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GASEOUS DISCHARGE DEVICE AND ELECTRODE ASSEMBLY FOR USE THEREIN

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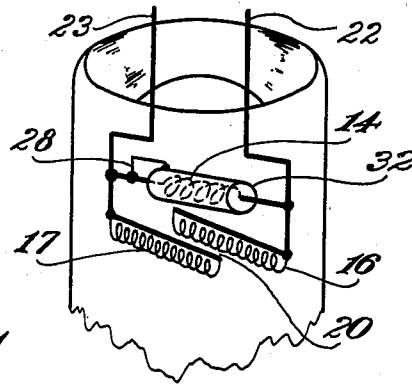


Fig. 1

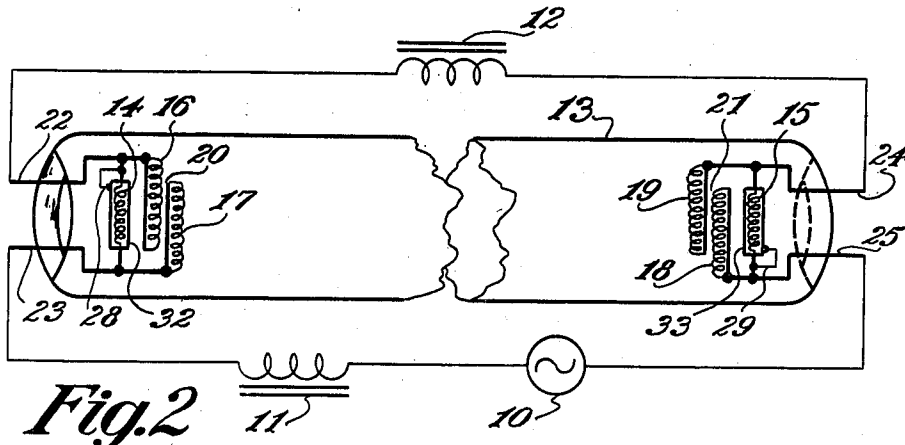


Fig. 2

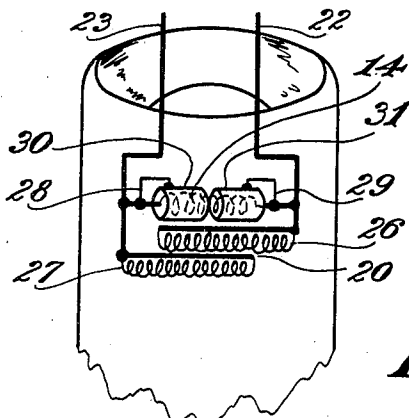


Fig. 3

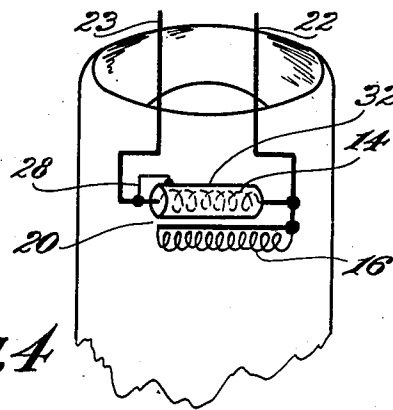


Fig. 4

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UNITED STATES PATENT OFFICE

2,272,486

GASEOUS DISCHARGE DEVICE AND ELECTRODE ASSEMBLY FOR USE THEREIN

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Application April 10, 1939, Serial No. 266,971

11 Claims. (Cl. 176—122)

This invention relates to gaseous electric discharge devices generally and more particularly to such devices having electrode assemblies which make use of filaments and auxiliary electrodes.

Typical low voltage gaseous discharge lamps usually contain mixtures of monatomic or diatomic gases, or mixtures of both, together with the vapor of some metal such as sodium, mercury, etc. These lamps operate on 110 volts and 220 volts and are usually provided with a fluorescent coating on the inside of the glass envelope so that the main gaseous electric discharge causes visible light to be emitted from the lamp. Such lamps are equipped with filaments coated with some electron emitting material such as barium, thorium, etc. During the starting operation the filaments are heated by current flow through the filaments, under which condition they emit electrons copiously. When the lamp ignites, the filaments are de-energized and the main gaseous electric discharge occurs between the two coated filaments which act as main electrodes. The main discharge produces a hot spot on the coated filaments which permits the lamp to be operated from the source of low voltage electric current.

In the low voltage electric discharge lamps, such lamps are equipped with filaments which require more current for heating the filament than is required by the main discharge arc when the lamp is in operation. For example, a commercially available 20-watt fluorescent lamp requires .5 ampere for filament heating and the normal discharge arc current through the lamp is .35 ampere.

In my copending U. S. patent application Serial No. 265,645, filed April 3, 1939, I show, describe and claim a low voltage electric discharge lamp starting circuit which depends for its operation upon the design of the gaseous electric discharge lamp so that the main discharge current is higher than the current required through the filament for the starting condition. Since it is necessary to make such a lamp with a filament of fine wire, it is desirable to transfer the main discharge arc from the filament to some electrode able to withstand the heavy discharge current.

My present invention provides for protecting the small starting filament during normal operation of the lamp. To accomplish this I make use of one or more coated auxiliary electrodes which are shunted by the filament. The filament may be coated or uncoated, but in any case it is used to initiate the main arc discharge.

An object of my invention is to provide a low

voltage electric discharge lamp in which the starting current is appreciably less than the operating current.

Another object of my invention is to provide a main electrode assembly in a low voltage gaseous discharge lamp, which main electrode assembly has two coated auxiliary electrodes shunted by a starting filament.

An object of my invention is to provide an electric discharge lamp having a starting filament, which is protected from the main arc discharge of the lamp by means of a coated auxiliary electrode.

Another object of my invention is to provide an electric discharge lamp having two main electrodes, each main electrode utilizing a plurality of elements coated with electron emitting material and a filament.

Another object of my invention is to provide a main electrode assembly, comprising a plurality of coated elements and a filament covered by a sleeve of material adapted to emit electrons when heated.

Another object of my invention is to provide for causing a local discharge to occur between parts of at least one of the main electrodes of a gaseous discharge device.

Another object of my invention is to cause an auxiliary arc to by-pass the current around the filament during starting.

Another object of my invention is to cause electric discharge lamps, equipped with filaments, to operate in the following sequence:

- a. Heat filaments.
- b. Cause auxiliary discharge.
- c. Maintain potential difference between main electrodes, sufficient to ignite electric discharge lamp.
- d. Limit current in main discharge path to decrease filament heating.
- e. Extinguish auxiliary arc discharge upon ignition of electric discharge lamp.
- f. Maintain reduced current flow through filaments during normal operation of electric discharge lamp.

Other objects and features of my invention, the novel features of which are particularly pointed out in the claims appended hereto, may be more readily and more fully understood from the following description when read with reference to the accompanying drawing, in which like parts of my invention are designated by like reference characters and in which:

Figure 1 shows in detail the construction of an

electrode assembly having a filament and two auxiliary coated electrodes all of which comprise a single main electrode.

Figure 2 shows an electric gaseous discharge lamp equipped with two main electrodes and connected in circuit relation for operation from a source of alternating current.

Figure 3 is a detailed drawing in which a main electrode assembly having two auxiliary electrodes shunted by a filament, the filament being protected by two coated electron emitting covers, each cover electrically connected to a different auxiliary electrode.

Figure 4 shows the construction of a main electrode assembly comprising one auxiliary electrode together with a filament with protective covering.

In the preferred embodiment of my electrode assembly shown in Figure 1, I provided two auxiliary electrodes 16 and 17 which may be made of wire and formed in a spiral. The auxiliary electrodes are coated with barium oxide or strontium oxide, or any other suitable electron emitting material. Filament 14 shunts auxiliary electrodes 16 and 17. Electron emitting sleeve 32 covers filament 14. Sleeve 32 is connected to auxiliary electrode 17 by lead 28.

With reference to Figure 2, lamp 13 is equipped with two main electrode assemblies. Each main electrode assembly comprises two coated auxiliary electrodes shunted by a filament. Saturable inductance 12 is connected in series with filaments 14 and 15 and in parallel with lamp 13. Source of alternating current 10 is connected through current limiting inductance 11 to the unused filament terminals 23 and 25 on lamp 13.

To start lamp 13, current flows from source of alternating current 10 through linear inductance 11, filament 14, saturable inductance 12, filament 15 and back to the source of alternating current 10. Under this condition and before the main discharge occurs between the spaced main electrodes, saturable inductance 12 saturates and passes sufficient current to heat filaments 14 and 15. Filaments 14 and 15 heat the electron emitting material which is shown as sleeves 32 and 33. Under this condition the voltage drop across filaments 14 and 15 is sufficient to cause an auxiliary arc discharge to occur between the auxiliary electrodes 16 and 17 and 18 and 19. These auxiliary discharges may occur through gaps 20 and 21 respectively and shunt filaments 14 and 15. The shunting action of the auxiliary arc is to bypass excessive current around the filament. In my invention the auxiliary arc discharge functions to condition lamp 13 for starting but it also serves to protect the filament from burn-out in case of slightly excessive currents. The auxiliary discharge, together with energy from the associated filaments, heats the coated auxiliary electrodes 16 and 17 and 18 and 19 and conditions the lamp for starting. It is to be understood that the discharge lamp contains a gaseous atmosphere capable of conducting electric current when excited by an electric discharge between the main electrode assemblies.

Due to the fact that the voltage sustained by saturable inductance 12 is higher than the voltage required for the ignition of lamp 13, during starting condition, a main discharge will occur from a part or a combination of parts of one main electrode to a part or a combination of parts of the other main electrode. Upon ignition of lamp 13, the voltage across saturable inductance 12 is decreased and saturable inductance 12 is operated at a lower flux density which causes the

impedance of inductance 12 to increase greatly. This increase in impedance reduces the heating in filaments 14 and 15 and permits the main arc discharge to occur between the main electrode assemblies. As shown in Figure 2, for example, the main discharge may occur between a hot spot on auxiliary electrode 17 and a hot spot on auxiliary electrode 18.

I consider the lamp 13 shown in Figure 2 as having two spaced main electrodes and each main electrode having spaced parts shunted by a filament.

I prefer to have the auxiliary electrodes made from wire or thin metal so that the heat, due to the main electric discharge will not be conducted away too rapidly. To function properly, the auxiliary electrodes should be capable of maintaining a hot spot which aids in causing the electron emitting material to maintain a supply of electrons. In Figure 1, auxiliary electrodes 16 and 17 are shown in the form of a spiral wire which contains the coating of material capable of supplying electrons. Many modifications of the auxiliary electrodes are possible, but it should be kept in mind that they should be capable of maintaining a hot spot when subjected to the main arc discharge of the lamp. The auxiliary electrodes are designed to be heated by the main discharge arc and since they are coated with an electron emitting material, they relieve the starting filaments 14 and 15 from the full heat of the main discharge during normal operation of the lamp. Also, due to the fact that auxiliary electrodes 16 and 17 and auxiliary electrodes 18 and 19 are coated, the auxiliary discharge arcs through gaps 20 and 21 are more easily started and the lamp is more easily conditioned for starting.

In the construction of the main electrode shown in Figure 1, I prefer to have the filament covered with a sleeve 32 of electron emitting material. This sleeve 32 is connected to one auxiliary electrode by lead 28. It is therefore possible for the main arc discharge to occur from electron emitting sleeve 32 or from auxiliary electrodes 16 and 17, or from a combination of these elements. When sleeve 32 is used, I prefer to omit the electron emitting material from filament 14. Sleeve 32 is used to protect filament 14 from the main electric discharge should this discharge localize upon some part of sleeve 32. Normally, however, the main electric discharge will occur from one of the auxiliary electrodes, that is, electrodes 16 or 17.

Figure 3 shows a modification of my invention in which the electron emitting sleeve is split into two parts designated 30 and 31. Sleeve 30 is connected to auxiliary electrode 27 by lead 28 and sleeve 31 is connected to auxiliary electrode 26 by lead 29. This construction permits electron emitting sleeves 30 and 31 to be maintained at potentials which are determined by the potential of the auxiliary electrodes to which they are attached. This means that an electric discharge lamp may be connected to a starting circuit and there will always be one auxiliary electrode and an associated electron emitting sleeve maintained at a high potential with respect to the other auxiliary electrode and electron emitting sleeve associated therewith in the same electrode assembly.

Figure 4 shows a construction of a main electrode in which one auxiliary electrode 16 is used and in which the other auxiliary electrode is the electron emitting sleeve 32 which covers filament

14. In this particular construction auxiliary discharges for starting purposes are provided between gap 20. It will be noted that electron emitting sleeve 32 is connected to terminal 23 by means of lead 28 and that auxiliary electrode 16 is maintained at the same potential as lead 22. It is therefore evident that the voltage drop across filament 14 is available to produce the auxiliary discharge arc through gap 20. In normal operation an electric gaseous discharge lamp equipped with two main electrode assemblies as shown in Figure 4 operates in a manner similar to that described in connection with Figure 2. In this case when the filament heat is reduced after ignition takes place the main arc discharge will occur between auxiliary electrode 16 or electron emitting sleeve 32 or combinations of these elements.

While I have described my invention with a certain degree of particularity, it is understood that the present disclosure has been made only by way of example and that numerous changes in the details of construction and the combination and arrangement of parts may be resorted to without departing from the spirit and scope of the invention as hereinafter claimed.

I claim as my invention:

1. An electrode assembly for use in a gaseous electric discharge lamp, comprising in combination, a filament, an electron emitting sleeve covering said filament, and at least one auxiliary electrode coated with electron emitting material electrically connected to one side of said filament, said electron emitting sleeve being connected to the opposite side of said filament and being interposed between said filament and said auxiliary electrode.

2. An electrode assembly for use in a low voltage gaseous electric discharge lamp, comprising a filament, an electron emitting sleeve covering the filament, two auxiliary electrodes coated with electron emitting material, said electron emitting sleeve being connected to one side of said filament, and said filament connected in shunt relation with said auxiliary electrodes.

3. A gaseous electric discharge lamp comprising, a container, main electrodes sealed therein, a gaseous atmosphere capable of conducting electric current when excited by an electric discharge between said main electrodes, said main electrodes each comprising two auxiliary electrodes coated with electron-emitting material; shunted by another electrode coated with electron-emitting material and located behind said auxiliary electrodes.

4. An electrode assembly for use in a gaseous electric discharge lamp comprising in combination, a filament, two electron emitting sleeves covering different portions of said filament, and at least one coated auxiliary electrode electrically connected to one side of said filament, means for connecting said electron emitting sleeves to opposite sides of said filament.

5. An electrode assembly for use in a gaseous electric discharge lamp comprising, a filament, an electron emitting sleeve in heat transmitting relation with said filament, an auxiliary electrode and two lead-in wires, said filament being connected

between said lead-in wires, said electron emitting sleeve being interposed between said filament and said auxiliary electrode and connected to one lead-in wire and said auxiliary electrode being connected to the other said lead-in wire.

6. In a low voltage electric discharge lamp having activated starting electrodes in which the current through the electrodes during starting is substantially less than the current taken by the electric discharge lamp in normal operation, an electrode assembly comprising, two auxiliary electrodes coated with electron emitting material, a starting electrode also coated with electron-emitting material and shunting said electrodes and located behind said auxiliary electrodes, said starting electrode having sufficient drop across it to cause an auxiliary discharge arc between said auxiliary electrodes during the starting condition.

7. A low voltage gaseous electric discharge lamp having two main electrode assemblies sealed therein, comprising a container, a gaseous atmosphere capable of conducting electric current when excited by an electric discharge between said main electrode assembly, said main electrode assembly being substantially as claimed in claim 1.

8. The method of operating a gaseous electric discharge device having spaced main electrodes in which the main spaced electrodes have spaced parts comprising, the steps of applying a preheating current to a portion of at least one of the spaced main electrodes, producing a local discharge between the spaced parts of said one of the spaced main electrodes, and impressing a voltage across the main electrodes to cause a discharge current to occur between the main electrodes, said discharge current between said main electrodes being substantially greater than said preheating current.

9. An electrode assembly for use in a gaseous electric discharge lamp, comprising in combination, a filament, at least one auxiliary electrode coated with electron emitting material electrically connected to one side of said filament, an electron emitting shield having a portion spaced between the filament and said one auxiliary electrode, said electron emitting shield being connected to the opposite side of said filament.

10. An electrode assembly for use in a low voltage gaseous electric discharge lamp, comprising a filament, two auxiliary electrodes coated with electron emitting material, an electron emitting shield having a portion spaced between the filament and said auxiliary electrodes, said electron emitting shield being connected to one side of said filament, and said filament connected in shunt relation with said auxiliary electrodes.

11. An electrode assembly for use in a gaseous electric discharge lamp comprising in combination, a filament, two electron emitting shields covering different portions of said filament, and at least one coated auxiliary electrode electrically connected to one side of said filament, means for connecting said electron emitting shields to opposite sides of said filament.

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