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ION GENERATOR USING RADIOACTIVE MATERIAL

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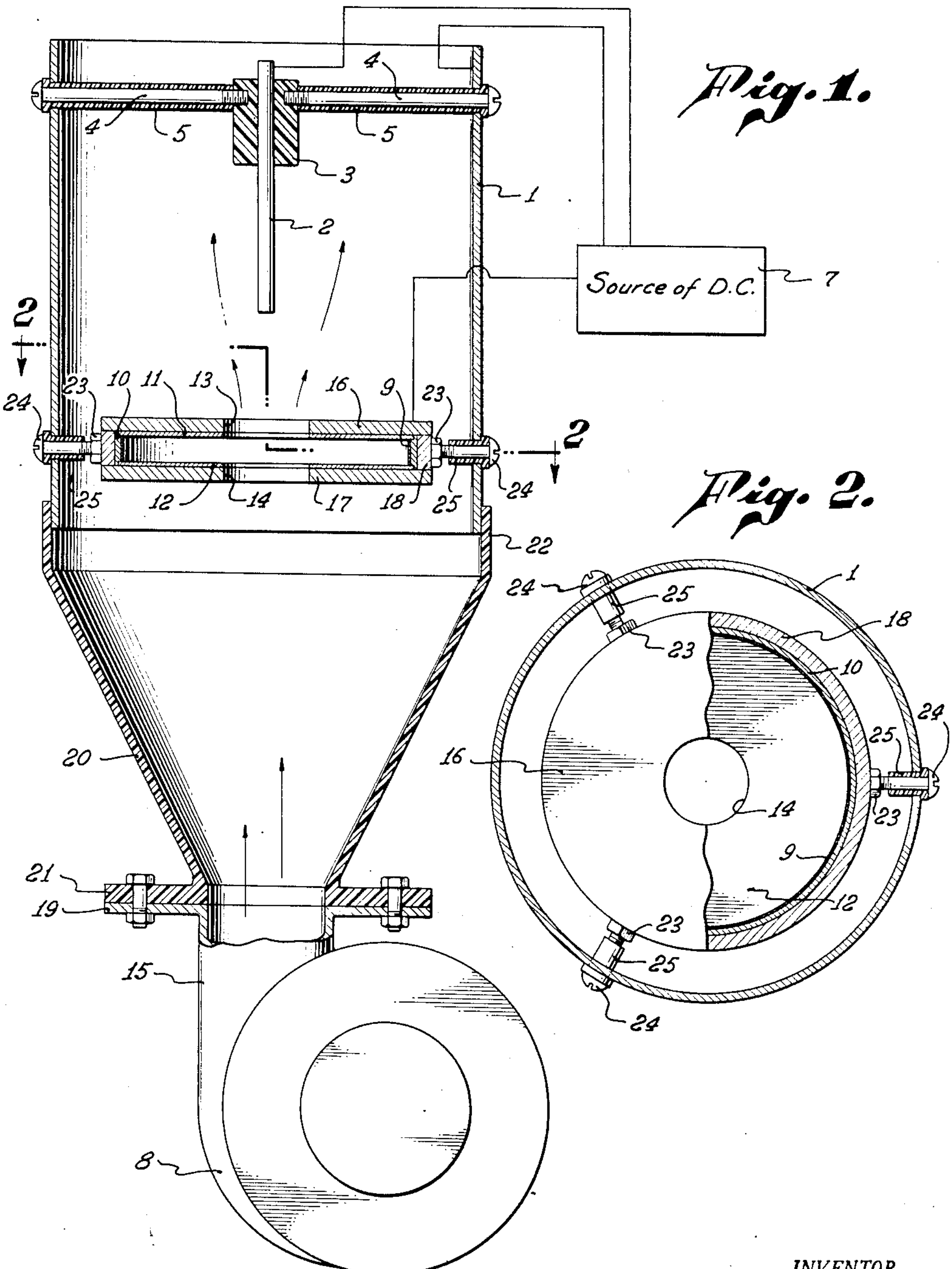

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ION GENERATOR USING RADIOACTIVE MATERIAL

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8 Claims. (Cl. 250—44)

This invention relates to a device for generating ions in air, useful for producing a predominance of light ions of either sign in the circumambient space.

Generators for this specific purpose are described in a prior application filed on June 3, 1953, under Serial No. 359,377, in the name of Thomas L. Martin, Jr. In that application, the generator utilizes a polonium element or cell, that emits alpha particles, causing by collision with air molecules light ions of opposite signs. Those ions of undesired sign are absorbed, and the desired ions are blown out by a fan. By appropriate choice of potentials on the various electrodes utilized in the device, it is possible to suppress all or nearly all of the undesired ions.

For general beneficial effects upon humans, the desired ions are of negative sign; but the apparatus may be used to produce predominantly ions of either sign.

Polonium as the active element has many advantages. Its radiation is confined almost entirely to alpha particles, which do not have great penetration power, and accordingly it is easy to guard against harmful radiations reaching the space where the apparatus is located. However, the half-life of polonium is quite limited, and it is accordingly advisable to renew the polonium element in less than one year.

It is one of the objects of this invention to provide an ion generator in which the active element need be renewed only about every twenty years, and yet without danger of harmful radiations reaching the atmosphere.

In order to accomplish this result, radioactive material such as radium D is used as the active emitter. Such material, in addition to emission of the relatively easily controlled alpha particles, also emits gamma and beta rays. The radioactive material slowly degenerates to polonium; but at the same time, care must be taken to confine the injurious gamma and beta radiations to a space where they cannot emerge into the atmosphere.

It is accordingly another object of this invention to provide a structure that is safe when material such as radium D is used as the active element.

This invention possesses many other advantages, and has other objects which may be made more clearly apparent from a consideration of one embodiment of the invention. For this purpose, there is shown a form in the drawings accompanying and forming part of the present specification. The form will now be described in detail, illustrating the general principles of the invention; but it is to be understood that this detailed description is not to be taken in a limiting sense, since the scope of this invention is best defined by the appended claims.

Referring to the drawings:

Figure 1 is a longitudinal sectional view of a device incorporating the invention, and shown connected with a source of potential difference; and

Fig. 2 is a cross sectional view, taken along a plane corresponding to line **2—2** of Fig. 1.

The ion generator in this instance includes a tubular

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metallic shell **1** serving as an anode. This tubular metallic shell may be formed of round aluminum tubing. The cathode structure is made of rod-like metal element **2** supported by the aid of a spider made of insulation material, such as Bakelite. The spider is attached to the inside of the electrode **1**, near its upper edge.

The spider structure includes a hub member **3**, within which electrode **2** is firmly supported. A plurality of machine screws **4** are threaded radially into the hub **3**, and extend through appropriate apertures in anode **1**. Insulation bushings **5** surround the screws **4**, and maintain the electrodes **1** and **2** out of electrical contact. Preferably, three equiangularly spaced screws **4** may be used.

In order to provide a potential difference between the electrodes **1** and **2**, use is made of any appropriate source of direct current **7**.

When it is desired to operate the device for the generation of negative ions and the suppression of positive ions, the electrode **1** is made the anode and the electrode **2** is made the cathode. Accordingly, as hereinafter explained, when there is a flow of ions upwardly into the interior of the electrode **1**, the positive ions are attracted to the central electrode **2**. The negative ions, however, are blown out through the top of the tubular electrode **1** by the aid of an appropriate centrifugal blower structure **8**.

In order to ionize the atmosphere, use is made of a radioactive material. In the present instance, this material is in the form of a ribbon-like foil **9** incorporating radium D or other equivalent material. The thickness of this foil is greatly exaggerated in the drawing. This foil lines the inner surface of a cylindrical metallic tube **10**, such as aluminum, covered with lead of suitable thickness. This tube **10** is provided with an upper cover member **11** and a lower cover member **12**, having central aligned apertures **13** and **14** respectively. These cover members **11** and **12** may also be made of aluminum or other material, covered with lead of suitable thickness.

The fan **8** has an outlet conduit **15** attached as by flange **19** to the flange **21** of a conical fan adapter **20**. This fan adapter may be made of plastic material, and it has a cylindrical projection **22** attached to the outer surface of anode **1**. The fan **8** thus produces a flow of air longitudinally along the inner surface of this anode. This flow of unionized air prevents losses of negative ions that would otherwise be separated from the stream of ionized air. Of course, there is also a flow of air through the structure **10—11—12**. Fan **8** is intended to produce an air movement at the rate of about 400 to 500 feet per minute.

The radioactive foil **9** serves as a source of radiations of alpha, beta and gamma particles. When the foil **9** is arranged as a circular band having a diameter of about six centimeters, the focusing effect is such that the area of intense ionization of the air occurs in a circle of approximately two centimeters in diameter. Accordingly, the apertures **13** and **14** are made of about this size, and axial of the foil **9**.

The radioactive material embodied in foil **9** has an extended half-life, so that only at long intervals is it necessary to replace it. The material deteriorates slowly into polonium, which provides a copious flow of alpha particles.

The alpha, beta, and gamma rays emitted from the radioactive foil **9** are so confined that there is little likelihood of any of these rays escaping through the apertures **13** and **14**. This effect is enhanced by the relatively short axial length of the band **9**. For example, it may be about one-half centimeter, or approximately one-fourth of an inch. Accordingly, the inner diameter of tube **10** is about ten times the width or axial length of foil 9. The mean range of the alpha particles radiated from the foil 9 is sufficiently short so that there is no danger that these alpha particles can ever extend into the aluminum electrode 1. In order to ensure that the more powerful beta and gamma radiations be properly confined, appropriate lead sheathing may be provided, although in most instances such shielding is unnecessary.

In the present instance the tubular structure comprising the tube 10 and cover members 11 and 12 are overlaid with relatively heavy lead covers. Thus there are lead discs 16 and 17 overlying the members 11 and 12. Also, there is a lead annular ring 18 around the periphery of the aluminum member 10. The lead members 16, 17 and 18 are soldered together to form an integral shield. The excess solder at the joints is removed to provide a smooth exterior. The lead shield is thus utilizable as a collimator, performing the same functions as the collimator described in the said prior application. Accordingly, it is connected to source 7 for placing an appropriate potential upon it.

For holding the radioactive unit in place, use is made of a plurality of nuts 23 soldered to the exterior of ring 18, and equiangularly spaced (Fig. 2). Engaging these nuts are the screws 24, passing through the anode 1, and insulated therefrom by insulation sleeves 25.

The shielding structure that supports the radioactive foil is shown as formed of an inner layer of aluminum and an outer layer of lead. This is of value in controlling or reducing the scattering of beta rays emitted from the foil. Such rays scatter very little from low density materials such as aluminum; but they do scatter from dense material such as lead. Accordingly, incident beta rays will pass through the aluminum and they will, to a large extent, be absorbed in the lead.

The characteristics of the device are similar to those described in said prior application. By appropriate choice of relative potentials of the three electrodes 1, 2, and 10, the device emits a copious flow of ions of either desired sign. When only negative ions are desired, the anode 1 is made positive with respect to cathode 2; and the potential of the collimator structures 10—16—17—18 is made still more negative. Thus, as before, the potential of cathode 2 may be about 200 volts below that of anode 1; and the potential of the collimator 10—16—17—18 may be about 425 volts below that of anode 1. With such values, the positive ions are substantially entirely suppressed.

The inventor claims:

1. In a device for supplying ions of a desired polarity in air: a tubular radioactive member; means forming an emission aperture at one end of the member, said aperture having an area substantially less than that bounded by the inner surface of the member; an electrode beyond the aperture and substantially coaxial therewith; means for creating an electrostatic field between the member and the electrode, such as to attract only those of the resulting ions that have the undesired polarity to said electrode; and means for producing a movement of air past said electrode.

2. In a device for supplying ions of a desired polarity in air: a tubular radioactive member; means forming an emission aperture at one end of the member, said aperture having an area substantially less than that bounded by the inner surface of the member; a rod electrode beyond the aperture and aligned therewith; a tubular electrode surrounding said rod electrode; but out of electrical contact with the member and the rod electrode; means for creating an electrostatic field between the member and the rod electrode to cause attraction of ions of undesired polarity, to the rod electrode; means for impressing a potential on the radio-active member with respect to the tubular electrode, to repel the ions of desired polarity; and means for producing a movement of aid through said tubular electrode.

3. In a device for supplying ions of a desired polarity in air: a tubular radioactive member; means forming an emission aperture at one end of the member, said aperture having an area substantially less than that bounded by the inner surface of the member; a rod electrode beyond the aperture and substantially coaxial therewith; a tubular electrode surrounding said rod electrode; a conducting shield for the radioactive member and in electrical contact therewith; means for impressing a potential on the rod electrode of such polarity as to attract only those of the resulting ions that have the undesired polarity; means for impressing upon the shield a potential to repel the ions of desired polarity; means for impressing upon the tubular electrode a potential relatively opposite that of the rod electrode; and means for producing a movement of air through the second tubular member.

4. In a device for supplying ions of a desired polarity in air: a tubular member; radioactive material within the tubular member and adjacent the inner wall of the member; a cover for the member having an emission aperture; a rod electrode beyond the aperture and aligned therewith; a tubular electrode surrounding said rod electrode and the tubular member, and spaced from said tubular member; and means creating a flow of air adjacent the inner surface of the tubular electrode.

5. In a device for supplying ions of a desired polarity in air: a tubular metallic support; a ribbon-like radioactive element supported on the inner wall of said support; the diameter of the support being of the order of ten times the width of the element; metal plates overlying the ends of the support; the plates having aligned apertures; a rod electrode extending beyond one of the plates and aligned with the apertures; a cylindrical electrode surrounding the rod electrode and the support and out of contact therewith; means for impressing a potential on the rod electrode of such polarity as to attract only those of the resulting ions that have the undesired polarity; means for impressing upon the support a potential to repel the ions of the desired polarity; means for impressing upon the cylindrical electrode a potential relatively opposite that of the rod electrode; and means for producing a movement of air through the cylindrical electrode.

6. In a device for supplying ions of a desired polarity in air: a tubular metallic support; a ribbon-like radioactive element supported on the inner wall of said support; the diameter of the support being of the order of ten times the width of the element; metal plates overlying the ends of the support; the plates having aligned apertures; a rod electrode extending beyond one of the plates and aligned with the apertures; a cylindrical electrode surrounding the rod electrode; means for impressing a potential on the rod electrode of such polarity as to attract only those of the resulting ions that have the undesired polarity; means for impressing upon the support a potential to repel the ions of the desired polarity; means for impressing upon the cylindrical electrode a potential relatively opposite that of the rod electrode; and a fan for passing air past the inner surface of the cylindrical electrode.

7. In a device for supplying ions of a desired polarity in air: a hollow metallic member; radioactive material within the hollow member and adjacent the inner wall thereof; a covering wall for the member and having an emission aperture; a hollow first electrode surrounding said tubular member to form an air passage between them; a second electrode within the first electrode and aligned with said aperture; means for impressing a potential on the second electrode of such polarity as to attract only those of the resulting ions that have the undesired polarity; means for impressing upon the hollow member a potential to repel the ions of desired polarity; means for impressing upon the first electrode a potential relatively opposite that of the second electrode; and means for producing a movement of air through the first electrode.

8. In a device for supplying ions of a desired polarity in air: a hollow metallic member; radioactive material within the hollow member and adjacent the inner wall thereof; a covering wall for the member and having an emission aperture; said aperture having an opening with an area of about one-tenth the area bounded by said inner wall; a hollow first electrode surrounding said tubular member to form an air passage between them; a second electrode within the first electrode and aligned with said aperture; means for impressing a potential on the second electrode of such polarity as to attract only those of the resulting ions that have the undesired polarity; means for impressing upon the hollow member a potential to repel the ions of desired polarity; means for impressing upon the first electrode a potential relatively opposite that of the second electrode; and means for producing a movement of air through the first electrode.

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