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IONISATION CHAMBER

Filed June 16, 1958

FIG.1

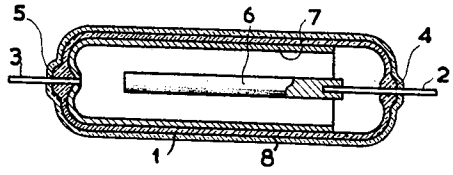
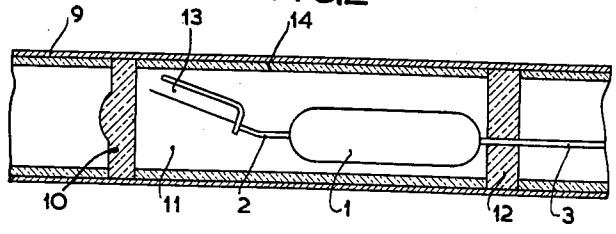


FIG.2



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IONISATION CHAMBER

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This invention relates to ionisation chambers, especially for measuring gamma and X-rays.

For measuring γ-rays and X-rays, use is made of the ionisation produced by these rays in a certain volume of a gas or gas mixture. The gas volume is enclosed in a chamber the walls of which are made entirely or in part of insulating material and in which two electrodes are provided. Generally one electrode is applied to the wall while the other is arranged in the chamber. Each electrode is connected to a conductor passing through the wall so that an electric potential is set up across them. The electrodes must be highly insulated from one another.

The wall material of ionisation chambers preferably consists of a substance which with respect to its permeability to the ionising radiation has about the same properties as air. Otherwise the sensitivity of the ionisation chamber will depend to a higher or lesser degree upon the hardness of the rays. Particularly in small ionisation chambers of small volume the measuring results can be materially influenced by the composition of the wall material. As the wall material, use is frequently made of an organic substance which has substantially the same absorption and diffusion for the rays to be measured as air. In general, such materials are referred to as "air-wall equivalent" materials.

Ionisation chambers are increasingly used in radiation counters for detecting ionising radiation and for safeguarding persons whose work entails that they can be exposed to radiation. Consequently these apparatus must be permanently disposed in the vicinity of the person to be protected and therefore their size is made so that they can readily be worn on or in the clothing. Consequently the ionisation chambers used must be very small. Hence the electrodes are closely adjacent and the insulation distance is slight, so that the wall material must have a very high insulation resistance.

It is known to use organic substances, such as polystyrene, as the wall material. The insulation resistance is sufficiently high, but they have a limitation which restricts their use to ionisation chambers filled with air under atmospheric pressure. The material is not completely airtight and consequently not completely reliable for chambers which are filled with a gas or gas mixture other than air or in which the pressure of the gas filling differs from the atmospheric pressure. In course of time the composition of the gas or the pressure in the ionisation chamber is slightly changed. In addition, it may be desirable for chambers which are closed hermetically to be degassed in order to remove entirely detrimental constituents, more particularly hydrogen. The organic substances cannot withstand the temperature required in this process.

It is an object of the present invention to avoid these disadvantages. It relates to an ionisation chamber the wall of which is airtight, has very high insulation resistance, can be heated at a sufficiently high temperature for the chamber to be completely degassed, while the radiation absorption is fairly similar to that of air, i.e., it is a substantially air-wall equivalent material. According to the invention, the wall of an ionisation chamber is made

of a vitreous substance, composed of pure boric acid anhydride which is usually referred to as boric oxide.

Glass compositions are known which contain a high percentage of boric acid. However, these glasses do not possess the property required in manufacturing ionisation chambers, that the radiation absorption in the material is similar to that of air. The absorption is greater, frequently even materially greater.

Owing to the slight electrical conductivity of the vitreous B_2O_3 the insulation distances required between the electrodes and the lead-in conductors can be small and the chamber can have the small size required for its use as the envelope of a radiation counter to be worn on or in the clothing.

An advantage of the substance consists in that it can be sealed to aluminum. Conductors of this material can be sealed in the wall directly. Conductors of copper are locally coated with a soft enamel as an intermediate layer.

As is known, the vitreous substance consisting of boric oxide is highly hygroscopic. Consequently, when it is used in an ionisation chamber in accordance with the invention, the wall must be protected against attack by moisture. The chamber can be arranged in an envelope filled with dry air or in a vacuum. The space surrounding the ionisation chamber within the envelope can be used to accommodate the electrostatic indicating system which is employed in radiation counters for the detection of the ionising radiation. If the ionisation chamber is to be used independently, a protective layer can be provided. This layer can consist of polyester or celluloid. After mounting, the ionisation chamber can be immersed in a solution of one of these substances and subsequently dried. If required, the immersion can be repeated until the layer has attained the required thickness.

In order that the invention may readily be carried out, reference is made to the accompanying drawing, in which—

FIG. 1 is a cross-sectional view of an ionisation chamber in accordance with the invention, provided with a protective coating,

FIG. 2 shows the ionisation chamber arranged in a protective envelope.

Referring now to the figures, the gas volume to be ionised is enclosed in a tubular chamber **1**, the wall of which consists of a vitreous substance made of boric oxide. The gas volume may consist of air or a gas filling may be provided which absorbs X-rays to the same extent as air. A suitable pressure of the gas lies between 1 and 1½ atm. At both ends the tube **1** is closed and provided with feed-through conductors **2** and **3** made, for example, of aluminum or copper. The copper wires are sealed in the wall **1** with the interposition of a vitreous enamel **4** and **5**. An inner electrode **6**, which may consist of a graphite rod, is connected to the lead-in **2**. The outer electrode **7** comprises a conductive substance, preferably carbon, which is applied to the wall **1**. Prior to filling the chamber with the ionisable gas, to remove detrimental constituents, such as hydrogen, the chamber may be heated to a temperature of 100 to 150° C.

On the wall **1** a coating **8** of moisture-proof insulating material, made of for example polyester or celluloid, is applied .

In FIG. 2 the ionisation chamber **1** is situated within a cylindrical or tubular housing **9** which is formed of an electrically conducting material that is pervious to radiation, such as for example aluminum. Within housing **9** is situated a lens **10** forming one end wall of a small compartment **11** the other end of which is closed by an insulating wall **12**. One electrode **3** of the ionisation chamber **1** extends through the wall **12** and the second

electrode **2** supports an electroscope assembly **13**, which is well known in the art so that it is not described in detail. The lens **10** and the wall **12** are spaced apart by a hollow cylindrical shell **14** having approximately the same outer diameter as the inner diameter of housing **9**. The space **11** is preferably filled with dry air.

The assembly as far as it is shown in FIG. 2 may form part of a radiation detection device as described in U.S. patent specification 2,613,327 to replace the electroscope assembly used therein.

What is claimed is:

1. An ionization chamber for measuring gamma rays, X-rays, and the like, comprising a sealed envelope having a wall portion of substantial surface area constituted of a substantial air-wall equivalent material and separating the envelope interior from the outside environment, an ionizable medium and electrode system within the envelope, external terminals sealed in the envelope and connected internally to the electrode system, said separating wall portion consisting of electrically-insulating, gas-tight, vitreous boric acid anhydride, and means surrounding the said wall portion of boric acid anhydride and preventing moisture from coming into contact therewith.

2. An ionization chamber as set forth in claim 1, wherein the last-named means comprises a moisture-impermeable coating provided on the said wall portion.

3. A chamber as set forth in claim 2 wherein the moisture-impermeable coating is selected from the group consisting of a polyester and celluloid.

4. An ionization chamber for measuring gamma rays, X-rays, and the like, comprising a sealed envelope wholly constituted of a substantial air-wall equivalent material and separating the envelope interior from the outside environment, an ionizable medium and electrode system within the envelope, external terminals sealed in and through the envelope wall and connected internally to the electrode system, said envelope consisting of electrically-insulating, gas-tight, pure vitreous boric oxide B_2O_3, and means surrounding the said envelope and preventing moisture from coming into contact therewith.

5. An ionization chamber as set forth in claim 4 wherein the last-named means comprises a hollow enclosure containing a moisture-free atmosphere.

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