April 11, 1933. L. L. BECK 1,903,496

LIGHTING SYSTEM

Original Filed Feb. 27, 1930

FIG.3.

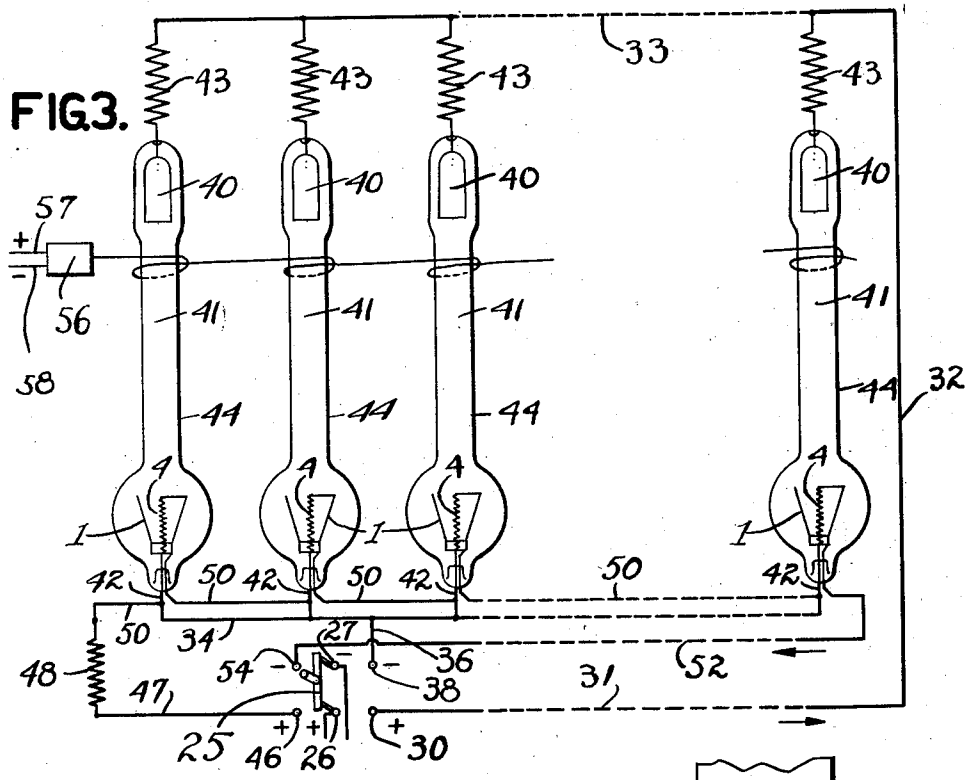


FIG.2.

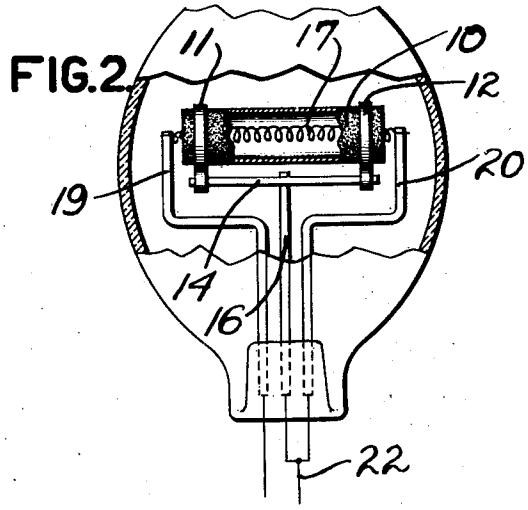
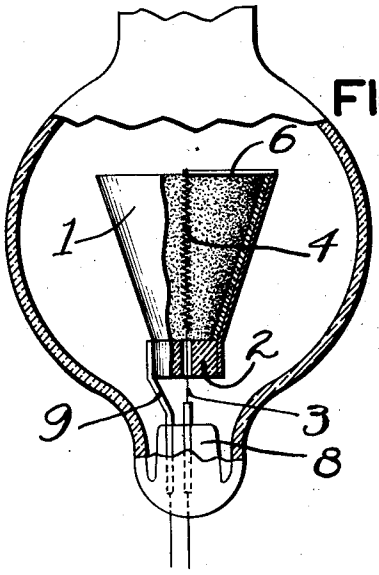


FIG.1.



Inventor
LEO L. BECK

By his Attorneys
Bohleber & Ladbetter

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UNITED STATES PATENT OFFICE

LEO L. BECK, OF WESTFIELD, NEW JERSEY, ASSIGNOR, BY MESNE ASSIGNMENTS, TO GENERAL TUBE LIGHTS CORPORATION, OF NEW YORK, N. Y., A CORPORATION OF DELAWARE

LIGHTING SYSTEM

Application filed February 27, 1930, Serial No. 431,674. Renewed June 22, 1932.

The present invention relates to gaseous discharge luminous tube devices.

The invention provides a new and improved combination of such devices and a new and improved method of starting and lighting the same.

The invention relates more particularly to a gaseous discharge device in which the cathode is provided with a thermo-emissive substance and is intended to be maintained at a high temperature to obtain certain advantages flowing therefrom, such as decreased cathode drop, prevention of sputtering and increase in the life of the gaseous filling of the cathode and of the device as a whole. The cathode employed in the preferred form of the present invention is fully described in a copending application of Kober, Noble and Homan, Serial No. 410,038 filed November 27, 1929. It comprises a thermo-emissive cathode which may be constructed by coating a surface of a refractory metal such as copper, iron, nickel or the like with a suitable thermo-emissive substance which may be a suboxide of an electro positive element, as, for example, barium suboxide. The said cathode may have a form particularly adapted for the purposes of electron emission, as, for example, a conical form. It is provided with a heating element which is situated in spaced relation to the cathode and is in series electrical connection therewith. The said heating element is connected to a lead wire which projects through the envelope and conveys current from the cathode to the source of discharge current and potential.

By means of this arrangement, the filament is automatically heated by the discharge current, which, in order to leave the discharge tube, must pass from the cathode and through the heating element as already stated is in series with the cathode.

One preferred form of the cathode and its auxiliary heating element is represented by a cathode having a conical shape provided with a heating element, which consists of a coiled filament coinciding substantially with the axis of the cone. The said heating element in this form is connected to a lead wire which passes through the neck of the cone which at that point is truncated. Insulation between the said lead wire and neck of the cone prevents electrical connection at that point. The coiled filament is substantially co-extensive with the height of the cone and is in electrical connection therewith only at the base or large diameter. By this arrangement, discharge current is obliged to pass from the cathode through the filament and therefore automatically heats the latter.

The cathode of the general type herein described is intended for use in electrical discharge devices where the cathode drop is of primary importance, as, for example, in cases where, as in the present invention, the available potential may be limited and where the successful operation of the device depends upon suitable reduction of the cathode drop.

In the type of cathode herein described, such reduction requires for its attainment the development of a high temperature in the cathode. In other words, the cathode must be heated in order to bring out its thermo-emissive properties and unless such heating is effected, the operation of the device may be impossible where the available potential is limited. Suitable heating of such a cathode may reduce its potential drop enormously, as, for example, from 150 volts in the case of a cold cathode to about 10 volts where the same is properly heated. When the entire potential flow through the dicharge device is approximately equal to the available potential when the cathode is suitably heated and is operating at a minimum drop, it will readily be appreciated that any substantial increase in cathode drop would result in a cessation of operation. For similar reasons, the cathode must be suitably heated prior to lighting the tube when such lighting is effected and is to be maintained by a predetermined and limited low potential, as, for example, 220 volts.

The present invention provides improved means whereby the cathode may be suitably heated and an improved method of carrying out such heating. The invention is of particular advantage in connection with the operation of a plurality of gaseous discharge devices, as, for example, such a plurality

of tubes as may be employed in the construction of script for advertising or display purposes. Regarding any individual discharge device equipped with a cathode and auxiliary heating element as herein described, it is possible to provide each cathode and auxiliary heating element with an auxiliary heating electrical circuit independent of the discharge circuit. It is for example possible to provide a circuit which comprises the terminals of the supply current, a step down transformer and the cathode and its auxiliary heating element. For many purposes, however, particularly where a plurality of gaseous discharge devices are employed such as in the construction of suitable script for sign and display purposes, it is highly desirable and from a commercial point of view necessary to have the external circuits as simple in nature and as free from cumbersome equipment as possible and the provision of independent heating circuits for each cathode is an undesirable complication in the circumstances mentioned. Heating the cathode and its auxiliary filament by merely connecting the same to the terminals of the supply current would result merely in destruction of the cathode or filament or both.

The present invention provides a novel improved means of heating the cathode and of eliminating cumbersome and undesirable external electrical equipment.

According to the present invention, the heating elements of the cathodes of a plurality of discharge devices are utilized not only for heating the said cathodes but also for providing the necessary ballast and resistance to enable the direct application of current from the supply mains through the said filaments. The said heating elements or filaments therefore are enabled to perform a double function, viz: first, that of supplying heat for the corresponding cathodes and, secondly, of supplying the necessary resistance to enable the complete or partial elimination of external resistance and the consequent simplification and improvement of the equipment.

The invention will be described in greater detail by reference to the accompanying drawing, which represents one embodiment thereof. It is intended and will be understood that the invention is illustrated by and not limited to such embodiment, as illustrated.

In the drawing, Figure 1 represents a partly sectional view of an electrode portion of a discharge tube showing a preferred form of cathode partly in section and partly in elevation.

Figure 2 shows a cathode portion of a discharge tube, partly broken away to indicate an alternative form of cathode construction.

Figure 3 shows an assembly of a plurality of discharge devices containing the preferred form of cathode illustrated in Figure 1 and connected together in the manner herein described to show the new and improved means of heating such cathodes to reduce the cathode drop to permit the devices to be readily lighted and operated. Although the tubes shown in Figure 3 are shown as substantially straight, for purposes of simplicity of illustration, it is to be understood that such tubes may severally be bent into any shape desired and may represent letters or other indicia.

In Figure 1, the cathode comprises a member 1 having a conical shape coated on the inside with an emissive coating which may, for example, be barium suboxide. The neck portion of the conical member contains the insulating member 2 through which a lead wire 3 extends, the lead wire being connected to the coiled filament 4 which is substantially co-extensive and co-axial with the conical member 1. A supporting and electrically conductive member 6 serves to maintain the coiled filament in spaced relation to the cathode and to establish connection between the cathode and coiled filament so that these elements are in series electrical connection. The lead wire 3 extends through a press member 8. The lead wire 9 likewise extends through the press member 8, is in electrical connection with the conical member 1 and serves to conduct heating current to the cathode and the lead wire as will be presently described.

In the somewhat different form of cathode shown in Figure 2, the cathode comprises a cylindrical member 10 provided at either end with circumferentially extending bands 11 and 12 which are connected to a cross piece or yoke 14, which is in turn connected to and supported by the wire 16. Extending axially through the cathode is a coiled filament 17 supported at its ends and maintained in spaced and insulated relationship with the cathode by means of the supporting members and wires 19 and 20. The wires 20 and 16 or extensions thereof are connected together exteriorly of the device, as shown, and may be merged into a single wire 22. Both the forms shown in Figures 1 and 2 are alike to the extent that the heating element or filament is in series electrical connection with the cathode member and is situated in spaced relation thereto and insulated therefrom except at the point which is necessary for the said electrical connection.

Referring more particularly to Figure 3, a two-way switch is shown adapted to supply current from the terminals 26 and 27 to either of two circuits. One of these circuits comprises the terminal 30, the wires 31 and 32, the discharge tubes connected in parallel as shown, the wire 34 to which the filaments 4 of the cathodes are connected in parallel

as shown, the wire 36 and the negative terminal 38. The individual discharge tubes comprise the anodes 40, the positive columns 41, the conical cathodes 1, the auxiliary heating elements 4, the lead wires 42 therefrom, and the envelopes 44. In series with each discharge device, there is a ballast resistance 43. The circuit which has just been described represents the discharge circuit.

The other circuit herein above referred to comprises the positive terminal 46, the wire 47, the resistance 48, the connecting wires 50, the filaments 4, the cathodes 1, the wire 52 and the negative terminal 54, all of these described elements being in series. This second circuit may be designated the heating circuit.

When the switch 25 is placed in position to close the said heating circuit, current flows through the several filaments and cathodes which are in series. The said filaments may be heated to incandescence and the corresponding cathodes brought to a temperature at which emission occurs. By quickly reversing the switch and placing it in a position to close the discharge circuit, discharge potential is then applied to the anodes and the cathodes, and the heating circuit is thereby broken. It is therefore easily possible by quickly manipulating the switch manually or otherwise to break the heating circuit and apply discharge current while the cathodes are still at an emissive temperature.

In addition to heating the cathodes and developing in them the heat necessary to cause adequate potential reduction upon initiation of electrical discharge, it may be necessary, as in the event when the available potential is limited to apply activating or ionizing energy to the positive column in order to develop in the gas sufficient conducting properties to permit the initiation of discharge through the gas column. A high frequency discharge represents one means of applying such energy and is indicated by the high frequency device 56 supplied with current from the terminals 57 and 58 and provided with extensions which serve to deliver high frequency to each of the discharge devices.

In carrying out the method of the present invention, the switch is closed as described, heating current is applied to the filaments and cathodes and the latter are brought to a high temperature, as, for example, a temperature corresponding to incandescence of the several filaments. A high frequency discharge is then applied to the tubes from the high frequency device and the switch is then suddenly reversed to apply discharge potential to the anodes and cathodes whereupon the tubes immediately light even though the available potential is low, as, for example, 220 volts.

To illustrate the number of filaments, such as filaments 4 that may be employed as described, let it be assumed that 220 volts are available at the terminals 26 and 27 and that the voltage drop through each filament, due to its resistance is 10 volts. Under those conditions, 22 lamps or tubes may be operated as described with substantially no resistance in the heating circuit except that supplied by the filaments 4. The bus wires 33 and 50 are shown with dotted portions to indicate the variable number of lamps that may be operated as shown.

The advantages of the invention have been set forth in some detail and the preferred embodiments have been described. It is to be understood, however, that various changes may be made without departing from the invention or sacrificing any of the advantages enumerated, or any other advantageous results which may be attained by an application of the principles and facts set forth.

What I claim is:

1. In combination, a plurality of luminescent tubes, a plurality of cathodes and heating elements for said cathodes, and a series circuit comprising the said plurality of heating elements and a source of current of predetermined potential.

2. In combination, a plurality of luminescent tubes, a plurality of cathodes and heating elements for said cathodes, each tube having a cathode therein and a heating element for said cathode, and a series circuit comprising the said plurality of heating elements and a source of current of predetermined potential.

3. In combination, a plurality of luminescent tubes, a plurality of cathodes and heating elements for said cathodes, each tube having a thermo-emissive cathode therein and a heating element for said cathode, each cathode being in series electrical connection with its respective heating element, and a series circuit comprising the said plurality of heating elements and cathodes and a source of current of predetermined potential.

4. In combination, a plurality of luminescent tubes, a plurality of thermo-emissive cathodes and heating elements for said cathodes, and a series circuit comprising the said plurality of heating elements and cathodes and a source of current of predetermined potential.

5. In combination, a plurality of luminescent tubes containing a rare gas, a plurality of cathodes for said tubes and heating elements for said cathodes, a circuit comprising the said plurality of heating elements, another circuit comprising the gaseous columns of the tubes, and means for feeding the said circuits with electric current.

6. In combination, a plurality of luminescent tubes containing a rare gas, a plurality of cathodes for said tubes and heating elements for said cathodes, a circuit comprising the said plurality of heating ele-

ments, another circuit comprising the gaseous columns of the tubes and the anodes, cathodes and cathode heating elements in the said tubes, and a common source of electric current for feeding circuits.

7. In combination, a plurality of luminescent tubes containing a rare gas, a plurality of cathodes for said tubes and heating elements for said cathodes, a series circuit comprising the said plurality of heating elements and cathodes, another circuit comprising the gaseous columns of the tubes, said columns being connected in parallel and also comprising the anodes, cathodes and cathode heating elements in the said tubes, a common source of electric current for feeding both circuits, and means to selectively connect said common source with either of the said circuits.

In testimony whereof I affix my signature.

LEO L. BECK.