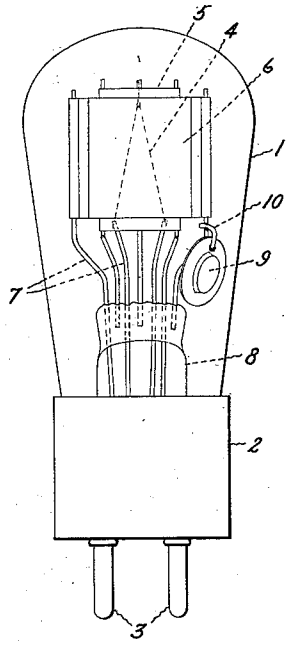
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ELECTRIC DISCHARGE DEVICE OR VACUUM TUBE

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ELECTRIC DISCHARGE DEVICE OR VACUUM TUBE

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The present invention relates to electric discharge devices or vacuum tubes, and more in particular to the introduction of highly oxidizable materials into such electric discharge devices, or vacuum tubes.

Because of the oxidizability of highly positive metals, such as alkaline earth metals, for example, they have been introduced heretofore into vacuum tubes as alloys. Unless such alloys contain but a very small percentage of the highly reactive or "getter metal" they are still attacked by oxygen of the air and by water vapor. Because of the necessary high percentage of alloying stable metal, an extremely high temperature is needed to liberate the getter metal. Even at high temperatures the getter metal is given off but slowly. Protracted high temperature treatment of a getter pellet accompanied by vaporization of undesired constituents may be deleterious.

By my present invention I have provided an improved reaction mixture which has the combined advantage of being chemically stable at ordinary temperatures, capable of ignition at a moderate glow temperature and when ignited by heating, being also capable of setting free heat by an exothermic reaction thereby rapidly evolving the desired getter vapor.

In accordance with my invention, highly reactive or "getter substances", such as the alkaline earth metals, are introduced into vacuum tubes, or the like, by liberation of such substances from a reaction mixture containing a material which is inert and protective in nature at room temperature. The reaction mixture, on the other hand, is ignitable at moderate temperature, the resulting reaction being exothermic, the liberated heat causing an efficient evolution of desired metal vapor for "getter" or other purposes. The reaction mixture, for example, may consist of an alkaline earth metal-aluminum alloy mixed with a reducible compound, such as iron oxide, other examples being described hereinafter.

As described in Charlton Patent 1,738,420, a reaction mixture may be placed either within a vacuum tube itself or in a chamber communicating directly with the tube. The alkaline earth metal may be liberated from the reaction mixture with heat produced by any suitable means, for example by the well known high frequency induction method. The term "vacuum tube" is intended to include both highly evacuated electrical discharge devices and also gas-filled discharge devices.

The accompanying drawing shows in the figure an electric discharge device in which the reaction mixture has been placed in a capsule.

The drawing illustrates a known form of radio receiving tube comprising a glass bulb 1, having a base 2, provided with contacts 3 and containing a cathode 4, a grid 5 and an anode 6. These electrodes respectively are carried by their leading-in conductors 7 which are sealed into a stem 8. The getter pellet is contained in a capsule 9 which is connected by a wire 10 to an anode support. The space within the bulb 1 may be evacuated, or may contain a suitable gas, such as one of the rare gases, or mercury vapor.

A reaction mixture embodying my invention may comprise about 60 to 90 parts by weight of suitable alkaline earth-aluminum alloy (containing 15 to 60 per cent of the alkaline earth metal) with about 10 to 40 parts by weight of iron oxide. Such a mixture has been found to remain chemically inactive for months. Thus no protective coating is required. When such reaction mixture is introduced into the evacuated tube in the form of a compressed powder, cake, or pellet, or in a capsule, such as shown at 9, and subjected to a moderate glow temperature, the aluminum (as an example of an active alloying metal) combines with the oxygen of the iron oxide with the generation of additional heat which drives the alkaline earth metal out of the capsule in a surprisingly short time without the generation of foreign gases. For this reason my reaction mixture is adapted particularly for quantity production. The rapid liberation of the alkaline earth metal is probably not due entirely to the heat of formation of aluminum oxide. After the formation of the aluminum oxide the remaining alkaline earth-aluminum alloy contains a high percentage of alkaline earth metal from which alloy the alkaline earth metal is rapidly liberated at a moderate glow temperature. It will thus be seen that by my process the stable reaction mixture forms an unstable or chemically active alloy containing a high percentage of alkaline earth metal directly in the discharge device.

The alloy of the alkaline earth metal is selected according to quality and quantity so that the alloying metal and not the alkaline earth metal combines with the oxygen of the oxide component. In order to ensure the starting of the reaction, an auxiliary reaction mixture may be used along with the main reaction mixture from which the alkaline earth metal is liberated. By using an auxiliary reaction mixture, or by coating or otherwise providing a surplus of the alloying metal (for example, aluminum) in the original reaction mix-

ture, the heat of the reaction may be controlled.

Although I have illustrated my reaction mixture employing certain metals my invention is not limited to the specific ingredients previously disclosed. For example, other metals may be used in the mixture in place of aluminum, such as beryllium, zirconium, thorium, scandium, or metals of the rare earths. As some of these metals do not form a binary alloy with the alkaline earths, a metal such as nickel may be added for this purpose. Other oxides, such as chromium oxide, tungsten tri-oxide, and the like, may be used instead of the iron oxide. In place of oxides, other reducible compounds, such as sulphide and halogen compounds, may be used. It has been found highly advantageous to preheat the reducible compounds to a high temperature before use as this treatment reduces their capacity for absorbing gases.

Other modifications of my invention obvious to those skilled in the art and coming within the true spirit and scope of my invention are meant to be covered in the claims appended hereto.

Examples of reaction mixtures:

I. 70–90 parts by weight of strontium-aluminum alloy (containing 30–50 percent strontium and 50–70 percent aluminum) with 10–30 parts by weight of iron oxide.

II. 70–90 parts by weight of barium-aluminum alloy (containing 30–60 percent barium and 40–70 percent aluminum) with 10–30 parts of chromium oxide.

III. 80–90 parts by weight of barium-nickel-zirconium alloy (containing 30 percent barium, 30 percent nickel and 40 percent zirconium) with 10–20 parts by weight of tungsten trioxide.

These reaction mixtures are ignited at about 700–850° C. and after ignition reach a temperature of 1000–1200° C.

After the reaction has taken place and large amounts of alkaline earth metal are liberated, more metal can be developed by heating the mixture at cherry red glow.

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

1. The method of introducing a highly reactive metal into the envelope of an electric discharge device which consists in forming a stable alloy of said metal with a highly reducing metal, mixing said alloy with an exothermically reducible compound sufficient in amount to react only with said reducing metal, and heating said mixture to a reaction temperature in said envelope.

2. The method of producing a pure alkaline earth metal vapor which consists in forming a stable alloy of said metal with aluminum, mixing said alloy with a quantity of an exothermically reducible compound sufficient to react only with said aluminum and heating said mixture to a reaction temperature.

3. In an electric discharge device, a stable reaction mixture consisting of an alkaline earth aluminum alloy and iron oxide, said aluminum and said iron oxide being in such proportions that said alkaline earth may be vaporized by their reaction without being oxidized thereby.

4. In an electric discharge device, a reaction mixture consisting of 60 to 90 parts of a stable barium-aluminum alloy and 10 to 40 parts of iron oxide.

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