

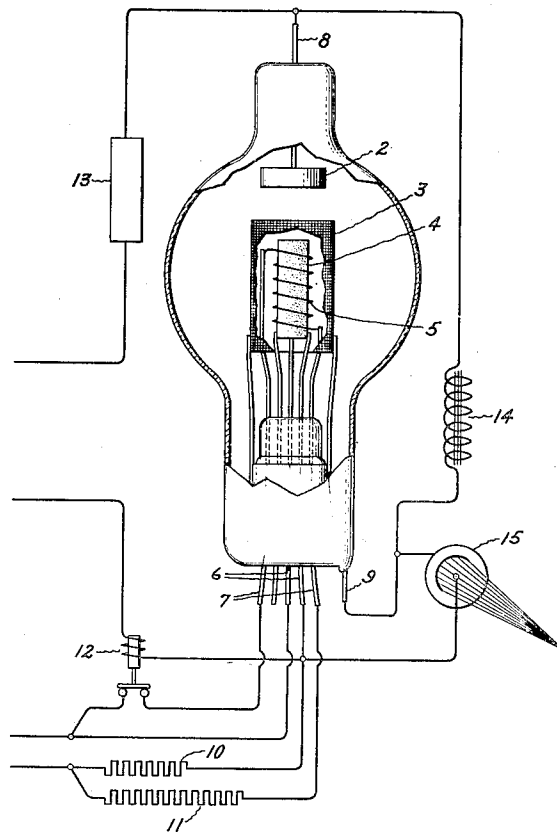
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Y. IMAOKA

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HOT CATHODE GASEOUS DISCHARGE DEVICE

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Inventor:
Yoshio Imaoka,
by *Charles E. Tuller*
His Attorney.

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HOT CATHODE GASEOUS DISCHARGE
DEVICEYoshio Imaoka, Tokyo, Japan, assignor to Gen-
eral Electric Company, a corporation of New
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4 Claims. (Cl. 250-27)

The present invention relates to an electric discharge apparatus and more particularly to devices containing gas or vapor and which are provided with an indirectly heated cathode. An object of the invention is to provide a device in which the electrical discharge is prevented from injuring a cathode of this sort by positive ion bombardment. The accompanying drawing shows an exemplary form of the improved tube.

In gaseous discharge apparatus, the negative space charge is overcome by ionization, so that the tube is capable of passing relatively large current. However, in these tubes, the cathode tends to become disintegrated by the intense bombardment of positive ions. In order to reduce this effect as much as possible, it is usual to employ rugged cathodes of the indirectly heated type and to coat the exterior with electron-emitting material. These cathodes contain considerable metal, hence the heat capacity is high, so that they do not attain their operating temperature for a considerable length of time after the heater is initially energized. In consequence, the cathode is bombarded by positive ions and the active coating destroyed before the electron emission reaches its full value. In order to eliminate this bombarding effect, it has been proposed heretofore to insert a relay in the anode circuit, the purpose of which is to retard the application of full voltage to the tube until the cathode has reached its proper operating temperature.

The present invention avoids the use of such a relay but still provides substantial protection to the cathode from the bombarding effect of the arc stream. The improvement is particularly adapted to circuits containing devices which may be damaged if the full line voltage were impressed on the circuit and no discharge current were flowing in the tube. In brief, my invention contemplates the use of an auxiliary cathode of relatively small heat capacity which quickly reaches its operating temperature and carries for a short period of time, a reduced load current. This auxiliary cathode remains operative until the main cathode has reached its full load current-carrying capacity or any predetermined portion thereof, after which the auxiliary cathode automatically is deenergized.

In the drawing, an anode 2, a control member 3 and an equi-potential cathode 4 are contained within a sealed envelope. The cathode is constituted of a metal cylinder containing a heater and is coated with alkaline earth oxide or other electron-emitting insulating material. It is apparent that a cathode of this type has large heat

capacity and may take considerable time to attain its proper temperature for operation. The grid or control member 3 substantially encloses the cathode and is constituted either of a perforated plate or metal mesh. The control member 3 and the cathode 4, which will be referred to hereinafter as the main cathode, are supported within the envelope from a reentrant stem by rigid leading-in conductors. The anode 2, consisting of metal or carbon, is supported from the opposite end of the envelope also by a leading-in conductor.

In accordance with my invention, there is provided about the main cathode 4, a helix 5 of fine wire of pure or thoriated tungsten and the ends of which are brought out through the same reentrant stem that supports the main cathode and the grid. Current is supplied to the main cathode and heater through conductors 6 and to the auxiliary cathode through conductors 7, 20 while the control member and the anode obtain their energy through conductors 9 and 8 respectively. The envelope contains inert gas or vapor at a suitable pressure for substantially eliminating space charge, for example, 50 millimeters of mercury more or less.

The device is shown as connected in an exemplary circuit which includes a photo-electric tube 15 for controlling the device. The main cathode 4 and the auxiliary cathode 5 are connected in parallel to a source of heating current (not shown) respectively through the resistances 10 and 11. The auxiliary cathode is designed to operate at very low voltages, e. g. below seven volts, so that the resistance 11 must be sufficiently large to provide the necessary drop in voltage.

The main cathode is connected to the anode through a relay 12, a source of electrical energy (not shown), and a load 13, while the control member 3 is connected to the anode 2 through an inductance 14 and to the main cathode 4 through the photo-electric tube. The relay 12 is energized by anode current and opens the heating circuit of the auxiliary cathode 5 when the current through the tube reaches a predetermined value, dependent upon the temperature attained by the main cathode.

It is apparent that when the auxiliary cathode is connected to its source of current in any suitable manner, and thereafter attains its maximum electron-emitting condition, the impedance of the tube is lowered to such an extent that current of a reduced value immediately flows between the anode and the auxiliary cathode. For

a short period of time, the anode current is maintained practically entirely by the electrons emanated from the auxiliary cathode and flows through the load 13 and the relay 12. The main cathode 4 then gradually heats up by reason of the contained heater and its emissivity increases until the anode current through relay 12 is of sufficient magnitude to cause the latter to pull up its armature, thereby opening the auxiliary cathode circuit.

The photo-electric tube represents any form of a variable resistance control member or the like for cooperating with the inductance 14 in such a manner as to change the phase of the voltages applied to the anode and control member, thereby varying the average value of current flowing through the load 13, as is well known in the art.

From the foregoing, it is evident that I have provided a novel form of tube which contains an auxiliary cathode in addition to the main cathode, the function of the auxiliary cathode being to provide a supply of electrons immediately upon energizing the tube so that a space current is caused to flow through the tube during the time when the main cathode is reaching its operating temperature. By reason of the improved cathode arrangement, it is possible to employ main cathodes of high heat capacity without being subject to excessive positive ion bombardment.

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

1. A gaseous discharge device comprising an evacuated envelope containing ionizable gas at a pressure sufficient to neutralize space charge, a plurality of electrodes therein including main and auxiliary cathodes and an anode, said main cathode being indirectly heated and said auxiliary cathode being in addition to the main cathode heater, said main cathode having a relatively large heat capacity and at its normally operating temperature adapted to carry the entire load current, and the auxiliary cathode having a relatively small heat capacity and at its normally operating temperature adapted to carry a portion only of the load current, said cathodes being heated independently of one another, and means for energizing the auxiliary cathode and raising its temperature to the operating condition prior to raising the temperature of the main cathode to its operating condition.

2. A gaseous discharge device comprising an evacuated envelope containing ionizable gas at a pressure sufficient to neutralize space charge, a plurality of electrodes therein including main and auxiliary cathodes and an anode, said main cathode being indirectly heated and said auxiliary

cathode being in addition to the main cathode heater, said main cathode having a relatively large heat capacity and at its normally operating temperature adapted to carry the entire load current, and the auxiliary cathode having a relatively small heat capacity and at its normally operating temperature adapted to carry a portion only of the load current, said cathodes being heated independently of one another, and means for energizing the auxiliary cathode and raising its temperature to the operating condition prior to raising the temperature of the main cathode to its operating condition, and means for de-energizing the auxiliary cathode when the main cathode has reached its operating temperature.

3. A gaseous discharge device comprising an evacuated envelope containing ionizable gas at a pressure sufficient to neutralize space charge, a plurality of electrodes therein including main and auxiliary cathodes and an anode, said main cathode being indirectly heated and said auxiliary cathode being in addition to the main cathode heater, said main cathode having a relatively large heat capacity and at its normally operating temperature adapted to carry the entire load current, and the auxiliary cathode having a relatively small heat capacity and at its normally operating temperature adapted to carry a portion only of the load current, said cathodes being heated independently of one another, and means for energizing the auxiliary cathode and raising its temperature to the operating condition prior to raising the temperature of the main cathode to its operating condition, and means comprising a relay responsive to anode current for deenergizing the auxiliary cathode when the main cathode has reached its operating temperature.

4. A gaseous discharge device comprising an evacuated envelope containing ionizable gas at a pressure sufficient to neutralize space charge, a plurality of electrodes therein including main and auxiliary cathodes and an anode, said main cathode having a relatively large heat capacity and at its normally operating temperature adapted to carry the entire load current, and the auxiliary cathode having a relatively small heat capacity and at its normally operating temperature adapted to carry a portion only of the load current, said cathodes being heated independently of one another, and means for energizing the auxiliary cathode and raising its temperature to the operating condition prior to raising the temperature of the main cathode to its operating condition, said main cathode comprising a cylindrical member coated with electronically active material and said auxiliary cathode comprising a helix surrounding the main cathode.

YOSHIO IMAOKA.