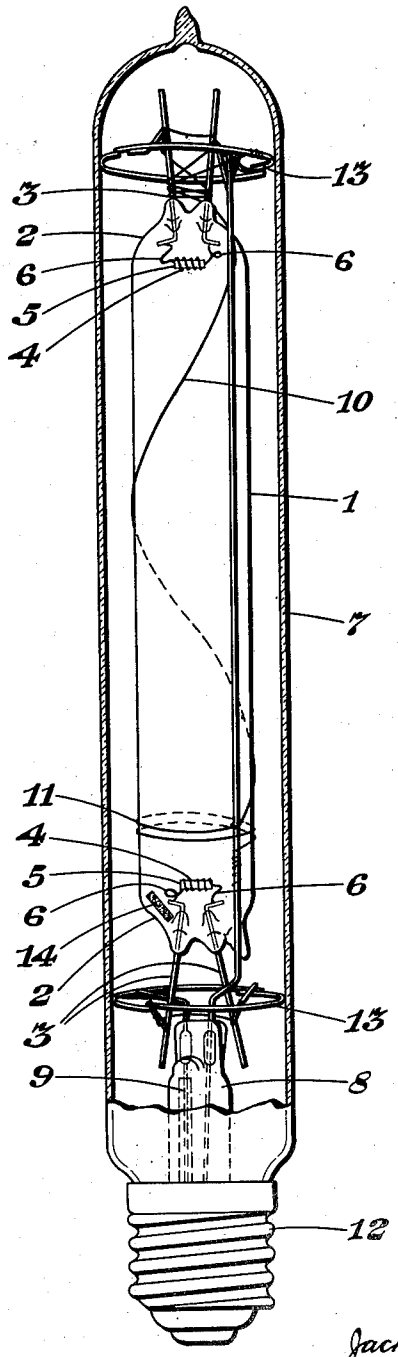
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ELECTRIC GASEOUS DISCHARGE DEVICE

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INVENTORS

Jack A. V. Fairbrother

John H. Mitchell

BY Harry E. Dunham

ATTORNEY

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ELECTRIC GASEOUS DISCHARGE DEVICE

Jack A. V. Fairbrother and John H. Mitchell, Rugby, England, assignors to General Electric Company, a corporation of New York

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The present invention relates to electric gaseous discharge devices generally, and in particular to devices operating with the gas content at a relatively high pressure.

A particular object of the invention is to provide a gaseous discharge device which will operate with the gas content at a relatively high pressure. A further object of the invention is to provide a device of this type which will start at a potential but little in excess of the discharge maintaining potential. Another object of the invention is to provide means to reduce the pressure of the fixed gas content when the device cools to room temperature. Another object of the invention is to provide a novel method of operating an electric discharge containing a fixed gas at a relatively high pressure. Still other objects and advantages of the invention will appear from the following detailed specification, or from an inspection of the accompanying drawing.

The invention consists in the new and novel combination of elements, and in the novel steps of the method, as hereinafter set forth and claimed.

It is known that the characteristics of a discharge in various gases change as the pressure and density of the gas increases. In some cases the luminous efficiency of the discharge is increased with increases in density. The relative amount of energy in various lines of the emitted spectrum also changes in most cases, this changing the composite color of the emitted light, or in some cases the amount of ultraviolet radiations available. For these and other reasons which will appear to those skilled in the art it is frequently desirable to operate an electric discharge in a gaseous atmosphere at a relatively high pressure, considerably in excess of say 100 m. m. of mercury. In the past, however, this type of operation has been limited to devices containing a vapor, such as that of mercury, which is condensible at the usual ambient temperature, due to the fact that at the elevated operating pressure thousands of volts are required to initiate a discharge which can be maintained on less than 230 volts. In the condensible vapor devices this pressure is automatically lowered, due to condensation as the device cools, so that the discharge can be reinitiated on 230 volts applied potential. But in the case of a fixed gas, that is, one that is normally in the gaseous state at room temperature, the gas density remains constant at all times, and thus the device cannot be started except by a potential of the order of ten to twenty times the normal arc maintaining potential. This handicap has more than offset the advantages of operation at elevated pressure with a fixed gas, with the result that this type of device has never gone into use.

We have now discovered that this disadvantage can be entirely overcome by placing within the device a substance which when cold will absorb, either physically or by chemical combination, the excess gas above that required for starting the discharge at a moderate potential, and which will when hot again evolve the absorbed gas. In some cases the amount of this substance is so chosen that it will only absorb a predetermined fraction of the gas content, while in others it is ample to absorb all of the main gas and an auxiliary gas which is not absorbed by the substance is added at a desired low pressure for starting the discharge. In either case the arc is started with the gas at a relatively low pressure, but operates, as soon as the substance is heated, at a very much higher pressure.

For the purpose of illustrating our invention we have shown in the accompanying drawing an electric discharge device embodying our novel structure.

In this drawing the luminous tube comprises internal envelope of glass 1 having approximately spherical ends 2 into which are sealed the leading-in wires 3. To these leads are spot-welded the thermionic electrodes each consisting of a short refractory rod 5 composed of a mixture of calcium and barium oxides surrounded by a tungsten spiral 4; two turns 6 of the spiral, free of the rod, are used as the curved part of the leads for preventing the conduction of excessive heat to the seals.

The internal envelope 1 is arranged within an outer envelope 7 (shown as partly cut away in the drawing) having a foot-tube 8 and a standard form of lamp cap 12 at one end. The leads 9 for the discharge tube are brought through the foot-tube in the ordinary way, and connected to the leads 3 sealed into the inner envelope; these leads 9 may conveniently carry wire rings 13 which bear against the inside of the outer envelope and serve as supports for the inner envelope. The sealed outer envelope may be either exhausted or filled with a suitable gas, such as nitrogen at a half an atmosphere.

The internal envelope contains a gaseous atmosphere which will be further described hereinafter. Furthermore, to render the tube self-striking, a wire 10 is carried from one of the leads along the outside of the inner envelope to a

point near the other electrode of the tube and there wound round the outside of the inner envelope to form a conductive ring 11. Alternatively an auxiliary electrode may be put inside the tube, near one of the main electrodes and connected to another main electrode in a known manner by a high resistance. The use of the outer envelope with these forms of starting arrangement is particularly convenient, for it permits live conductors to be run along the outside of the discharge tube proper, without any danger that they may be accidentally touched.

A quantity 14 of a substance which will absorb a very considerable portion of the gaseous content of the device is enclosed within the envelope 1. For example, in case the envelope 1 is filled with hydrogen at a pressure of the order of an atmosphere, the substance 14 may be a quantity of platinum or palladium black, since these substances absorb many times their own volume of hydrogen at room temperature and again evolve the absorbed gas when heated. Nickel also may be used to absorb the excess hydrogen at starting.

With other gases other substances may be used. Thus copper granules formed by the reduction of copper oxide by hydrogen are effective to absorb nitrogen, hydrogen and carbon monoxide. Charcoal in various forms absorbs hydrogen, nitrogen, oxygen, carbon dioxide, hydrogen sulphide, argon, nitrous oxide, acetylene and other gases, and hence can be used to reduce the pressure at starting in devices containing any of these gases.

In addition to using the foregoing materials which absorb or adsorb the gas filling of the lamp we have found that other substances which combine chemically at ambient temperature with the gas can be used, provided they again decompose at higher temperatures. Thus ammonia will combine with the halogen compounds of zinc and cadmium at room temperature and again separate at high temperatures.

The gas used can, of course, be at any desired pressure to provide the particular operating characteristics required, since it is no longer necessary to compromise with the pressure required at starting. The substance 14 is provided in such a quantity as to absorb any desired proportion of the gas content in order to permit the discharge to be reinitiated at a potential but little in excess of the arc maintaining potential. For example a device which will operate with the necessary ballast on 230 volts is preferably so designed that it will restart on the same 230 volts, so as to minimize the auxiliary apparatus required.

In some cases, especially where the gas employed rapidly cleans up, it may be difficult to keep the gas at a desired pressure when cool. In such a case we prefer to use a sufficient quantity of the substance 14 to absorb all of the principal gas and then to add a small quantity of a starting gas at a low pressure which will not be absorbed by said substance. For example, in a carbon dioxide lamp we prefer to use charcoal in sufficient quantity to absorb all of this gas, at whatever pressure it is used, and then to add a few m. m. of neon. The latter gas is not absorbed to any extend by the charcoal, and hence is always present in a fixed amount to permit restarting under identical conditions at all times.

The substance 14 is, of course, so located as not to interfere with the light emission from the envelope 1, as shown, and in some cases may even be located in a side tube. Likewise external heating or shielding means can be provided to control the temperature of the absorbing material and thus the gas pressure within the lamp, and hence its volt-ampere characteristic. Such a means may, in fact, be utilized to compensate for the gradual clean-up of the principal gas, so that the useful life of the device may be greatly extended. For example, the absorbing substance may be moved by agitation from one point to another closer to the discharge after a certain period of operation, the substance being hotter in the latter position and therefore evolving more gas. Thus in the example shown the substance is nearer the discharge as shown than if it were above the seal-off.

While we have described our invention by reference to a specific embodiment thereof it is to be understood that various omissions and substitutions, within the scope of the appended claims, may be made therein without departing from the spirit of our invention. In particular it is to be noted that various other types of electrode of the directly or indirectly heated type, or of any other type, may be substituted for the particular type illustrated.

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

1. An electric gaseous discharge device comprising a sealed envelope, a pair of electrodes sealed therein, a fixed gas within said envelope at a relatively high pressure above that at which minimum breakdown potential occurs, and means within said envelope to reduce said gas pressure when said device is cold, said means being responsive to temperature and directly exposed to the heat produced by the discharge between said electrodes whereby said high pressure is restored each time said device is operated.

2. An electric gaseous discharge device comprising a sealed envelope, a pair of electrodes sealed therein, a fixed gas within said envelope at a relatively high pressure above that at which minimum breakdown potential occurs, and a substance within said envelope which absorbs a substantial part of said gas when cool to reduce said gas pressure and again evolves said gas when heated, said substance being directly exposed to the heat produced by the discharge between said electrodes whereby said absorbed gas is substantially all re-evolved each time said device is operated.

3. An electric gaseous discharge device comprising a sealed envelope, a pair of electrodes sealed therein, a fixed gas within said envelope at a relatively high pressure, above that at which minimum breakdown potential occurs, means within said envelope to absorb all of said gas, and another fixed gas within said envelope which is not absorbed by said means, said last mentioned gas being present at a pressure which permits initiation of a discharge at relatively low voltage.

4. An electric gaseous discharge device comprising a sealed envelope, a pair of electrodes sealed therein, a fixed gas within said envelope at a relatively high pressure above that at which minimum breakdown potential occurs, means within said envelope which absorbs a substantial part of said gas when cool and again evolves said gas when heated, and means to vary the temperature of said last mentioned means to control the proportion of the absorbed gas which is evolved during operation of the device.

5. The method of operating an electric gaseous discharge device containing a fixed gas at a relatively high pressure above that at which minimum breakdown potential occurs which comprises absorbing enough of said gas when said device is cool to permit a discharge to be initiated therein at a potential but little in excess of the discharge maintaining potential.

6. The method of operating an electric gaseous discharge device containing a fixed gas at a relatively high pressure above that at which minimum breakdown potential occurs which comprises absorbing some of said gas when said device is cool to facilitate the initiation of a discharge therein, and varying the amount of gas reevolved during operation to compensate for loss of said gas through clean-up to provide constant operating characteristics for said device.

JACK A. V. FAIRBROTHER.
JOHN H. MITCHELL.