

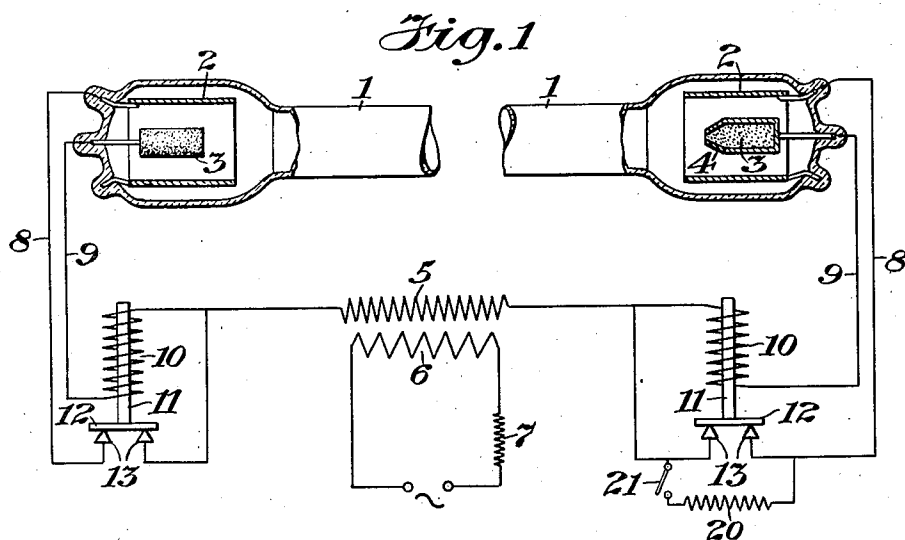
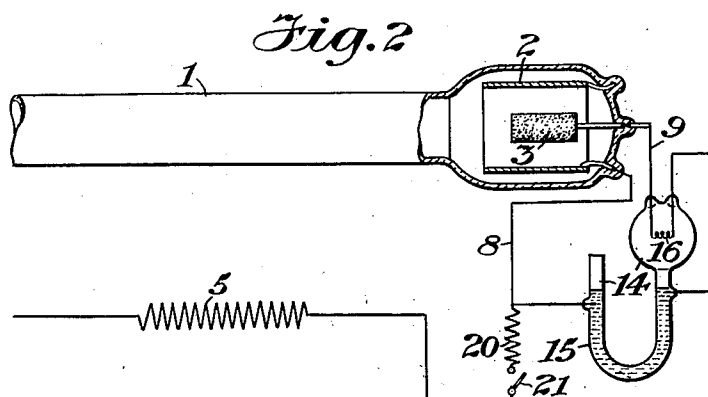
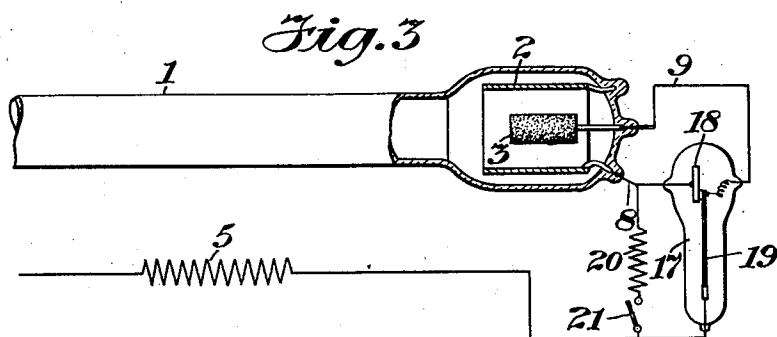
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GASEOUS ELECTRIC DISCHARGE DEVICE

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GASEOUS ELECTRIC DISCHARGE DEVICE

Application filed September 10, 1929, Serial No. 391,680, and in Germany November 10, 1928.

The present invention relates to gaseous electric discharge devices in which a gas evolving material is mounted in the container of said device.

5 Hitherto in devices of this character it has been difficult to maintain a normal operating gas pressure as the filling gases are used up in the operation of the device. Various methods and expedients have been tried for replenishing the gas filling, such as heating a gas evolving material by placing such material in close proximity to the discharge path or in a hollow space in the electrodes. In all these known contrivances the evolved gas 10 replenishment is apt to be either too large or too small due to the uneven heating of the gas evolving material because of the fluctuations of the gas discharge. It is the object of this invention to feed gas replenishments to the gas filling in such proportions as to maintain a constant normal operating pressure of the gas filling.

The invention comprises a gas evolving material placed in a hollow electrode in such a manner that it is physically independent of the hollow electrode. This gas evolving material is connected to a source of electrical energy in parallel with the hollow electrode, and is made of materials which enable it to 30 function as an electrode. These two electrodes, the gas evolving electrode and the hollow electrode, are so proportioned with respect to each other than in the normal operation of the device, that is with the gas discharge coming off both electrodes, the gas evolving electrode gives off a slightly less amount of replenishing gas than is needed to maintain a normal operating pressure in the device. We accomplish the object of our invention by utilizing an electromagnet or 40 thermostatic governor connected to the current leads of both electrodes for controlling the operation of the electrodes. In the course of operation, of the tube, as the pressure of the gas filling drops below a predetermined amount the current density mounts correspondingly and under these conditions, the governor, because of the greater current flowing through it, is actuated and short circuits the hollow electrode, thus throwing the

entire arc over onto the gas evolving electrode. Naturally during this phase of operation the gas evolving electrode is heated to a higher temperature and as a result a greater evolution of gas takes place than occurs in 55 normal operation with the gas discharge coming off both electrodes. Upon the restoration of normal pressure and consequent normal current density the governor resumes its original position, automatically restoring the hollow electrode in parallel relation with the other electrode in the circuits.

In the drawings accompanying and forming part of this specification are shown three embodiments of the invention, in which 65

Fig. 1 is a schematic view of a gaseous electric discharge device and operating apparatus therefor.

Fig. 2 is a schematic view of the gaseous electric discharge device and an alternative 70 embodiment of the operating apparatus, and

Fig. 3 is a schematic view of the gaseous electric discharge device and a still further embodiment of the operating apparatus.

Referring to Fig. 1 the gaseous electric discharge device consists of a cylindrical glass chamber 1, with cylindrical sheet metal electrodes 2 sealed therein. The tube can be filled either with common gas, for example carbon dioxide, nitrogen or hydrogen, or else 80 with a mixture of a common gas with a rare gas or gases. In the interior of each hollow sheet metal electrode 2 is provided an independent smaller electrode 3 spaced apart therefrom and containing gas evolving material. The latter can consist of a rod shaped sintered mixture of a gas evolving material and a material having a lower sintering point. As the gas evolving materials to fill the tube with carbon dioxide, nitrogen or hydrogen, we use magnesium carbonate, calcium carbonate, sodium or barium azide, sodium or barium nitride or lithium hydride. As the lower temperature sintering material, pulverized glass or pulverized enamel can be 95 used. The gas evolving material can also be used in pulverized form, as shown in the right side of Fig. 1, and be placed in a very small sheet metal container 4 having its only opening in the direction of the discharge 100

path. The hollow sheet metal electrode 2 and the gas evolving electrode 3 are energized by and connected parallelly to, the secondary winding 5 of the tube transformer 5-6. The primary winding 6 of the transformer, in the well known manner, is kept at a desired potential when using alternating current by the influence of a resistance 7. An electromagnet circuit is in series with the inleads 8, 9 of the electrodes 2, 3. Said electromagnet circuit consists of a coil 10 connected in series with inlead 9 and a core 11 carrying a conducting plate 12 which bridges the contacts 13 of the inlead 8 of the hollow sheet metal electrode 2.

When both the hollow electrode 2 and the gas evolving electrode 3 of the light tube are in circuit, the gas discharge through said tube covers both electrodes with a glow discharge as the arc comes off both electrodes in the normal operation of the device. The intensity of the glow discharge covering electrode 3 can be controlled by the proportionate size of electrode 2 to electrode 3, or by covering electrode 3 within certain limits with an insulating material, so that even with unfavorable operating conditions, for example, a high current density, said gas evolving electrode 3 gives off a slightly less amount of replenishing gas than needed. In the course of operation the current density of the tube rises due to the loss of pressure of the gas filling so that more current flows through coil 10. This actuates the electro-magnet core 11 which raises the conducting plate 12 from the contacts 13. The hollow sheet metal electrode 2 is thereby cut out of the circuit and the gas evolving electrode 3 then carries all the current which results in an increase of its electrode covering glow discharge and a very greatly increased evolution of gas. As soon as the pressure of the gas filling and the current density again reach normal operating conditions, the core 11 falls back to its at rest position, restoring to the circuit the hollow electrode 2 and decreasing the intensity of the glow discharge covering electrode 3.

In the light tube shown in Fig. 2 a thermostatic governor is connected in series with the inleads 8, 9 which are again connected parallelly to the secondary winding 5 of the tube transformer and to the electrodes 2, 3. Here the thermostatic governor consists of a U shaped chamber filled with mercury 15 and a gaseous atmosphere surrounding a heating filament 16. The latter is connected in series with the inlead 9 of the gas evolving electrode 3; the mercury filling of the chamber 14 bridges the ends of inlead 8 of the hollow electrode 2. As the current density of the tube increases, the gas filling is proportionately brought to a higher temperature by filament 16 and expands. This displaces the mercury with a consequent interruption of

the current to the hollow electrode 2. As soon as the rapidly evolved gas from the electrode 3 restores the pressure of the gas filling to normal the current density decreases causing the filament 16 to become cooler and its surrounding gas to contract; then the mercury resumes its normal position bridging the ends of lead 8 which energizes the hollow electrode 2.

In Fig. 3 is shown a thermostatic governor consisting of an evacuated glass bulb 17, in which contact 18, makes contact with a bimetallic member 19. The bimetallic member 19 is in series with lead 9 of the gas evolving electrode 3, the contact 18 in series with lead 8 of the hollow electrode 2. With normal conditions the current from the source of supply flows to both the electrodes 2, 3 through the contacting members 18, 19. When the current density increases to a predetermined amount the bimetallic member 19 is separated from the contact member 18, thus disconnecting the hollow electrode 2. Again, all the current to the tube flows only to the gas evolving electrode 3, which then evolves gas more rapidly, until the required amount is produced, and a normal current is flowing, whereupon the hollow electrode 2 is again energized.

In the operation of the governors sparking may occur between the contacts 13, 13, for example, to the detriment of positive quick making and breaking of the circuit of hollow electrode 2. This difficulty can be avoided by the provision of a high ohmic resistance 20, for example, connected in shunt across said contacts, together with a switch 21 for cutting the resistance in or out, as desired, in each embodiment of the operating apparatus heretofore described to meet varying conditions of service of said devices.

While the invention has been described with control for the electrodes at both ends of the tube, it is to be understood that it is not necessary to provide a gas evolving electrode and an automatic governor at each end of the device as said device will operate with only one gas evolving electrode and one automatic governor in conjunction therewith.

What we claim as new and desire to secure by Letters Patent of the United States, is:

1. In an electric discharge device a container, a filling of gas therein, electrodes therefor, at least one of said electrodes being a gas evolving electrode mounted in a hollow electrode but spaced apart therefrom, both electrodes operating in parallel to simultaneously support the electric discharge, and means operated by variations of current flowing in said device for cutting into and out of circuit the hollow electrode to control the feeding of gas replenishments and to maintain normal operating conditions in the tube of said device.

2. In an electric discharge device, a con-

tainer, a gas filling therein, a pair of electrodes therefor at each end of said container, one of which is a gas evolving electrode for supporting the electric discharge in said device, the other electrode of said pair being intermittently connected in parallel with said gas evolving electrode to divide therewith the support of said electric discharge, the evolution of gas from said gas evolving electrode during the time it is connected in parallel being less than is sufficient to supply the necessary gas replenishments for the device, and the evolution of gas from said electrode when it is supporting the discharge alone being sufficient to supply the necessary gas replenishments to said device.

3. In an electric discharge device, a container, a gas filling therein, a pair of electrodes therefor at each end of said container, one of which is a gas evolving electrode the other electrode of said pair being intermittently connected in parallel with said gas evolving electrode to divide the support of the electric discharge in said device, and means operated by variations of current flow through said device for cutting the other electrode of said pair into and out of circuit to control the feeding of gas replenishments and to maintain normal operating conditions in the container of said device.

4. In an electric discharge device, a container, a filling of gas therein, electrodes therefor, at least one of said electrodes being a gas evolving electrode mounted in, but spaced apart from a hollow electrode, the evolved gas replenishments of said gas evolving electrode being slightly less than is needed to maintain the desired gas pressure in the container, both electrodes being connected normally in parallel and means controlled by variations of current flowing in said device for cutting into and out of circuit the hollow electrode to control the feeding of gas replenishments and to maintain normal operating conditions in the container of said device.

In witness whereof, we have hereunto set our hands this 26th day of August, 1929.

HANS EWEST.
MARTIN REGER.