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ELECTRODE STRUCTURE FOR ELECTRON DISCHARGE DEVICES

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FIG. 1

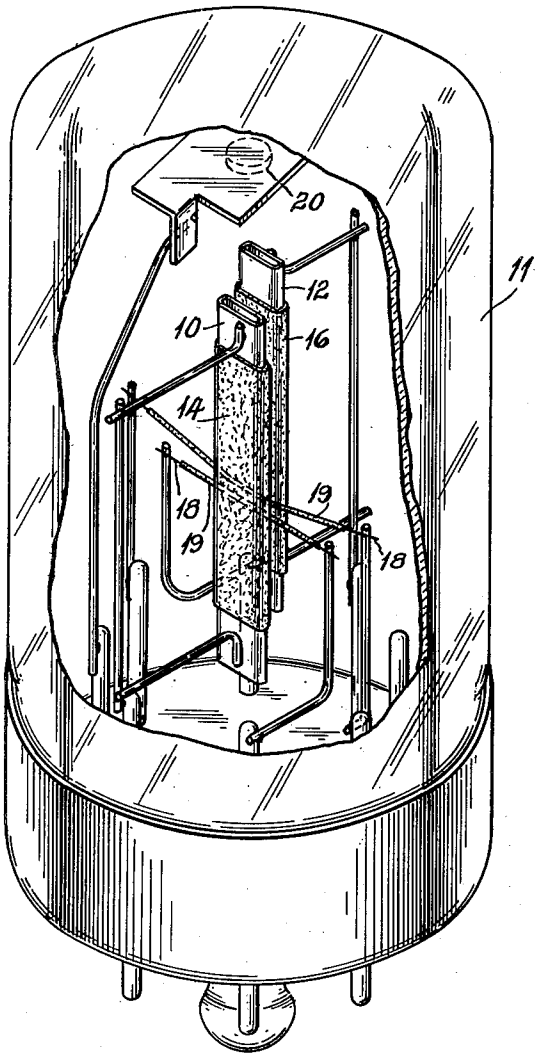
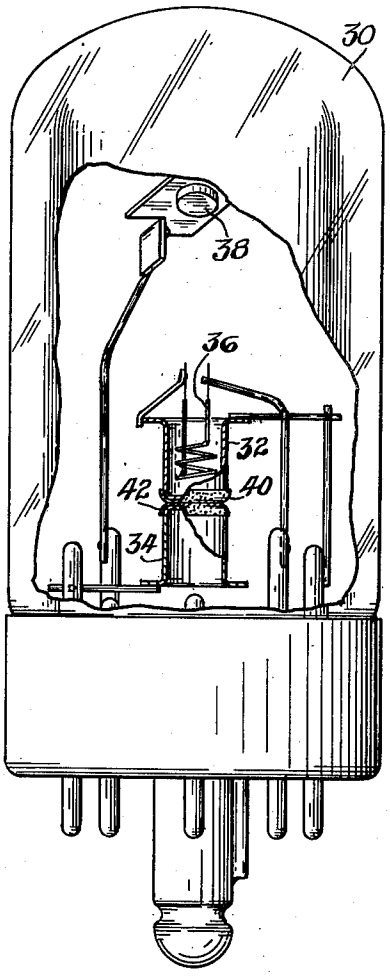



FIG. 2




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## ELECTRODE STRUCTURE FOR ELECTRON DISCHARGE DEVICES

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5 Claims. (Cl. 313—235)

1

This invention relates to an electronic device, more particularly it relates to a device in which an ionic crystalline material is an essential element.

The need for electronic devices which do not require heating elements has been growing steadily. As the various electronic circuits have become more and more complicated and as the demand for smaller units has increased, the problem of heat dissipation has become greater and greater. Furthermore, with a demand for mobile electronic units increasing, the desire to cut down on the power required for operation of circuits has also increased. Since the heating of filaments in quantities takes considerable current, the elimination of the need for such heating and therefore reduction in power requirement is readily apparent.

It is therefore an object of this invention to provide an electronic device whose operation will not be dependent upon filament heating.

Another object of this invention is to provide power and voltage amplifiers which do not require filament heating.

These objects and advantages as well as other desirable features can be obtained with the use of ionic crystals in direct contact with the electrodes. In the drawings which illustrate embodiments of this invention,

Fig. 1 illustrates an embodiment of a power amplifier of this invention.

Fig. 2 illustrates an embodiment of a rectifier of this invention.

In the embodiment shown in Fig. 1 of the drawings, 10 and 12 represent nickel electrodes which contain an ionic crystalline coating, 14 and 16 respectively. These electrodes are positioned in the tube 11 in such manner that they butt against one another; that is, their coating makes contact down along one side of the electrode. Tungsten wires or probes, 18 are shown as being sandwiched between these electrodes. These tungsten wires are also coated with ionic crystalline material as shown at 19. The device is further shown as being provided with a normal gettering agent 20.

The ionic crystalline material which which the electrodes 10, 12 and probe 18 are coated may include salts of low work function metals such as any of the salts of the alkali metals as well as the salts of the alkaline earth metals including their oxides and carbonates. This coating may be applied by any of the known methods including spraying and cataphoresis.

In making an amplifier tube of the type illustrated in Fig. 1, it is preferable practice to break down the surfaces thoroughly as for example by thoroughly exhausting the tube followed by an aging process at about 800° C. This has been found to greatly increase the conduction of the coating and the amplification which can be obtained.

2

A tube which has been made in this manner will be found to be effective in its use as an amplifier at room temperature without heating any of the electrodes and therefore without the aid of any filament heater. It has been found that excellent results can be obtained with a tube of this type when the grid or probe voltage is about 0 and the plate voltage ranges between 10 and 40 volts. Under these conditions power amplification of between 30 and 50 can be obtained.

It is further noteworthy that the characteristics of the tube can be changed or modified to a considerable degree by varying the composition of the ionic crystal which is being used either by the addition of impurities or by using different ionic crystalline material. For example, it is to be noted that if the electrode parts are copper plated prior to being coated with the ionic crystalline material, the copper will diffuse through the coating during the degassing period. This increases the conductivity by a factor of 10 to 100 whereas when materials such as barium fluoride are added to a coating consisting of triple carbonate of barium, strontium and calcium, the resistance will go up by a factor of 10 to 100 and thus bring the device to the order of 1 to 10 of current at the operating point. It is thus readily apparent that this device is quite flexible in that variations of chemical composition and processing can advantageously be made use of to achieve the desired results.

From the above it is readily apparent that the materials of which the electrodes and probes are made will have some effect on the ultimate characteristics of the electronic device. However, its fundamental characteristics will remain the same. In this regard it is to be noted that although the distance between the probe wires of the electronic device illustrated in Fig. 1 does not appear to be critical, these wires are preferably kept about 1 millimeter apart.

When the device is to be operated as a recitifier, no probes are used. However, one of the electrodes is run hot and the other is run cold. The heated electrode being operated preferably at a temperature between 350 and 800° C.

The ionic crystalline material in the form of a coating on an electrode of an electronic device

can however also be advantageously used if one of the electrodes containing the coating is heated. A device of this type is illustrated in Fig. 2 of the drawing. The embodiment illustrated is particularly suitable for use as a rectifier. The device there shown consists of an envelope 30 enclosing two cup-shaped electrodes 32 and 34 and a filament 36 within cup 32 adapted for heating the cup-shaped electrode 32 by indirect heat. A getter 38 is also provided for the normal gettering action. Each of the cup-shaped electrodes is further provided with an ionic crystalline coating 40 and 42 respectively. The two electrodes in the embodiment illustrated in Fig. 2 are also in surface contact with one another through the coating materials in much the same manner as is the device shown in Fig. 1. In this case however, no probes are provided.

The illustrated device can readily be operated as a rectifier when the electrode 32 containing the filament 36 is heated. The heated electrode is preferably operated at a temperature between 350 and 800° C. whereas the other electrode is preferably operated at room temperature.

The ionic crystalline materials which are used to coat the electrodes are the same as those which were noted above for the electronic device illustrated in Fig. 1, namely, any of the salts of the alkaline metals as well as the salts of the alkali earth metals including their oxides and carbonates. It is of course understood that these coatings may be applied by any of the known coating methods including spraying and cataphoresis.

In order to achieve optimum results, it is of course understandable that the same treatment is necessary, that is, the surface should be broken down thoroughly by first thoroughly exhausting the tube and then aging the electrodes at about 800° C.

It is also readily understandable that the characteristics of the device as a rectifier can be varied by variations of the temperature differential between the two electrodes as well as by variations in the chemical composition of the coatings which variations may be in the nature of variations in the compounds going into making the composition or by changing the characteristics of the compounds by the use of impurities such as copper or other foreign materials.

While the above description and the drawings submitted herewith disclose preferred and practical embodiments of the electronic devices of this invention, it will be understood by those skilled in the art that the specific details of construction and arrangement of parts as shown and described are by way of illustration and are not to be construed as limiting the scope of the invention.



What is claimed is:

1. In an electronic device a pair of electrodes coated with copper plus an ionic crystalline material the coated surfaces of which are in physical contact with one another and probes coated with an ionic crystalline material sandwiched between said electrodes, said ionic crystalline material consisting of a salt of an alkaline earth metal.

2. In an electronic device a pair of electrodes coated with an ionic crystalline material the coated surfaces of which are in physical contact with one another and probes coated with an ionic crystalline material sandwiched between said electrodes, said ionic crystalline material consisting of a salt of an alkaline earth metal.

3. In an electronic device a pair of electrodes coated with an ionic crystalline material the coated surfaces of which are in physical contact with one another and probes coated with an ionic crystalline material sandwiched between said electrodes, said ionic crystalline material consisting of a salt of an alkaline metal.

4. In an electronic device a pair of electrodes coated with an ionic crystalline material the coated surfaces of which are in physical contact with one another and probes coated with an ionic crystalline material sandwiched between said electrodes, said ionic crystalline material consisting of a mixture of barium, strontium and calcium carbonates.

5. In an electronic device a pair of electrodes coated with an ionic crystalline material the coated surfaces of which are in physical contact with one another and probes coated with an ionic crystalline material sandwiched between said electrodes, said electrodes having a precoating of copper, said ionic crystalline material consisting of a salt of an alkaline earth metal.

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