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RADIOACTIVE BATTERY

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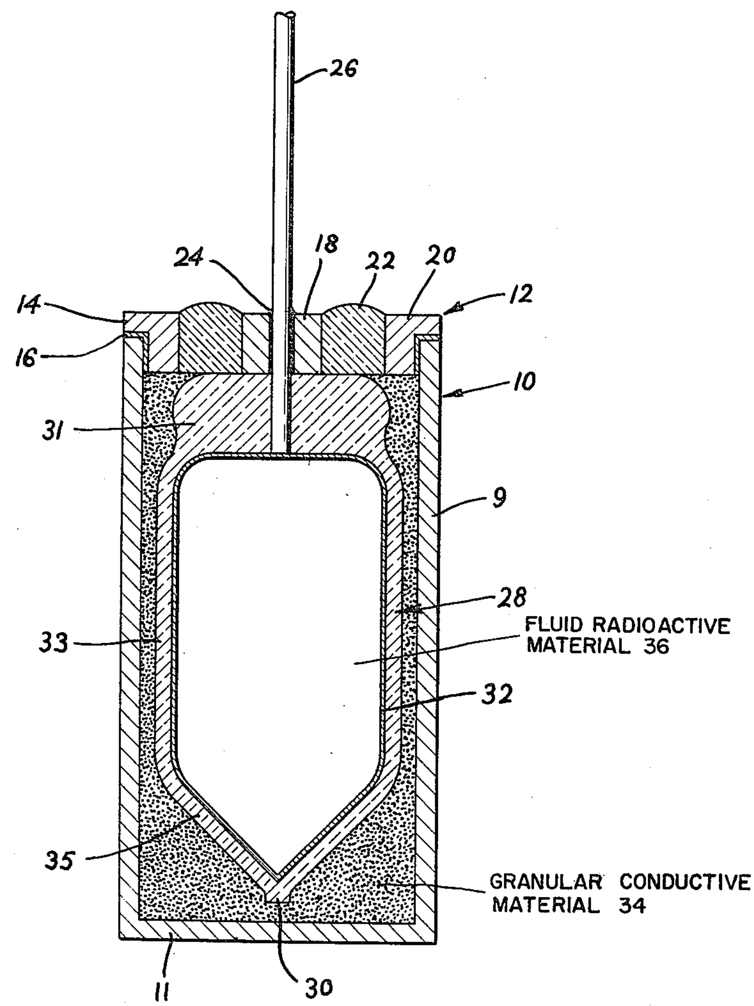

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RADIOACTIVE BATTERY

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The present invention relates to the generation of electrical energy and more particularly relates to an apparatus for utilizing the electrical energy of nuclear reactions.

Radioactive materials emit alpha or beta particles, or both in the course of their nuclear reactions. The alpha particles are positively charged and the beta particles are negatively charged and the energies of these particles may be several million electron volts. In the past, batteries have been made utilizing the radioactive material strontium 90 in the form of strontium chloride enclosed in a solid dielectric which in turn is enclosed in a collector case. Such batteries while highly efficient and normally safe for the personnel using them, do present numerous manufacturing problems due to the high toxicity of strontium 90. Therefore, great care must be taken in the manufacture of such prior art batteries, resulting in high manufacturing costs.

It is accordingly one object of the present invention to provide a compact and efficient device for utilizing directly the electrical energy from a nuclear reaction.

Another object of the present invention is to provide a device for utilizing directly the electrical energy of nuclear reactions wherein the electrons emitted from a radioactive material are collected in a highly efficient manner.

Another object of the present invention is to provide a device for utilizing directly the electrical energy of nuclear reactions that is dependable and which can be produced in large quantities at reasonable cost.

Another object of the present invention is to provide a device for utilizing directly the electrical energy from a nuclear reaction that is rugged and which will continue to function under extreme conditions of temperature and/or shock.

Another object of the present invention is to provide a device for utilizing directly the electrical energy from a nuclear reaction that can be safely manufactured and which will not endanger the health of personnel using it.

Another object of the present invention is to provide a device for utilizing directly the electrical energy emitted from a gaseous or fluid radioactive material.

Other objects of the invention will in part be obvious and will in part appear hereinafter.

The invention accordingly comprises the article of manufacture possessing the construction, combination of elements and arrangement of parts which are exemplified in the following detailed disclosure, and the scope of the application of which will be indicated in the claims.

For a fuller understanding of the nature and objects of the invention, reference should be had to the following detailed description taken in connection with the accompanying drawing which is a sectional view of a preferred embodiment of the present invention.

The device of the present invention for directly utilizing the electrical energy of a radioactive material will be referred to hereinafter as a radioactive battery. The present battery comprises a supply of radioactive material in liquid or gaseous form, preferably krypton 85 enclosed in a dielectric ampoule under normal or elevated pressures. Said ampoule in turn is enclosed in an electron collector can. An electrically conductive coating is provided on the inner walls of said ampoule and in contact

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with the radioactive material contained therein. A lead connected to said coating extends through said ampoule and said can and forms the positive terminal of the battery and the collector can forms the negative terminal.

Referring now to the drawing, one embodiment of the radioactive battery of the present invention comprises a cylindrical outer casing or can **10** of any suitable conductive material as, for example, brass, having cylindrical side wall **9** and flat bottom wall **11** of substantially the same thickness.

A dielectric glass envelope or ampoule **28** is enclosed in can **10**. The interior surface of ampoule **28** is provided with a conductive coating **32**, preferably silver fired on the glass forming said ampoule. The ampoule **28** has a cylindrical side wall **33** and conical bottom wall **35** of substantially the same thickness, said conical bottom wall terminating at point **30**. The upper wall **31** of ampoule **28** is thicker than side and bottom walls **33** and **35** and has a copper wire lead **26** extending through the center of and fused to said wall. The inner end of lead **26** is electrically connected to the conductive coating **32** and the other end of said lead extends a suitable distance outside of ampoule **28**. The ampoule **28** contains a fluid radioactive material **36**, preferably krypton 85, sealed in under normal or elevated pressures. A conductive filler **34** of any suitable material, as, for example, powdered metal or a low temperature melting alloy surrounds the glass ampoule **28** filling the space between the outer walls of the glass ampoule and the inner walls of casing **10**.

Whereas it is preferred that coating **32** be silver fired on said glass ampoule it will be understood that other convenient conductive coatings can be used, as for example, an evaporated metal coating or a tin sulphate coating. The silver coating **32** which is laid down by chemical means, results in an extremely thin film in the order of .0001 to .00001 inch in thickness. While this thickness is not sufficient to stop the beta particles or electrons, it is sufficiently conductive to serve the purpose for which it is intended. The purpose of this silver film is solely to permit conductivity of any space charges which might accumulate on the inner surface of the dielectric chamber to the emitter electrode. Also other fluid radioactive materials can be substituted for krypton 85, as for example the elements chlorine 36, xenon 133 or xenon 135 and the compounds of carbon 14 (any organic compound), or compounds of sulfur 35 (SO_2) etc. can be used.

A cap **12** closes the open end of case **10**. Cap **12** is comprised of bushings **18** and **20** made of anv suitable material, such as, brass and insulating ring **22**. Ring **22**, preferably formed from glass, is fused between bushings **18** and **20** to form a unitary closure. An axially located hole **24** through the bushing **18**, provides an opening through which the lead wire **26** extends. The lead wire **26** is sealed into hole **24** by solder and extends a suitable distance beyond cover **12**. The periphery of cap **12** is rabbeted to provide a plug-like portion **16** which fits inside can wall **9** and lip or flange **14** which extends over the upper edge of said wall **9**. Cap **12** is secured to casing **10** by means of a solder joint between plug **16**, flange **14** and wall **9**. The case **10** not only functions as a receptacle for the radioactive material, but also serves as the negative terminal of the battery.

The wall thickness of dielectric ampoule **28** is such that the electrons emitted from the radioactive material contained therein can pass therethrough and enter the conductive filler **34** and the collector casing **10**. However, said wall preferably is thick enough to prevent backscatter secondary electrons from either said conductive filler **34** or said casing **10** from passing back therethrough to the conductive coating **32**. The combined thickness of conductive filler **34** and the wall of collector casing **10** is such that all electrons that pass through dielectric envelope **28** are absorbed thereby thus preventing any of them from passing completely out of the radioactive battery.

The above described apparatus functions in the following manner. Electrons emitted by the radioactive material carried by ampoule **28**, pass through the thin-walled glass ampoule into conductive filler **34** and case **10** giving these two units a negative charge. At the same time the loss of the electrons from the radioactive material leaves it and conductive coating **32** with a positive charge. Therefore, when casing **10** and lead wire **26** are connected, electrical energy will flow from said casing **10** to conductive coating **32**.

A specific example of a device including the invention set forth herein was constructed with the components thereof having the following proportions:

Diameter of brass casing—7/16″
Overall height of casing excluding lead wire—1″
Wall thickness of casing—.040″
Wall thickness of glass ampoule—.020″
Conductive coating—silver film fired on glass
Material and particle size of conductive filler—aluminum powder 200 mesh
Radioactive material—krypton 85—2 curies

The battery thus constructed used the kinetic energy of the beta particles emitted from the radioactive material to build up to an open circuit equilibrium voltage of approximately 10,000 volts and delivered approximately 2 millimicroamps current.

The current delivered by radioactive batteries incorporating the present invention will depend on the quantity of radioactive material employed and will amount to approximately 1 millimicroamp for each curie activity. However, the ampere output of such a battery will not increase at this rate after 10 curies of radioactive material is exceeded due to self-absorption.

The radioactive battery of the present invention has been described herein as employing a sealed glass dielectric ampoule with an electrically conductive coating on the inner surface thereof. It should be pointed out however that a sealed metallic container for the radioactive material may be substituted and said container covered with some suitable insulation, as for example, polystyrene.

Since certain changes may be made in the above article of manufacture without departing from the scope of the invention herein involved, it is intended that all matter contained in the above description or shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. A radioactive battery comprising a dielectric ampoule having a conductive coating on its inner surface, a conductive casing including said ampoule, a conducting lead in electrical contact with said conductive coating, dielectric material defining a seal for said battery, said conducting lead extending through said dielectric material and out of said casing, and a fluid radioactive material in said ampoule, said dielectric ampoule being permeable to charged particles emitted by said radioactive material, said ampoule being spaced from said casing and having a granular conductive material in said space, said dielectric ampoule being permeable to charged particles emitted by said radioactive material but absorbing backscattered radiation.

2. A radioactive battery comprising an ampoule formed from dielectric material, a conductive coating on the inner surface of said ampoule, a conductive casing enclosing said ampoule, a conductor connected to said conductive coating and extending through said ampoule and out of said casing, insulating means separating said conductor from said casing, and a fluid radioactive material in said ampoule, said ampoule being permeable to charged particles emitted by said radioactive material, said ampoule being spaced from said casing and having a granular conductive material between said ampoule and said casing.

3. A radioactive battery comprising a sealed container formed from conductive material and having a fluid radioactive material therein, a dielectric enclosure surrounding said container, a conductive casing enclosing said dielectric enclosure and a conductor connected to said sealed container of conductive material and extending through said dielectric enclosure and said casing, insulating means separating said conductor from said casing, said dielectric enclosure being permeable to charged particles emitted by said radioactive material, said dielectric enclosure being spaced from said casing, said battery including a granular conductive material between said enclosure and said casing, said dielectric enclosure absorbing backscattered radiation reflected from said granular conductive material.

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