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G. GAIDIES ET AL

2,251,045

GASEOUS ELECTRIC DISCHARGE DEVICE

Filed April 24, 1930

Fig. 1

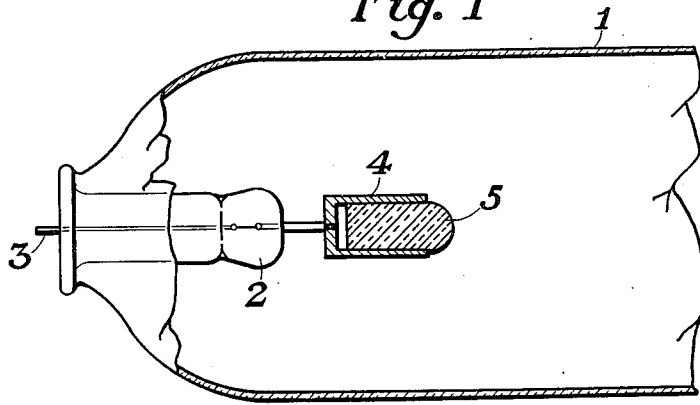


Fig. 2

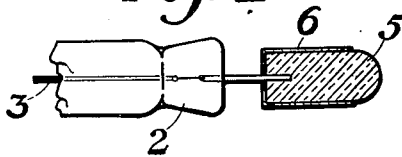


Fig. 5

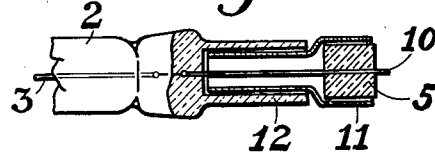


Fig. 3

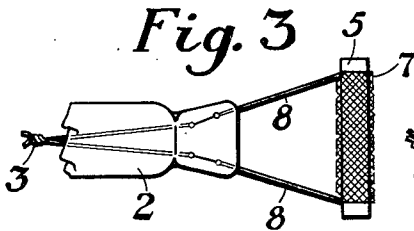


Fig. 6

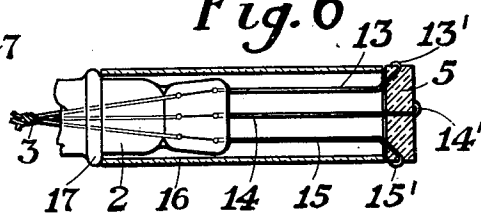
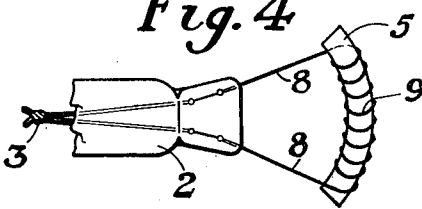


Fig. 4



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UNITED STATES PATENT OFFICE

2,251,045

GASEOUS ELECTRIC DISCHARGE DEVICE

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Application April 24, 1930, Serial No. 447,051
In Germany June 29, 1929

1 Claim. (Cl. 176—126)

The present invention relates to gaseous electric discharge devices generally and methods of operating the same and more particularly the invention relates to electrodes useful in electric discharge devices generally.

It is the object of this invention to provide electron emitting electrodes for electric discharge devices, which electrodes are extremely rugged in structure, have a long operating life, are free from sputtering, do not require a separate heating circuit, will function by being connected directly to the current supply circuit of the discharge device, will permit the use of greater current densities in electric discharge devices than any electrodes heretofore proposed, and in the case of gaseous discharge devices do not consume or clean up the gaseous content whether of rare gas or common gas, or mixtures thereof, thus extending the life of such devices considerably beyond that of previous devices. Further objects and advantages of the invention will be apparent from the following particular description and from the claims.

In accordance with these objects the invention comprises an electrode made of a compact body of desired shape, being electron emitting oxide material poorly conducting in its cold state, and a metal body supporting, as by covering, in part, the surface of the compact oxide body. The surface of the compact oxide body exposed is small in comparison to the mass of said body, hence the electrode material is not easily sputtered. A thick compact mass of the oxide material may be made by pressing and sintering the pulverized form of said material. The metal body partially covering the surface of the oxide body has a large surface as compared to its mass and this is quickly heated and brought to a glow under the influence of the discharge. The parts of the oxide body adjacent the metal covering are strongly heated by radiation and conduction of the heat of the metal covering and in this heated condition send out a continuous stream of electrons to support the discharge. By reason of the small surface of the oxide body exposed, as compared to the mass of said body, a large reservoir of electron emitting material is provided so that a strong steady stream of electrons is sent forth which maintains the arc at greater constancy than oxide coated metal shell electrode. Because of the greater constancy of the discharge and the reduction in sputtering of electrode material, due to the small surface exposed, consumption of the gas filling is avoided and it thus is now possible for the first time to operate elec-

tric discharge devices filled with common gases such as nitrogen for more than several hundred hours, whereas heretofore replenishing of the gaseous content of such common gas tubes every few seconds or minutes has been necessary.

The metal part of the electrode, used for heating the electron emitting oxide part of the electrode, may be attached to said oxide part in any desired manner. It may be in the form of a shell into which fits the oxide body, it may be a coil wound around the oxide part, or it may be a wire web enclosing said oxide part. A manner of attaching the metal part to the oxide part possessing many advantages is by placing one or more wires in such position in the oxide part, which in this case has a block or slab shape, that the ends of said wire extend beyond the surface of the oxide part. In this case the wires are connected directly to the current circuit of the discharge device. The oxide body enclosing parts of the wires prevents the radiation of heat from said parts so that the end parts of the wires extending beyond the surface of the oxide part of the electrode are quickly and strongly heated by the current from the discharge device circuit. This naturally facilitates the starting of the discharge.

If the starting voltage of the discharge device is not sufficient to bring the metal part of the electrode to a glowing condition, as 220 volts or less, a higher voltage can be connected to the electrodes to facilitate starting. In this case the metal part of the electrode is likewise maintained at a glow exclusively by the potential necessary to operate the tube, the higher voltage being used merely for starting purposes, so that even with lower voltages a large current density is produced.

In the drawing attached to and forming part of this specification several embodiments of the invention are shown for purposes of illustration in which:

Fig. 1 is a side elevational view partly in section of a container of a discharge device having therein one embodiment of the new and novel electrode shown in section.

Fig. 2 is a side elevational view of a stem of the container shown in Fig. 1 showing in section an alternative embodiment of the new and novel electrode sealed therein.

Fig. 3 is the same as Fig. 2 showing another embodiment of the new and novel electrode in side elevation.

Fig. 4 is the same as Fig. 3 showing another embodiment of the new and novel invention.

Fig. 5 is a side elevational view of the stem partly in section and of another embodiment of the invention entirely in section.

Fig. 6 is a side elevational view of the stem with another embodiment of the new and novel electrode shown in section.

Like numbers denote like parts in all views of the invention.

Referring to Fig. 1 container 1 may be of ordinary glass or of glass which transmits ultra violet radiation such as quartz. Said container 1 may have any desired gaseous filling such as rare gas, common gas, mixtures of these gases with each other or with a vaporizable metal such as mercury. At each end of the container 1 is a stem 2 in which is sealed a current lead 3. A metal shell 4 is connected to said current lead 3 having therein a body 5 of electron emitting oxide material in the form of a plug said material being a poor electrical conductor in its cold condition. Said oxide body 5 may be set into shell 4 either firmly or with slight play as desired. The method of making oxide body 5 is by pressing and sintering the pulverized form of the oxide or silicate of alkalies, alkali earths, or rare earths. Suitable materials are, for example, the oxide or silicates of potassium, sodium, caesium, rubidium, calcium, barium, strontium, thorium, cerium, lanthanum and didymium. Oxide body 5 is not entirely covered by shell 4 but the end parts thereof extend beyond the rim of the shell into the discharge path. The discharge path forms first between metal shells 4 connected to the current circuit of the discharge device, heating said shells 4 until they glow. By radiation and conduction of the heat developed in the shells 4 the parts of the oxide body 5 adjacent the rim of metal shell 4 are brought to an electron emitting condition and send out a strong stream of electrons which supports the arc. The large bulk of oxide body 5 is a reserve of electron emitting material. If, in the course of time, the oxide body 5 becomes pitted at its electron emitting parts adjacent the metal shell 4 and said parts are not heated other parts adjacent said shell 4 become electron emitting to support the discharge.

In the embodiment shown in Fig. 2, the electron emitting oxide body 5 is attached to the interior end of the current lead 3. The back part of the rod or peg shaped oxide body 5 is provided with a thin sprayed metal layer 6, which is connected to current lead 3.

In the embodiment shown in Fig. 3 a rod shaped electron emitting oxide body 5 is used, placed at right angles to the discharge path, enclosed by a wire net 7, and kept therein by friction. The wire net 7 and therewith the oxide body 5 is supported by two wires 8 which are connected to the same current lead 3.

The electrode shown in Fig. 4 consists of a rod shaped oxide body 5, straight or curved, as desired, which is surrounded by a wire coil 9. The supports 8 of the wire winding and therewith the

set-in oxide body 5 are again connected to a single current lead 3.

In the embodiment shown in Fig. 5 the current lead 3 extends through a plug shaped body 5 and in this case the front end 10 of said lead 3 extends on through the front surface of oxide body 5. The front end 10 of the current lead 3 forms a metal coating, so that when the wire end 10 is brought to a glow by the current the heating of the surface part of the body 5 is effected. If the oxide body 5 and the back part of the current lead 3 is enclosed in a shell 11 consisting of heat resisting material such as quartz or magnesium oxide, said oxide body 5 emits electrons better and the discharge is prevented from attaching to lead wire 3 located between the body 5 and the pinch part of the stem 2. Said shell 11 fits snugly into an off-set tube 12 of stem 2.

In the embodiment shown in Fig. 6 three wires 13, 14, 15 pierce a slab shaped electron emitting oxide body 5, said lead wires 13, 14, 15 are connected to the same current lead 3 in the interior of stem 2. The ends 13', 14' and 15' of the wires 13, 14, 15 extend beyond, and are bent over the surface of body 5 to facilitate the heating of body 5. Shell 16, which slips over the stem 2 and seats against a ring 17 of the latter, is used in this case as the guard of the back part of the wires 13, 14, 15.

The electron emitting body shown in Figs. 5 and 6 are held in place by the tension exerted by wires 13, 14, 15. The supporting wires may also be pressed in the pulverized form of the electron emitting substance with their ends extending beyond the surface thereof. When the sintering takes place a good supporting joint between the support wire and the body 5 is made.

The new electrode may be used in the arts generally and particularly in electric light tubes and in rectifiers.

While we have shown, described and have pointed out in the annexed claim certain new and novel features of the invention it will be understood that various omissions, substitutions and changes in the forms and details thereof may be made by those skilled in the art without departing from the broad spirit and scope of the invention.

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

An electric discharge device comprising a container, electrodes sealed therein, a filling of gas therein, said electrodes comprising an oxide material having high electron emissivity characteristics, a plurality of metal wires having ends extending beyond said oxide body, and adapted to support a starting discharge to the said electrode when the device is started into operation by the operating current applied across the main terminals of the device, and to support an arc discharge in said device when the oxide has reached an electron emitting temperature.

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