contact piece 17 is connected to the upper electrode of the discharge tube 11 by means of the wire 19, whereas the lower electrode of this tube and the strip 16 are each connected to one of the contact pieces 20. These contact pieces are located at the lower end of the cap 21 of the glass envelope 22 which completely embraces the discharge tube 11. This envelope 22 is preferably evacuated. To support the discharge tube 11 against the envelope 22, a mica disc 23 is provided at the upper end of the tube 11. In this manner a very simple constructional unit is obtained which may be easily connected in parallel with the main discharge tube 1.

What I claim is:

1. In combination, a source of alternating current supply, a gaseous electric discharge device connected to be supplied therefrom, said device having electrodes arranged to be initially heated, and a branch circuit including an auxiliary discharge device, a thermal switch and means for heating the switch arranged in series and connected across said gaseous device, the ignition voltage of said auxiliary device being less than that of said gaseous device and greater than the working voltage thereof.

2. In combination, a source of alternating current supply, a gaseous electric discharge device connected to be supplied therefrom, said device having electrodes arranged to be initially heated and a branch circuit including an auxiliary discharge device, a bimetallic switch, and a resistance heater therefor arranged in series and connected across said gaseous discharge device, the ignition voltage of said auxiliary device being less than that of said gaseous device and greater than the working voltage thereof.

3. In combination, a source of alternating current supply, a gaseous electric discharge device connected to be supplied therefrom, said device having electrodes arranged to be initially heated and a branch circuit arranged to shunt said device including an auxiliary discharge device and a thermal switch connected together in series, said auxiliary device being arranged in heat conducting relation with said switch, the ignition voltage of said auxiliary device being less than that of said gaseous device and greater than the working voltage thereof.

4. In combination, a source of alternating current supply, a gaseous electric discharge device connected to be supplied therefrom, said device having electrodes arranged to be initially heated and a branch circuit connected across said device including a thermal switch and an auxiliary discharge device arranged to supply heat to said switch, the ignition voltage of said auxiliary de-

vices being less than that of said gaseous device and greater than the working voltage thereof.

5. In combination, a source of alternating current supply, a ballast reactor, a gaseous electric discharge device connected with said source through said reactor, said device having spaced electrodes therein, means for supplying energy from said reactor to said electrodes to initially heat them, and a branch circuit connected across said device and including a heater, a thermal switch adjacent thereto and an auxiliary discharge device connected together in series, the ignition voltage of said auxiliary device being less than that of said gaseous device and greater than the working voltage thereof.

6. In combination, a source of alternating current supply, a ballast reactor, a gaseous electric discharge device connected with said source through said reactor, said device having spaced electrodes therein, means for supplying heating current to one of said electrodes from a portion of said reactor and a branch circuit connected across said device and including a heater, a thermal switch adjacent thereto and an auxiliary discharge device connected together in series, the ignition voltage of said auxiliary device being less than that of said gaseous device and greater than the working voltage thereof.

7. In combination, a source of alternating current supply, a ballast reactor, a gaseous electric discharge device connected with said source through said reactor, said device having electrodes arranged to be initially heated and a branch circuit including a thermal switch, a heater therefor and an auxiliary discharge device connected together in series, said branch circuit being connected in shunt with said device and an adjacent portion of said reactor, the ignition voltage of said auxiliary device being less than that of said gaseous device and greater than the working voltage thereof.

8. In combination, a source of alternating current supply, a ballast reactor, a gaseous electric discharge device connected with said source through said reactor, said device having spaced electrodes therein, means for supplying energy to said electrodes to initially heat them including a tap on the reactor connected with one electrode and a winding associated with the reactor and connected across the other electrode, and a branch circuit connected across the device including a thermal switch, a heater therefor and an auxiliary discharge device connected together in series, the ignition voltage of said auxiliary device being less than that of said gaseous device and greater than the working voltage thereof.

9. In combination, a source of alternating current supply, a gaseous electric discharge device connected to be supplied therefrom, said device including electrodes arranged to be supplied with heating current and means for controlling said heating current comprising a circuit arranged to shunt said device, said circuit not including said electrodes and including a thermal switch and means for supplying heat thereto.

10. In combination, a gaseous electric discharge lamp having spaced electrodes, means including a ballasting impedance for operatively connecting said lamp with a source of alternating current supply, at least one of said electrodes being filamentary and arranged to be supplied with current for the preheating thereof, and a circuit connected in shunt with said lamp and not including said electrodes for controlling said preheating current, said circuit including a bi-

metallic switch and a heating resistor therefor.

11. In combination, a gaseous electric discharge lamp having filamentary electrodes, means including a ballast reactor for connecting it to be supplied from a source of alternating current, and means for controlling the flow of current through said electrodes for producing an initial heating thereof comprising a thermal switch and a resistance heating member therefor connected in a circuit shunting said lamp but not including the lamp electrodes.

12. In combination, an electric discharge device having spaced electrodes therein, one of said electrodes being arranged to be supplied with heating current, means for connecting said device to be supplied from a source of current, and means for controlling said heating current comprising a circuit connected between said electrodes, said circuit including a thermal switch and a resistor independent of said one electrode for supplying heat thereto.

13. In combination, an electric discharge device having spaced electrodes therein constructed to be heated by current flow therethrough, means for connecting said device to be supplied from a source of current, and controlling means for said electrode heating current comprising a circuit shunting the discharge path through said device and including a thermal switch and resistance heating means therefor located outside of said device.

14. In combination, an electric discharge de-

vice comprising a closed tube having spaced electrodes therein arranged to be supplied with heating current, means for connecting said device to be supplied from a source of current, and means for controlling said heating current comprising a circuit connected between said electrodes and shunting the arc path, said circuit including a thermal switch and heating means separate from and independent of said electrodes and located externally of said tube for supplying heat to said switch.

15. In combination, an electric discharge device having spaced electrodes therein, at least one of which is of the filamentary type arranged to be supplied with heating current, means for connecting said device to a source of current and means for controlling said heating current comprising a circuit connected between said electrodes, said circuit including a bimetallic switch and a resistor for supplying heat thereto.

16. In combination, an electric discharge device having spaced electrodes, at least one of which is of the filamentary type arranged to be supplied with heating current, means for connecting said device to a source of current and a circuit connected between the electrodes and shunting the arc path for controlling said heating current, said circuit including a bimetallic member and a resistor in series therewith for supplying heat to said bimetallic member.

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