UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

May 20, 1994

The Honorable Amo Houghton
United States House of
Representatives
Washington, D.C. 20515-3231

Dear Congressman Houghton:

I am responding to your letter of April 12, 1994, to Ms. Elizabeth Cecchetti of the U.S. Department of Energy, which was forwarded to me for response. In your letter, you asked for suggestions to aid your constituent Virginia Russell, in marketing the use of specially designed nuclear shielding which could dissipate the absorbed energy from radioactive emissions as electricity.

As an independent regulatory agency, the U.S. Nuclear Regulatory Commission does not promote the commercial development of individual technologies. However, without making any judgment as to the merit of Ms. Russell's idea, I suggest that your constituent contact a technical consultant or business manager familiar with the nuclear material or power generating industries. These sources should be familiar with current industry practices and requirements for designing shielding for shipping and storage casks, and other shielded nuclear components. Some professional organizations that may be helpful to your constituent in finding such a consultant or business manager include the American Nuclear Society (ANS), the Electric Power Research Institute (EPRI), or the Nuclear Energy Institute (NEI).

I trust that this reply has been helpful.

Sincerely,

James M. Taylor
Executive Director
for Operations

CC32

Department of Energy
Washington, DC 20585

APR 29 1994

The Honorable Amo Houghton
U.S. House of Representatives
Washington, D.C. 20515

Dear Congressman Houghton:

This will acknowledge your recent letter in which you referred a letter from your constituent:

Virginia Russell

Because the subject of your constituent's letter does not fall within the purview of the Department of Energy, we have forwarded your letter to:

Mr. Dennis K. Rathbun
Director
Office of Congressional Affairs
Nuclear Regulatory Commission
Washington, D.C. 20555

Sincerely,

Bonnie Betancourt

Bonnie Betancourt
Director of Special Projects
Office of the Executive Secretariat

AMO HOUGHTON
31st District, New York

COMMITTEE
COMMITTEE ON WAYS AND MEANS
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April 12, 1994

Ms. Elizabeth Ann Cecchetti
Assistant Secretary for Congressional and Intergovermental Affairs
Energy Department
Forrestal Building
1000 Independence Avenue, S.W.
Washington, D.C. 20585

Dear Elizabeth:

A constituent of mine, Virginia Russell has an idea to save taxpayers money and help the environment.

Her idea is to use special nuclear shielding to absorb emissions (she's worried about radioactive atoms giving off dangerous emissions) and convert them to electrical energy. She has three patents to back up her proposal. Now, she's looking for some help in marketing her idea.

Do you have any suggestions I could pass along? Thanks. I look forward to hearing from you.

All the best,

Amo Houghton

AH/ss
Enclosure

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FEB 07 RECD
CD

435 Crescent Ave.
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February 5, 1994

Hon. Chairman Marilyn Lloyd
Subcommittee on Energy, Space, Science, & Technology
House of Representatives, Washington DC

Copies to some members of Congress

Dear Chairman :

I just read the December 1993 GAO report on NUCLEAR WASTES-DEVELOPING TECHNOLOGY TO REDUCE RADIOACTIVE WASTE MAY TAKE DECADES AND BE COSTLY

May I add a comment, that Chemical Transmutation, to which they are referring, does not address the problem of nuclear wastes. The radioactive atoms continue to give off dangerous emissions regardless of their chemical or physical form. THE PROBLEM IS THE EMISSIONS. THEY MUST BE TREATED, NOT THE EMITTERS. They used 6 feet of Concrete shielding at Chernobyl, but when they looked inside, the emissions had reduced the second floor and other structures to radioactive dust and had also severely damaged the shielding. Now they are worried that the radioactive dust will escape and make matters far worse than before.

Radiations are Energy and Energy is always conserved. The wastes can however be surrounded with shielding that absorbs the emissions and converts it to electrical energy which is electrically connected through an outside load with parts of the circuit that have absorbed relatively little emissions energy, thus creating a potential difference.The electricity produced is safely consumed, safely stored or transformed to safer forms of radiation. This process is a source of electricity but the real purpose is that it disposes of the emissions thus protecting the shielding, the environment and personnel.

I am enclosing a sheet of specifications for the process and 3 patents describing it. I will be happy to provide this same material for any members of your committee or of the Congress, if you will send me the number you would like or the names of members who should be interested. Any member interested in reducing the deficit or providing funds for health care, crime prevention, disaster relief, entitlement reform, education etc. should be interested. This process will save the government vast sums of money, and make the public happier, safer and healthier. It can also be put into effect very quickly.

Yours truly,

Virginia Hillis Russell

DESCRIPTIUN OF RUSSELL PROCESS AS APPLIED TO NUCLEAR WASTES

It is still customary to confine the energy of the emissions from nuclear wastes within the shielding. At Chernobyl, after the nuclear accident, which even effected Antarctica, they built a tremendous sarcophagus to enclose the radioactive site. But the structures inside are crumbling into radioactive dust and the sarcophagus itself is threatened because the emissions keep attacking the structures. Just surrounding radioactive material, is not sufficient - it is necessary to dispose of the energy of the emissions as our process does. And it is not sufficient to cool the wastes, allowing contact with the air, because when heat is escaping, other more harmful radiation may also be escaping. In general our process for nuclear wastes will:

Absorb alpha rays in conductive shielding near the Source of radiation and create a potential difference with other parts of the circuit that absorb more beta and gamma radiation.

Insulate and add other layers of conductive shielding that create a potential difference between layers that absorb more of the radiation striking them and parts of the circuit that absorb less radiation thus creating a potential difference. Materials absorb more if they are of material that is appropriate to the frequency of radiation striking them, nearer the source, thicker, rougher or honeycombed. The purpose however, is NOT to build up voltage between different parts of the circuit, as in nuclear batteries: it is to DISPOSE OF THE ELECTRICAL ENERGY AS IT IS CREATED THUS PREVENTING BUILD-UP OF VOLTAGE AND HEAT AND DISPOSING OF THE HARMFUL EMISSIONS AND PROTECTING THE ENVIRONMENT. Potentially harmful emissions are being constantly released from the radioactive material, and if they are not absorbed, and carried outside the shielded area, and controlled, they attack the container and its contents, and create nuclear accidents. At Chernobyl, for example, there is now a danger that not only harmful emissions, but radioactive dust may be released. If the emissions are controlled and consumed they cannot do harm INSIDE the shielding or OUTSIDE.

Therefore, construct a circuit with appropriate insulation to conduct the energy of the potential difference outside the shielded area where it is consumed as produced. Connect the relatively more positive parts of the circuit through a load and an automatically variable resistance with the relatively negative parts of the circuit. .The automatic resistance may include monitoring the current being produced and the temperature. It can automatically introduce additional loads at certain levels. If the shielding is being used around active nuclear reactors, it can also introduce warning signals as current increases, and at a certain level can automatically shut down the plant. This type shielding should be used around all the electrical system including connecting wires.

∵ Consuming the electricity includes, using it, feeding it safely back into the system, storing it, and transforming it into safer forms such as light. There are literally millions of uses for the small but continueing current being produced. However the production of a small but continueing amount of electricity is an insignificant value compared to the environmental value and the cost of not disposing of the emissions.

SPECIFICATIONS FOR SHIELDING EMISSIONS OF
NUCLEAR WASTES AND RADIATION EMITTING DEVICES

Following is an application of the new process. First are notes that apply generally, and then steps in the process.

"Consuming" is used in the broadest sense and includes immediately using the electrical energy, converting it to safe forms, storing it ,transporting it away from the shielded area and storing it, setting off warning or shut-off devices, or safely feeding it back into an electrical system.

Conductive layers may be alloys or composites .

The automatic variable resistance in the circuit introduces sufficient load(s) to consume the energy produced and prevent build-up inside shielded area and to prevent release of harmful emissions to the environment.

Figure 1 is a schematic of one embodiment for shielding nuclear wastes:

1. In this embodiment 1 is Nuclear Wastes which are shielded and contained by (2)

2. This layer surrounds nuclear wastes. It is of relatively low density very conductive material which contains LOW DENSITY metals such as aluminum, sufficiently thick to stop most alpha particles but thin enough to transmit most beta particles and which is rough and honeycombed on the side facing the Source. The energy of alpha particles that are absorbed is converted to positive electricity relative to other parts of the circuit such as (4) , which absorbs more negative energy, thus causing an electrical potential difference between them. Conduct this more positive electrical energy to a terminal outside the shielded area in an insulated circuit.

3. Add a layer of dielectric (3) outside, which can be air, films, solids or other dielectric, thick enough to electrically isolate (2) from (4), and surround leads with dielectric.

4 . Surround (3) with a rough honeycombed layer of conductive material which is a good absorber of the radiation striking it and of lower density than (6). This layer should be thick enough to absorb beta rays and absorb or slow down radiation striking it. It is an absorbing layer and produces more negative electrical energy than layers (2) or (6) . Conduct the electrical energy to the more negative terminal outside the shielded area.

5. Add dielectric outside (4) as described in (3)

6. Surround (5) with a very thin smooth layer of conductive material denser than in (2) and (4) Emissions of lower Energy will be reflected back to (4) where they may be absorbed, and emissions of very high Energy may be transmitted to (8), the next absorbing layer. This layer(6) will absorb very little radiation and be positive relative to the absorbing layers.

7. Add dielectric outside (6) as in (3)

8.Add a thick layer similar to (4) of conductive material which will absorb the emissions striking it. It will be negative relative to (2) and (6).

Test for radiation still being emitted and add layers that will absorb such radiation. The emissions have successively lower energy as they go through the different layers and metals like Aluminum or even Beryllium may be useful. Always insulate layers and wires.

. An electrical potential will be created between more positive parts of the circuit such as (2) and (6), and more negative parts of the circuit such as (4) and (8). Conduct the electrical energy between the more negative and more positive parts of the circuit through a load and a variable resistance and safely consume it, feed it back into the system, transform it, or store it, thus disposing of the emissions and creating a little useful electricity. The value of the electricity however is minimal compared to the value of protecting the environment, personnel and equipment.

Automatic warning signals may also be included and even means for shutting down a nuclear reactor, when the current or heat show dangerous levels.

Space should be left to add additional shielding as needed if time reduces the efficiency of the shielding.

When tests show no radiation being released for a safe period of time, valuable materials left can be recycled and used, because the radioactivity is gone.

FIGURE 2. - BLANKET APPLICATION

In emergencies and in many permanent applications the shielding can be in the form of a flexible blanket. Figure 2 is a Schematic of the blanket form. Number 9 represents radioactive matter just as Number 1 does for Figure 1 and the other layers follow consecutively. Where the radiation does not contain alpha particles 9 and 10 can be omitted.
Additional blanket material can be added at any time when radiation is escaping, and it can take any form.

APPLICATION IN NUCLEAR POWER PLANTS

Nuclear power plants can use layers of shielding as described above, which control unwanted emissions. This shielding can be around the nuclear reactor itself, and/or in the walls ceiling and floor of the room. The conductive materials used will depend on the frequency of radiation to be absorbed, and will be of greater density when near the reactor. They will be connected to, and turn on warning systems when they produce a certain level of electrical energy. If they reach a higher, limiting level of electrical energy, they can be connected to and turn on shut-down devices. The connections should be insulated with this-type shielding.

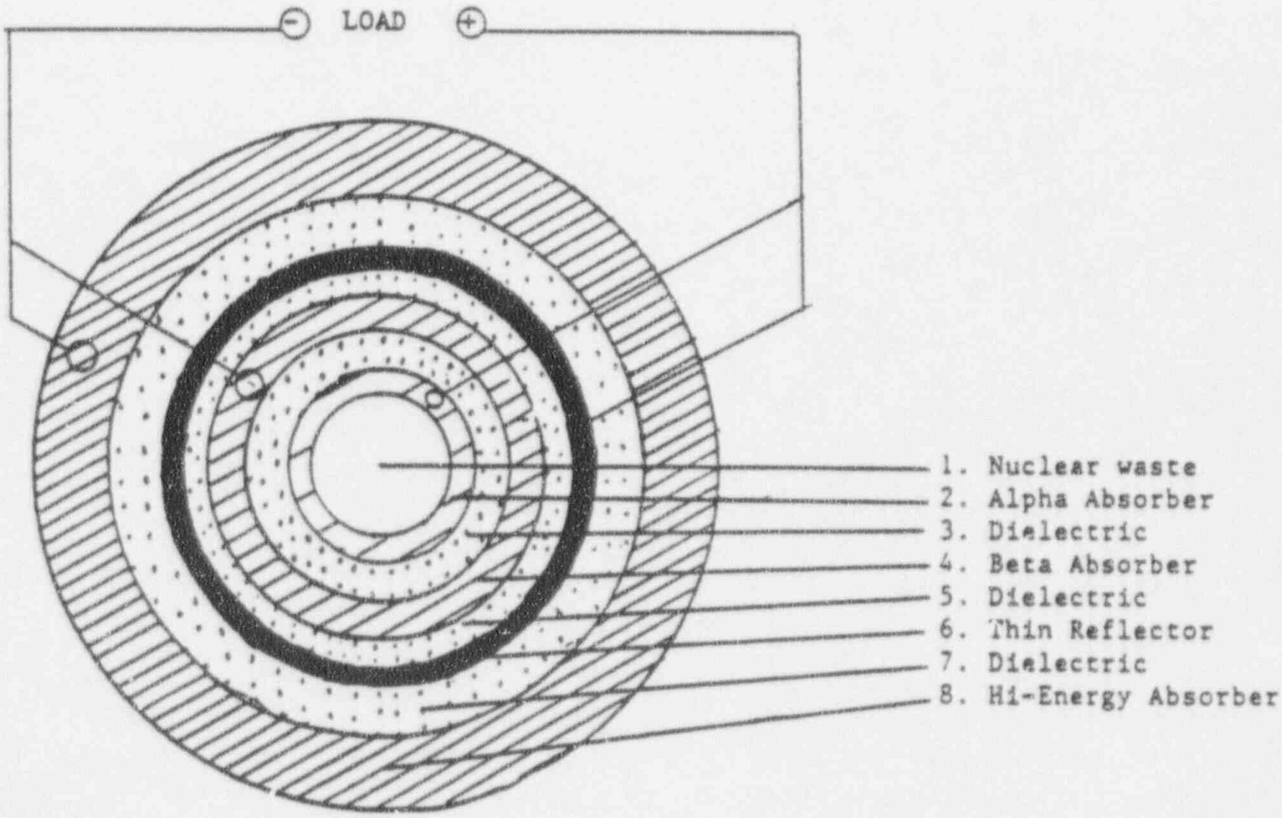
APPLICATION TO ELECTRIC POWER LINES

In Electric Power lines the major Source of radiation is the principal conductors(s) (usually copper) which carries most of the current. The central wire is surrounded by shielding as described.Where there are no alpha particles, steps 1 and 2 can be eliminated. The energy produced in the shielding is conducted away in a thoroughly insulated circuit through a load which may constitute feeding it back into the primary system. If it is grounded there should be a load between the collectors and the ground, and the electrical energy produced should be consumed to prevent drying out and charging of the Earth..Diodes and other devices must prevent feed-back to the absorbers from the primary system, so power is not drawn from the lines. If this is happening, the power from the radiations can be stored elsewhere with diodes to prevent back-flow,and later fed into the system, or otherwise consumed.

APPLICATION TO ELECTRIC AND ELECTRONIC DEVICES

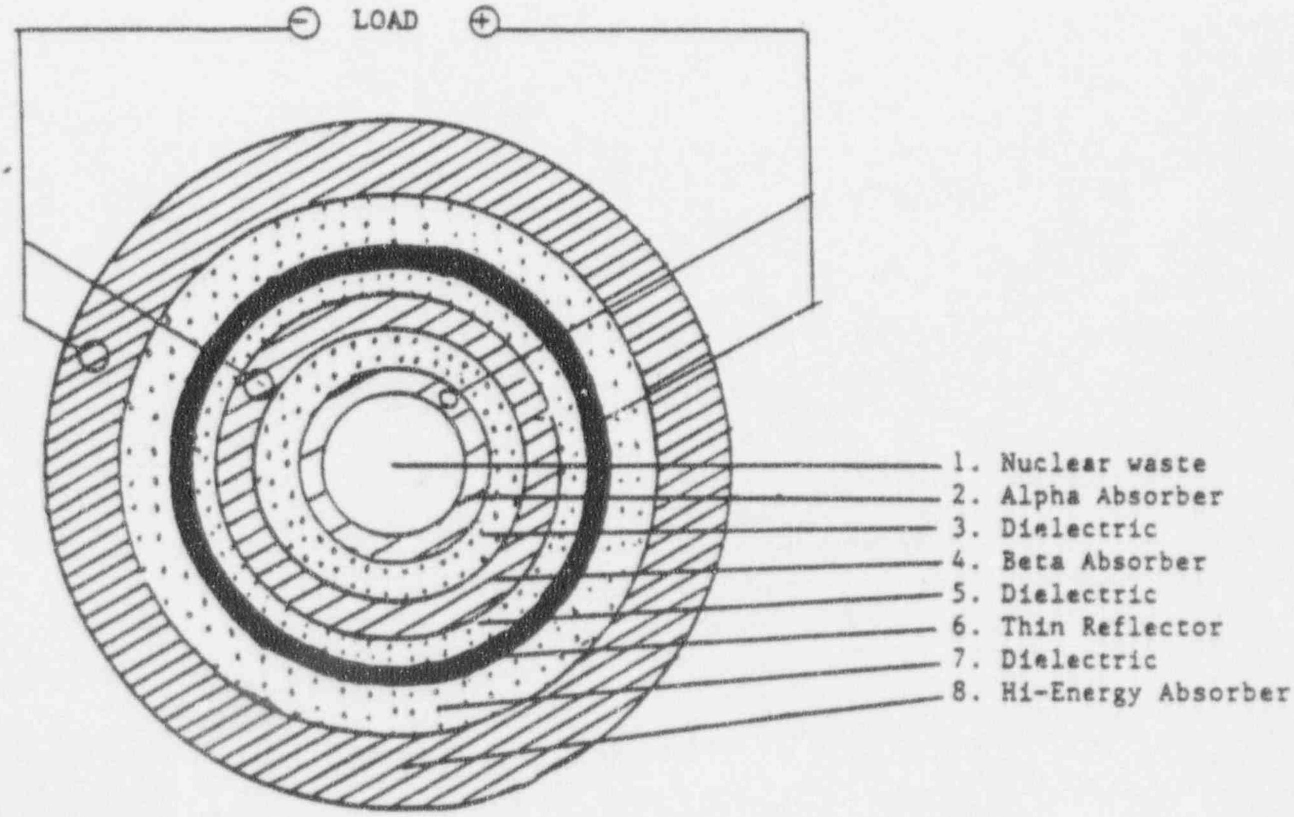
A more simple form of this invention can be used around electric and electronic devices, wherein conductive layers absorb the radiation striking them and create a potential difference between such layers and another part of the circuit, and conduct this electrical energy outside and feed it back into the system or otherwise safely control it.

FIGURE 1



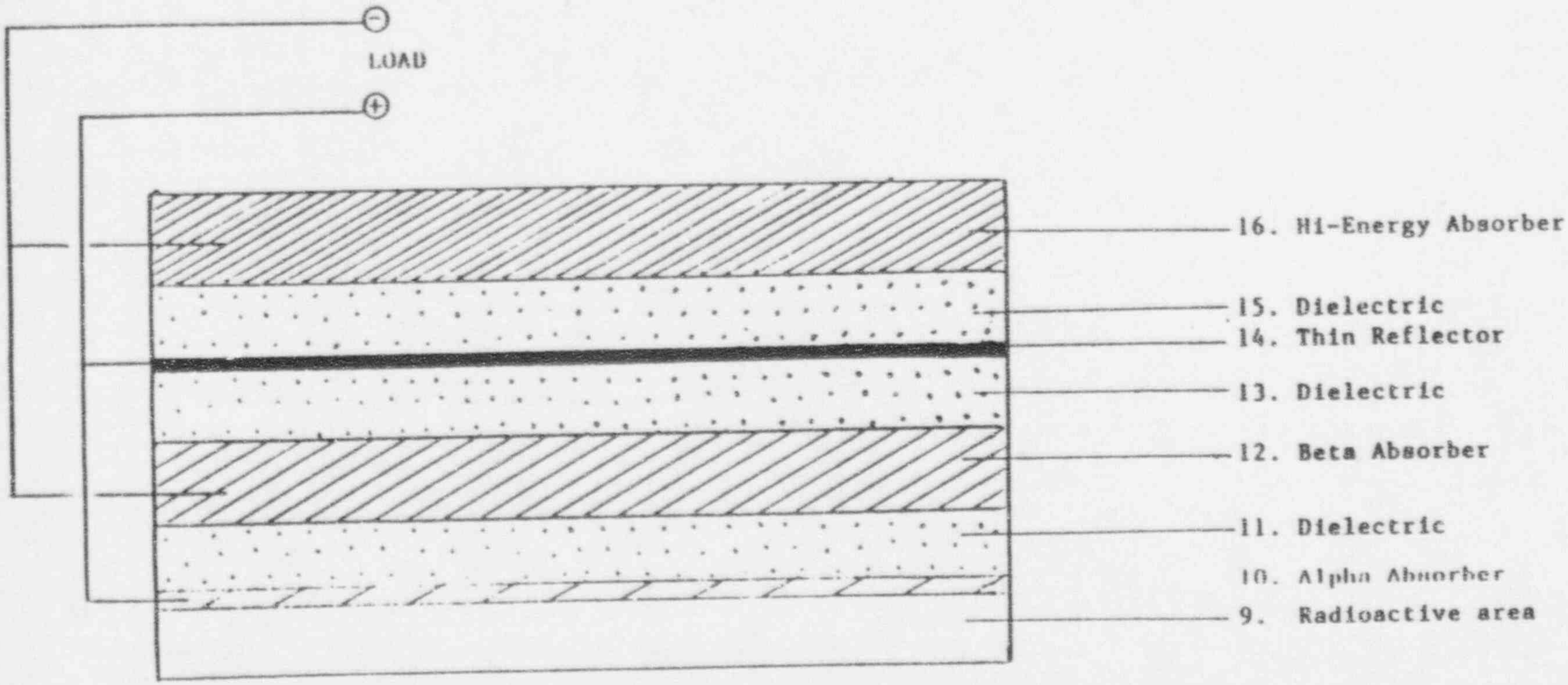
Additional layers to be added appropriate to emissions

FIGURE 1



Additional layers to be added appropriate to emissions

FIGURE 2



additional layers to be added appropriate to emmissions

US005149494A

United States Patent [19]

Russell

[11] Patent Number: 5,149,494

[45] Date of Patent: * Sep. 22, 1992

[54] PROTECTING PERSONNEL AND THE ENVIRONMENT FROM RADIOACTIVE EMISSIONS BY CONTROLLING SUCH EMISSIONS AND SAFELY DISPOSING OF THEIR ENERGY

[76] Inventor: Virginia Russell, 435 Crescent Ave., Buffalo, N.Y. 14214

[*] Notice: The portion of the term of this patent subsequent to May 5, 2004 has been disclaimed.

[21] Appl. No.: 327,418

[22] Filed: Mar. 22, 1989

Related U.S. Application Data

[63] Continuation of Ser. No. 30,041, Mar. 24, 1987, abandoned, which is a continuation of Ser. No. 426,824, Sep. 29, 1982, Pat. No. 4,663,115, which is a continuation-in-part of Ser. No. 933,529, Aug. 14, 1978, abandoned, which is a continuation of Ser. No. 781,503, Apr. 13, 1977, abandoned.

[51] Int. Cl.[5] G21D 7/00

[52] U.S. Cl. 376/320; 376/321; 310/304; 136/253

[58] Field of Search 376/320, 321; 310/304; 136/253

[56] **References Cited**

U.S. PATENT DOCUMENTS

2,847,585	8/1958	Christian	376/320
3,219,849	11/1965	Webb	376/320
3,591,860	7/1971	Sampson	376/320
4,663,115	5/1987	Russell	376/320

FOREIGN PATENT DOCUMENTS

1103076	4/1961	Fed. Rep. of Germany	376/320
1330926	6/1963	France	376/320
900056	7/1962	United Kingdom	376/320

Primary Examiner—Donald P. Walsh

Attorney, Agent, or Firm—Burns, Doane, Swecker & Mathis

[57] **ABSTRACT**

An apparatus for protecting personnel and the environment from harmful emissions of radiation from a source thereof includes a plurality of shielding parts so located as to be in the path of the radioactive emissions and to absorb them (one such part being located farther away from the source of emissions than the other) so that an electrical potential difference between the shielding parts is established, due to different absorptions of radiation by them, means for consuming electrical power at a location remote from the radioactive source, and electrical conductors communicating the consuming means (or load) with such shielding parts. Although the invention is primarily intended for protecting personnel and the environment against emissions from radiation sources, such as radioactive wastes, it is also useful for shielding other sources of harmful radiated emissions. Also within the invention are processes for protecting personnel and the environment against radiation hazards.

5 Claims, 2 Drawing Sheets

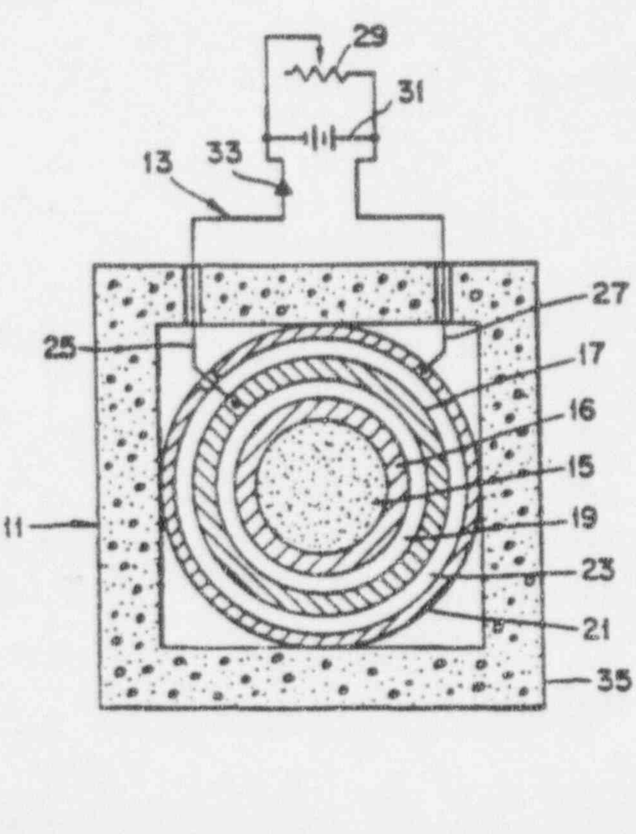


Fig. 1

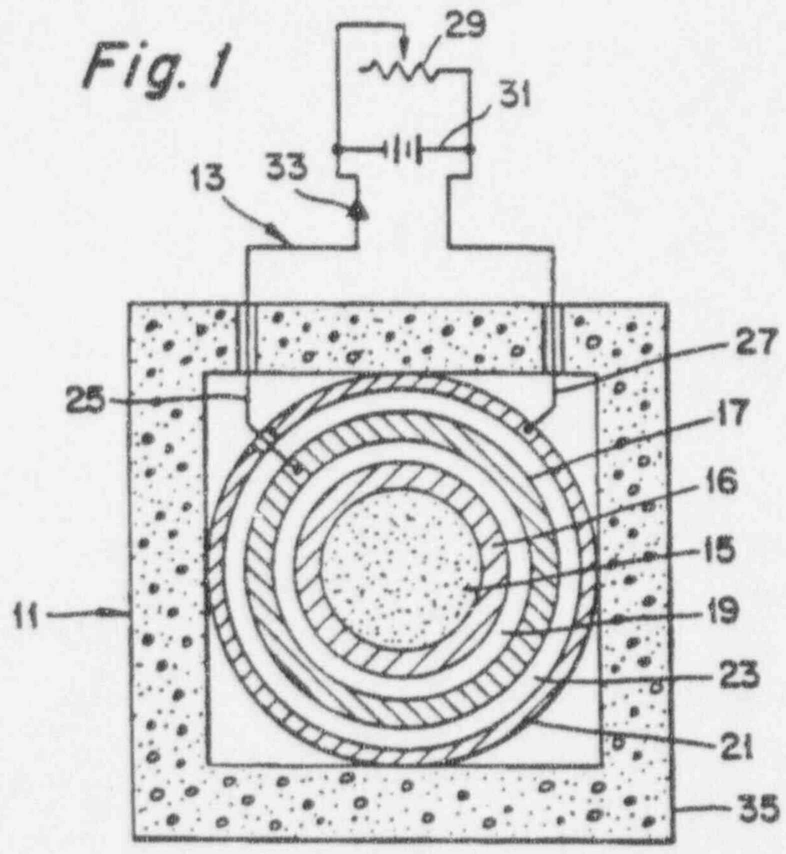

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Fig. 2

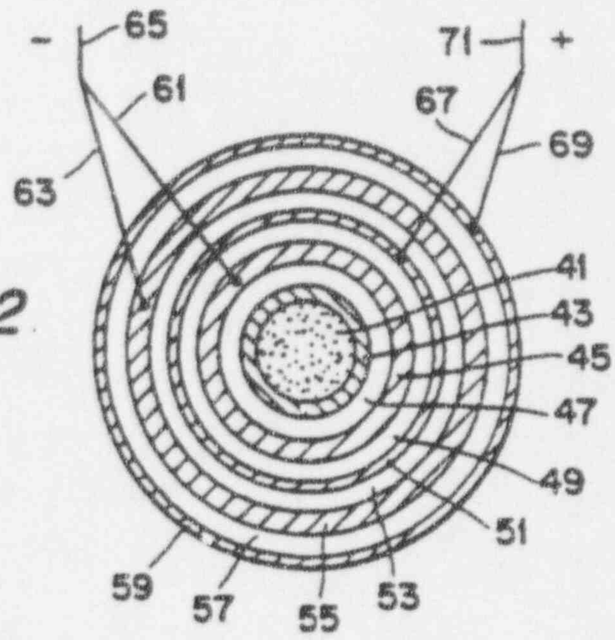
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Fig. 3

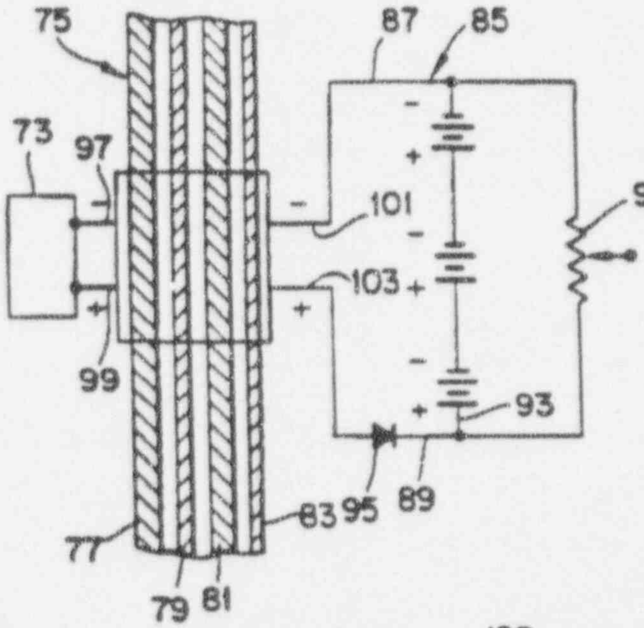
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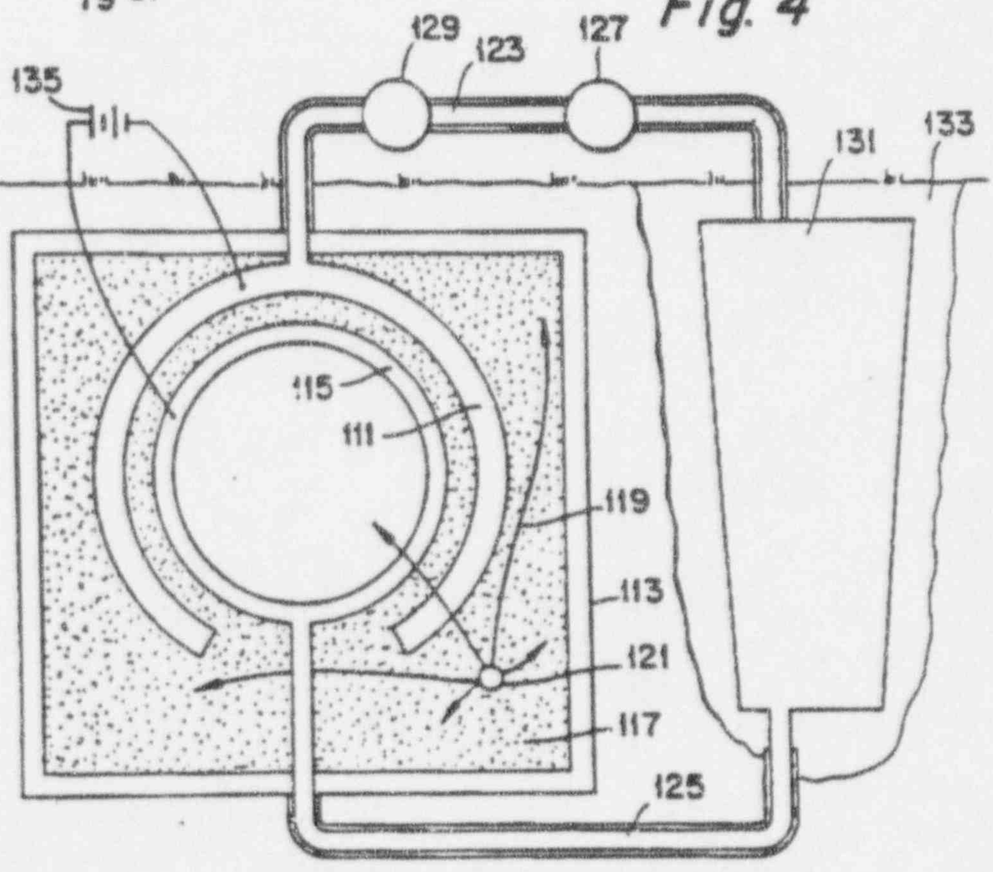
Fig. 4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PROTECTING PERSONNEL AND THE ENVIRONMENT FROM RADIOACTIVE EMISSIONS BY CONTROLLING SUCH EMISSIONS AND SAFELY DISPOSING OF THEIR ENERGY

This application is a continuation of application Ser. No. 030,041 filed Mar. 24, 1987, abandoned, which is a continuation of Ser. No. 426,824 filed Sep. 29, 1982, now U.S. Pat. No. 4,663,115 issued May 5, 1987, which is a continuation-in-part of Ser. No. 933,529 filed Aug. 14, 1978, abandoned, which in turn is a continuation of Ser. No. 781,503 filed Apr. 13, 1977, abandoned.

This application relates to an apparatus for protecting personnel and the environment from emissions of harmful radiation, such as radioactive emissions emanating from radioactive waste. More particularly, it relates to such an apparatus which includes a shielding part or parts so located as to be in a path of the radiated emissions and to absorb such emissions, at least in part, so that the electrical potential of the shielding part will be changed, and electrically conductive means for connecting such shielding part with a sink through an electrical load so as to consume the electrical energy generated and so as to remove the electrical charge from the shielding part, thereby enabling such part better to absorb additional radiation, and helping to stabilize the material of such part and prevent potentially explosive buildup of energy therein. The invention also relates to processes for protecting personnel and the environment from radiation.

For many years intensive efforts have been made to protect personnel and the environment from harmful radiations from various sources and in recent years extensive research has been performed in an effort to reduce the harmful effects of various radioactive wastes, especially mixed wastes, such as those from spent fuel rods used for power generation, and those known as "weapons wastes". Various treatments of such nuclear wastes that have been tried include calcining, gas diffusion, concentration, solidification, fusion and incorporation in vitreous matrices, synthetic organic polymers or inorganic sorbents. After concentration and "solidification" in a suitable matrix, as described above, such wastes are transported to disposal sites, such as salt domes, and are buried therein. Although such treatments and storage may seem to be comparatively safe, there is always the possibility that radiation and heat released by the decaying radioactive material will fracture the matrix, and earth movements and water flows could carry released radioactive materials away from the disposal site, to areas where they may be harmful to humans, animals, fish and the environment in general. The present invention provides a means for converting at least a portion of the harmful radiation from radioactive wastes (and from other sources of harmful radiated emissions) to environmentally acceptable, safe, and often useful form, and it does this at relatively low voltage and low temperature so that any danger of explosion is minimized. Thus, harmful radiation is converted to useful electrical power, although the object of this invention is to protect the environment, rather than to produce power. The removal of electrical energy from the radiation absorbing means of this invention promotes further absorption of such radiation and also improves the resistance of the absorbing means to deterioration by radiation. Utilization of pairs of electrically conductive absorber-converters in paths of the radiation, which absorbers are connected to a load to draw off electrical charges therefrom, is preferred, and the employment of pairs of such absorbers, connected to common conductors to carry electricity to the load, is a further preferred mode of the invention.

In accordance with the present invention an apparatus for protecting organisms and the environment from harmful emissions of radiation from a source thereof by shielding said organisms and the environment from at least a portion of such emissions comprises a plurality of shielding parts located so as to be capable of absorbing radiation emissions from the source thereof, with one such part being located farther away from the source than the other and with the shielding parts both being in the path of the same emissions, so that an electrical potential difference between such shielding parts is established, due to different absorptions of radiation by them, and electrical conductors communicating with such shielding parts and transmitting such difference in potential to a means for consuming electric power located remote from the radioactive source. In preferred embodiments of the invention the shielding parts are of electrically conductive materials, such as metals of different atomic numbers, separated by an insulator, e.g., epoxy resin, ceramic, mica, glass, air and means are present to induce initial charging of the shield(s) and to produce the resulting electric current. Also, it is often preferable for the shielding members to be in roughly spherical form and for pluralities of pairs of such shielding members to be used so that radiation passing through the first set(s) of members may be absorbed by subsequent set(s). In a broader aspect of the invention an electrically conductive shield acts to collect energy from harmful radiation and discharges such energy through an electrical load. The invention also relates to various processes for protecting humans and the environment and for reducing radioactivity.

The closest references known to applicant include U.S. Pat. No. 3,939,366 (Ato et al.) and U.S. Pat. No. 4,178,524 (Ritter) and an article in Chemical and Engineering News, Vol. 32, No. 7, at p. 592 (Feb. 15, 1954), all of which are references that were relied upon by the Patent Examiner during the prosecution of Ser. No. 933,529. The Ato et al. patent teaches the direct generation of electricity from radioactive materials by means of semiconductors. The Chemical and Engineering News article mentions a semiconductor crystal with an impurity in it to form a junction similar electrically to a junction in a junction transistor and mentions strontium-90 as a source of radiant energy. The Ritter patent is for a radioisotope photoelectric generator to produce electrical energy at a high voltage, e.g., 25,000 volts. Ritter intentionally builds up potential difference while in accordance with the present invention such build-up is prevented. Ritter specifies that his photon-producing radioactive source of energy must be a source of energy less than 1 million electron volts and Ritter teaches the use of pure isotopes, rather than mixtures of different radioactive materials, such as are found in nuclear wastes. A very significant distinction between Ritter and the present invention is in the fact that Ritter is attempting to produce electricity and the object of the present invention is to protect personnel and the environment from radioactive emissions. Ritter does not teach varying resistance to consume the energy of the emissions and his "load" may not be sufficient to handle a burst of energy. Ritter does not mention such protective function for his apparatus and the lead shielding of the Ritter apparatus, which has no part in the electrical functions thereof, is the means by which he prevents harmful radiation from the radioactive source from reaching any personnel and the environment. Certainly, the environment is not protected by Ritter's "battery". Thus, it is seen that the present invention is novel, useful and unobvious from the "prior art" mentioned. It is not conceded that the Ritter patent is part of the prior art, in view of applicant's conception of the invention at a date prior to Sep. 1, 1976, the filing date of the Ritter et al. parent application Ser. Nos. 719,532, and applicant's claimed diligence until the filing of her grandparent application on Apr. 13, 1977 (papers deposited on Mar. 24, 1977).

The invention will be readily understandable from the following description, taken in conjunction with the drawing, in which:

FIG. 1 is a schematic representation, substantially like a central vertical sectional view, of an apparatus of this invention;

FIG. 2 is a front vertical sectional view of a modification of a portion of the apparatus shown in FIG. 1;

FIG. 3 is a schematic representation of a modified apparatus of this invention, partially in cross-section, in which plural shielding apparatuses are employed to consume the energy of radioactive material; and

FIG. 4 is an elevational view, partially in cross-section, of another embodiment of the apparatus of this invention.

In FIG. 1 numeral 11 represents the emissions absorbing portion of an apparatus of this invention, and the remainder of the apparatus, for carrying off and consuming the energy generated in portion 11, is designated by numeral 13. In portion 11 radioactive waste material 15, suitably shaped in spherical form (although other forms may also be employed and held in a suitable interior container 16, preferably of compatible material, is positioned inside an inner spherical shell of electrically conductive material (such as aluminum), and is separated from such material by dielectric 19, which may be a suitable dielectric, solid or gaseous, e.g., alumina, mica, air. An enveloping sphere 21 surrounds sphere 17 and is separated from it by dielectric 23. Sphere 21 is preferably of an electrically conductive material, such as a metal of higher atomic number than the material of sphere shell 17. Suitable such materials are copper and silver, with copper normally being preferred, but other metals may also be used. When solid dielectrics are utilized they may be the sole means for separating the spheres but when gaseous dielectrics, such as air (or a high vacuum) are employed, mechanical means (not shown), preferably of electrically insulating material, will be employed. Electrical conductors 25 and 27, which will usually be insulated copper, and/or silver wires, conduct electricity to a variable resistance 29 and/or a battery 31. Diode 33 is provided to act as a check switch on current flow, preventing battery 31 from delivering electricity to part 11 of the apparatus. Other switches (not shown) may also be provided to separate the variable resistance and the battery from the rest of the system, if desired, and the variable resistance may be made automatically variable to draw a relatively small current, due to the difference in the electrical potentials of the spherical shells 17 and 21, drawing more current when the potential difference is sufficiently high and being of decreased resistance so as to allow and promote current flow when the potential difference is lower. Also, means may be provided for automatically reversing the polarity of the battery so as initially to stimulate or induce electrical current flow between spherical shells 17 and 21.

While spherical shells are shown, these may be of other suitable shapes, such as cylindrical, cubical, tetrahedronal and ellipsoidal too, and in some instances the shells may desirably be perforated to allow release (through suitable absorbers or safety means, not shown) of gaseous materials generated from the radioactive waste or generated by expansion of gases present, as heat is released from the waste. Sometimes the inner shells may be perforated to permit some radiant energy flow through such openings, as when plural pairs of shields or electrodes are employed, e.g., 4 to 200 concentric metal spheres, with separating dielectrics. In the illustration a single apparatus is illustrated but banks of such devices may be connected together, with the current produced flowing through single or multiple resistances and/or being employed to charge one or more batteries.

In FIG. 1 the nuclear waste is in a suitable metal container 16 but it is contemplated that other materials of construction may be employed and sometimes it can be omitted Concrete enclosing container 35 encloses the waste, the container for the waste, and the pair of spherical shells of electrically conductive material, but other suitable exterior containers may also be utilized.

While this invention is not bound or limited by the following theory of operation, it is considered that alpha particles emitted by the radioactive waste (which usually is a complex mixture of various radioactive isotopes) tend to make the charge of the first metal absorber positive whereas beta particles and gamma rays, being more penetrating, tend to make the charge of the next contacted electrically conductive material negative, as illustrated in FIG. 1. When plural pairs of absorbers are employed the metals of low density will tend to be negative relative to the high density metals. Metals of low density, if sufficiently thick, will react with more beta particles reaching them than will metals of higher density because the high density metals, if sufficiently thin, will reflect some of the lower frequency radiation back to the more absorbing low density metal and transmit some to the next set of shielding levels. If the wastes emit gamma rays there should be several layers of combinations of insulator, low density conductor, insulator, high density conductor, etc. For example, aluminum and copper may be employed, as may be other metals and alloys, and combinations of metals (or alloys) outside the ranges specified in the Ritter patent. Magnesium, aluminum and/or titanium may be employed as the low atomic number metal, together with vanadium, chromium, manganese, iron, cobalt, nickel, copper or zinc as the higher atomic number metal. Similarly, magnesium or aluminum may be used with titanium. Also, for example, vanadium, chromium, manganese or iron may be used with cobalt, nickel, copper or zinc, with preference being to employing such combinations with atomic numbers further apart within such groups. Other such combinations that are useful include vanadium, chromium, manganese, iron, cobalt, nickel, copper or zinc with molybdenum, silver, tin, platinum, gold, mercury and/or lead. In some applications alloys or amalgams may be employed. Also, with respect to the higher atomic number materials, silver, cadmium and tin may be used with lead.

Thus, while, within the broader aspects of this invention it is possible to utilize as the absorber or shield materials metals with atomic numbers below 23 in combination with those of atomic numbers above 46, it is also possible to utilize combinations of metals outside such ranges and still obtain the radiation absorbing and energy consuming effects desired.

In FIG. 2 heterogeneous nuclear waste 41, in a suitable metal container 43, is surrounded by concentric absorbing materials and dielectrics, all of which are in spherical shape conforming to the shape of waste 41 and container 43. Thus, between the container for the radioactive waste and the first radiation absorbing sphere 45 of electrically conductive material there is a dielectric layer or sphere 47 and subsequently, in order, about the sphere 45 are a spherical layer 49 of dielectric, another absorbing sphere 51 of electrically conductive material, another dielectric layer 53, another metal layer 55, a dielectric layer 57 and an outer metal layer 59. Spheres 45 and 55 are of aluminum or copper, as shown, and spheres 51 and 59 are of copper or lead, respectively. The same dielectric, mica, alumina or other suitable solid, or air, may be used between the various metal spheres. Of course, other shapes than spherical may also be employed. As illustrated, in normal operation spheres 45 and 55 will usually be relatively negative and spheres 51 and 59 will be relatively positive. Conductors 61 and 63 connect the "negative" potentials of spheres 45 and 55 to line 65, which line connects to an electrical power consuming part of the circuit, not shown herein, but like that of FIG. 1. Lines 67 and 69 act to transmit the "positive" potentials from parts 51 and 59 to line 71, which is also connected to the energy consuming parts of the circuit. Of course, lines 61, 63, 65, 67, 69 and 71 are insulated to avoid any short circuits. While only two sets of pairs of electrodes, shields, or electrically conductive spheres are illustrated in FIG. 2, a multiplicity of such pairs may also be employed. Also, container 43 and/or waste 41 may be connected to line 71.

In FIG. 3 there is shown a nuclear installation, battery or other source of electrical power 73, which also is a source of harmful radiation due to the presence therein of radioactive material. Numeral 75 designates a multilayered shield of alternating high Z and low Z metals, separated by dielectrics. For example, electrically conductive metal sheets 77 and 81 may be of a low Z material, such as aluminum, and sheets 79 and 83 may be of a higher Z material, such as copper or lead. Between the sheets are dieletric layers, which may be of suitable dielectric material, such as alumina, mica, silica, glass and in some cases, synthetic organic polymeric plastics. If gaseous materials are employed for the dielectric, air or high vacuum is usually preferred. Electrical connections of the more negative first and third layers and the more positive second and fourth layers and the insulated metal surface of source 73 can be made to a power consuming portion of the circuitry, 85, which includes lines 87 and 89, a variable load 91, batteries to be charged, such as that at 93, and a diode 95 to prevent batteries from discharging through the radioactive source. As is seen from the drawing, voltages from energy converting device 73 and shield 75 may be combined via conductors 97 and 99, and 101 and 103 respectively. Thus, shielding 75 can protect humans and the environment from nuclear installation 73 and can be employed to help consume the radiation energy from the nuclear material in such installation. Of course, shielding 75 may be used to enclose the source of radiation 73 or may be employed to enclose and protect a "target" of such radiation, such as a room in which personnel are located, near the nuclear installation.

FIG. 4 illustrates another embodiment of the invention in which an aluminum electrode 111, or "shield", in the form of an empty truncated sphere, with a few small holes in it, and insulated from surrounding container 113, has another conductive sphere 115, made of copper or silver, inside it. Radioactive waste 117 is in the container surrounding the spheres, and arrows, such as that identified by numeral 119, show some paths of radioactive emissions from a particular location 121 of the radioactive material. Instead of aluminum, other conductive materials, preferably metals, can be used as the material of the outer sphere as long as they are stable at the temperature obtaining within container 113 and as long as they are dense enough to absorb alpha particles emitted from the heterogeneous nuclear waste. Among such materials may be mentioned magnesium, titanium, copper, iron, chromium and nickel. Outer shell 111 does not have to be spherical in shape but a sphere presents the greatest variety of directional surfaces and is an excellent target for emitted radiation. Inner electrode 115, preferably of silver or copper, may also be of other conductive metals, with the identity of its electrode material depending to some extent on that of the other electrode material. For example, it is preferred that "the high Z" and "low Z" metals should be at least five atomic members apart, more preferably at least ten atomic numbers apart and most preferably twenty or more atomic numbers apart. Also, relatively high and low Z materials may be employed. Thus, two "high Z" metals or alloys may be used so long as they are a sufficient atomic number difference apart and are operative in the present invention.

Electrical conductors 123 and 125, together with the outer shell source of electrical potential and the inner shell source of electrical potential, can be communicated through a load or resistance, such as that shown at 127, and the current flowing can be read by an ammeter, such as that at 129. Absorbing of alpha particles by conductors 123 and 125 may send a positive charge through the circuit but relatively high Z shield 115 will tend to be more charged than low Z 111 due to 111's greater photoelectron reactivity and its greater absorption of electrons. Also, as illustrated, the electrical potential from either of the metal spheres may be transmitted to a sink, represented by metal plate 131, in pond 133, which plate serves as a ground. At 135 is shown a battery which may be employed to induce the flow of electricity between the metal spheres or from the metal spheres to the metal plate 131. Switches for cutting off the auxiliary battery 135 are present, but are not illustrated in the drawing.

As is seen from the previous description the present process affects dangerous emissions from the heterogeneous radioactive or comparable radiation source, which are converted to electrical energy, which is consumed. Thereby radiation is removed from the environment and is changed to a harmless energy form. It is well known that huge sums of money have been expended in research efforts to solve nuclear waste storage problems but despite all such efforts no prior art disclosure taught the process of this invention. Prior art efforts were directed to containing the nuclear waste, usually after concentration thereof, by storing it in a container or matrix in a remote area or deep in the earth. Often shielding was utilized which, in effect, merely contains the radiation or is itself affected by absorption of such radiation. When containment is the only effect of the shielding dangerous energy levels can be produced and when conversion of the shielding material takes place due to energy absorption, the nature of the material may change, leading to deterioration thereof.

Before the present invention it was known that certain types of radiation could be converted into electrical energy (but many experts refused to believe that gamma rays could be so transformed). Still, the prior art did not teach the use of any of such conversion mechanisms for shielding the environment from dangerous emissions. In fact, such apparatuses could leak primary emissions and could generate dangerous secondary emissions. Also, for satisfactory operation of various prior art nuclear devices for producing electrical energy, such as that of the Ritter patent, purified sources of radioactivity had to be used, rather than heterogeneous wastes such as usual nuclear wastes. The present invention allows the treatment and shielding of such wastes and also allows the protection of various sources of complex radioactive emissions, such as decommissioned nuclear plants, pools of highly radioactive materials, radioactive mill tailings, nuclear wastes being transported, nuclear wastes being processed, and stored solidified wastes that have been "vitrefied", encased in a synthetic organic resin, or embedded in ceramics or concrete.

The present invention also incorporates several safety features not suggested by the prior art. For example, by drawing off radiant energy from shield material the invention allows for stabilization of such material and thereby increases its shielding life. Also, whereas in the Ritter patent an object has been to build up high voltages, thus putting a strain on the shielding and increasing the danger of accident, such is not necessary nor is it an object of the present invention, which allows for regulation of the resistance to maintain a current flow and thereby to aid the conversion of radioactivity to electricity. In other words, there is no "back pressure" on the system due to any requirement to produce a high voltage, and the present apparatus acts as a safety valve, allowing the flow of more electricity in response to any flare-ups or sudden emissions of radioactivity.

The embodiment of the invention described uses form-retaining electrically conductive metal shields but such shields may also be made in the form of a flexible blanket which can be easily placed over a source of radiation or over a subject to be protected from such radiation. In such and other instances the intervening dielectric material, which will then preferably be a solid, may be molded or otherwise attached to the electrically conductive materials. Of course, in such blankets suitable conductors will be provided to carry off electricity from the shielding metals to an electrical load, where it is consumed.

In employing the invention modifications may be made depending on the particular type of heterogeneous waste being utilized and its state of "decay". If the predominant emission is of alpha particles the load should be across contacts with the first layer of shielding and the rest of the shielding. If the predominant emission is of beta rays it is considered best to have a high Z outermost shielding layer and/or a ground as one electrode and all the other layers as the other electrode. When gamma rays are the principal radiation it is considered best to employ thin layers of relatively high Z material with thicker layers of relatively low Z material, in repeating pairs, with the current flow being between such high Z and low Z layers. Usually the various shield layers are at different distances from the radioactive source but it is also within the invention to utilize different shield electrodes at the same distance from such source. For conversion of gamma rays to harmless electricity a honeycomb form of shielding is considered to be efficient, and it is also effective for absorption of beta rays. However, in some cases, as when the metal shields deteriorate after use (some reduced amount of deterioration may be observed) only a single type of metal shielding material may sometimes be best employed, with dependence being on direct conversion, photoelectricity, Compton effect and ion pair formation for conversion of the radiation energy. Normally, as when a source of radiation is aboveground, as in a decommissioned nuclear power plant, the shielding may have to be changed as time goes by. Such changing may also be dictated by the changing nature of the radiation source, and it will be preferable to utilize shieldings for greatest effects versus various types of radiation, for example, radioactive cobalt 60 during the first years after decommissioning, and isotopes of nickel and niobium many years later (each having different peak frequencies of radiation). As described, shields may be used around a nuclear reactor or installation, and above the installation they may be in staggered form to allow air circulation (but any air emitted will be filtered and monitored for leakage of radionuclides).

Liquid wastes may be shielded by means of the present invention, as may be radioactive wastes being transported in containers. Such containers may be made of shielding materials and the electrical load may be a part of the electrical system of the transporting vehicle. For example, the electricity generated from the waste being carried may be used to operate electric lights on a truck or trailer being employed, which lights will blink on and off to act as a warning that radioactive material is present.

The present invention is useful for protecting humans and the environment. Even if it had been known that electricity could be produced from heterogeneous radiation including gamma rays, such "new use" of such process would be patentable, especially in the absence of any suggestion thereof in the art. Especially in view of the long felt need for such a process and the great number of researchers attempting to invent it it is considered that the process was not merely inherent in the prior art and was not obvious to those of ordinary skill in such art.

Apparently the closest "prior art" to the present invention is U.S. Pat. No. 4,178,524, to Ritter. Ritter does not mention the employment of his apparatus to absorb radiation and protect the environment. In fact, he utilizes a lead housing to attenuate the radiation emitted by the source thereof. It may be inferred that the Ritter apparatus creates additional emissions. Ritter uses particular types of radioactive sources, emitting energies less than a million electron volts. Such radioactive sources of Ritter appear to be relatively pure isotopes, not heterogeneous nuclear wastes emitting large amounts of radiations of different types. Ritter specifies the employment of his particular high and low-Z materials whereas the present invention allows the use of a wide variety of such materials, for example, nuclear wastes include alpha and beta radiation emitters, but

Ritter's device is limited to a source of gamma rays with less than 1 Mev power. Ritter tries to produce maximum voltage whereas such is not the purpose of this invention and in fact, preventing voltage build-up is very important. Ritter's invention is a "remote electrical generator" whereas the present apparatus is intended for use in or next to power plants, hospitals, waste processing centers or other places that generate or house nuclear wastes, and allows treatment of the wastes at such sites, thereby, at least in part, obviating the need to transport them to a dump. Finally, the Ritter patent makes no mention of consuming the energy developed in the load, especially one of variable resistance, which makes the apparatus adaptable for use with radioactive wastes of different strengths and of changing activities. Unlike the Ritter apparatus, which requires the regulation of the energy the radioactive source can emit so as to maintain it low, the present apparatus is capable of operations with high energy sources and is adaptable to consume whatever electrical energy is produced by such source, thereby aiding in continuous conversion of radiation to electrical energy.

The invention has been described with respect to various illustrations and embodiments thereof but is not to be limited to these because it is evident that one of skill in the art, with the present specification and drawings before him, will be able to utilize substitutes and equivalents without departing from the invention.

What is claimed is:

1. An apparatus for protecting organisms and the environment from harmful emissions from a radiation source by shielding said organisms and environment from at least a portion of such emissions, comprising;

a plurality of metallic shielding parts located to absorb emissions from the source, with one of said plurality of parts being located farther away from the source than an other of said plurality of parts and with the one and other of the shielding parts being respectively of metals having atomic numbers differing from one another by at least ten atomic numbers so that an electrical potential difference between said one and other shielding parts is established; and

means, electrically interposed between the one and other shielding parts and physically remote from said source, for dissipating said electrical potential difference by consuming electric power, said means including a variable resistance element and means for automatically varying the resistance of said variable resistance element to keep the potential difference low by maintaining a current flow between the shield parts.

2. An apparatus according to claim 1 wherein the shielding parts are of good conductors of electricity, the radiation source is radioactive waste material, and the electrically conductive shielding parts are separated by a dielectric material.

3. An apparatus according to claim 2 comprising a source of electrical potential difference connected to the different electrically conductive shielding parts, with a positive connection being to the shielding part more absorbent of beta rays and a negative connection being to the shielding part less absorbent of beta rays, which source of electrical potential difference, when connected as mentioned, helps to stimulate flow of radioactivity induced electricity, with at least one of such connections being disconnectable so that when such radioactivity induced flow of electricity is begun the flow of the stimulating current may be halted by disconnecting such connection.

4. An apparatus according to claim 1 which comprises a plurality of pairs of metallic shielding parts in a path of radiation from a radioactive source, with the parts of each pair being seperated by a dielectric substance and with the pairs being separated from other such pairs by a dielectric substance, each pair comprising different electrically conductive metals differing from each other by at least twenty atomic numbers, so that an electrical potential difference between them is established, due to the differing absorptions of radiation by them, and with the shielding parts of each pair being connected to an electrical load so that the effect of the plurality of pairs of electrically conductive materials is to absorb a significant proportion of the radiation from the radioactive source and consume the energy thereof at the electrical load.

5. An apparatus for controlling emissions from a radiation source, said apparatus comprising;

a first shield composed of a metallic element having a first atomic number and exposed to said emissions so that its electrical potential assumes a first value different from that of ground;

a second shield which is of a metallic element having an atomic number differing from said first atomic number by at least ten and which, due to exposure to the emissions assumes a potential having a second value different from the first value;

a dielectric between the first and second shields; and

an electrical load connected between the first and second shields, said load including an automatically variable resistance which maintains the flow of current and keeps the voltage low.

* * * * *

SHEET 1 OF 1

INFORMATION DISCLOSURE CITATION

PTO-1449

ATTY. DOCKET NO. 023605-004

SERIAL NO. ~~Unassigned~~ 848,187

APPLICANT V. RUSSELL

FILING DATE March 10, 1992

GROUP ~~Unassigned~~ 220

MAIL ROOM SEP 1992 PAT. & TRADEMARK

U.S. PATENT DOCUMENTS

EXAMINER'S INITIALS	PATENT NO.	DATE	NAME	CLASS	SUBCLASS	FILING DATE
N.M	4,663,115	5/5/87	RUSSELL	376	320	
N.M	3,591,860	7/6/91	SAMPSON	376	320	
N.M.	2,847,585	8/12/58	S.M. CHRISTIAN	376	320	
N.M	2,837,666	6/3/58	E.G. LINDER	310	305	

FOREIGN PATENT DOCUMENTS

EXAMINER'S INITIALS	PATENT NO.	DATE	COUNTRY	CLASS	SUBCLASS	Translation Yes	Translation No

OTHER DOCUMENTS (Including Author, Title, Date, Pertinent Pages, Etc.)

EXAMINER Ngoclan Mai

DATE CONSIDERED 10/5/92

EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609; draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

The United States of America

The Commissioner of Patents and Trademarks

Has received an application for a patent for a new and useful invention. The title and description of the invention are enclosed. The requirements of law have been complied with, and it has been determined that a patent on the invention shall be granted under the law.

Therefore, this

United States Patent

Grants to the person or persons having title to this patent the right to exclude others from making, using or selling the invention throughout the United States of America for the term of seventeen years from the date of this patent, subject to the payment of maintenance fees as provided by law.

Acting Commissioner of Patents and Trademarks

Attest

US005122332A

United States Patent [19]

Russell

[11] Patent Number: 5,122,332

[45] Date of Patent: Jun. 16, 1992

[54] PROTECTING ORGANISMS AND THE ENVIRONMENT FROM HARMFUL RADIATION BY CONTROLLING SUCH RADIATION AND SAFELY DISPOSING OF ITS ENERGY

[76] Inventor: Virginia Russell, 435 Crescent Ave., Buffalo, N.Y. 14214

[21] Appl. No.: 442,442

[22] Filed: Nov. 28, 1989

Related U.S. Application Data

[63] Continuation of Ser. No. 320,787, Mar. 9, 1989, abandoned, which is a continuation of Ser. No. [illegible], Sep. 29, 1982, abandoned, which is a continuation-in-part of Ser. No. 933,529, Aug. 14, 1978, abandoned, which is a continuation of Ser. No. 781,503, Apr. 13, 1977, abandoned.

[51] Int. Cl.[5] G21C 9/00

[52] U.S. Cl. 376/288; 376/321; 310/301; 310/304; 310/305; 429/15; 136/202; 136/253

[58] Field of Search 310/301, 304, 305; 429/15; 136/202, 253; 376/320, 321, 288

[56] References Cited

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2,847,[illegible]	8/1958	Christian	376/320
3,591,[illegible]	7/1971	Sampson	376/320
4,178,524	12/1979	Ritter	310/304

Primary Examiner—Brooks H. Hunt

Assistant Examiner—Ngoclan T. Mai

Attorney, Agent, or Firm—Burns, Doane, Swecker & Mathis

[57] ABSTRACT

A radiation gradient is utilized to transform harmful radiant energy into safer, more useful forms, thus collecting, controlling and consuming the energies of radiant emissions and protecting the environment and living organisms from them. More specifically, there is disclosed a new process for shielding emitters of harmful radiation by establishing an electrical circuit, which process includes shielding the source of radiation while collecting the energy of relatively more radiation on an electrically conductive material and collecting the energy of relatively less radiation on other electrically conductive material, which may include a ground or external sink, thus establishing a difference in electrical potential, and transferring this potential difference, along with any potential difference from auxiliary devices, outside the shielded area, to resistors and/or variable other loads, which consume the voltage as it is created. In this way emissions of radiation are converted to electrical energy and are controlled and the source of radiation is better shielded because the described process prevents build-up of energy within the shielded area and prevents consequent deterioration of the shielding material, thus preventing flash-overs, accidents, breaks and leaks in the shielding and providing greater protection of living organisms.

31 Claims, 1 Drawing Sheet

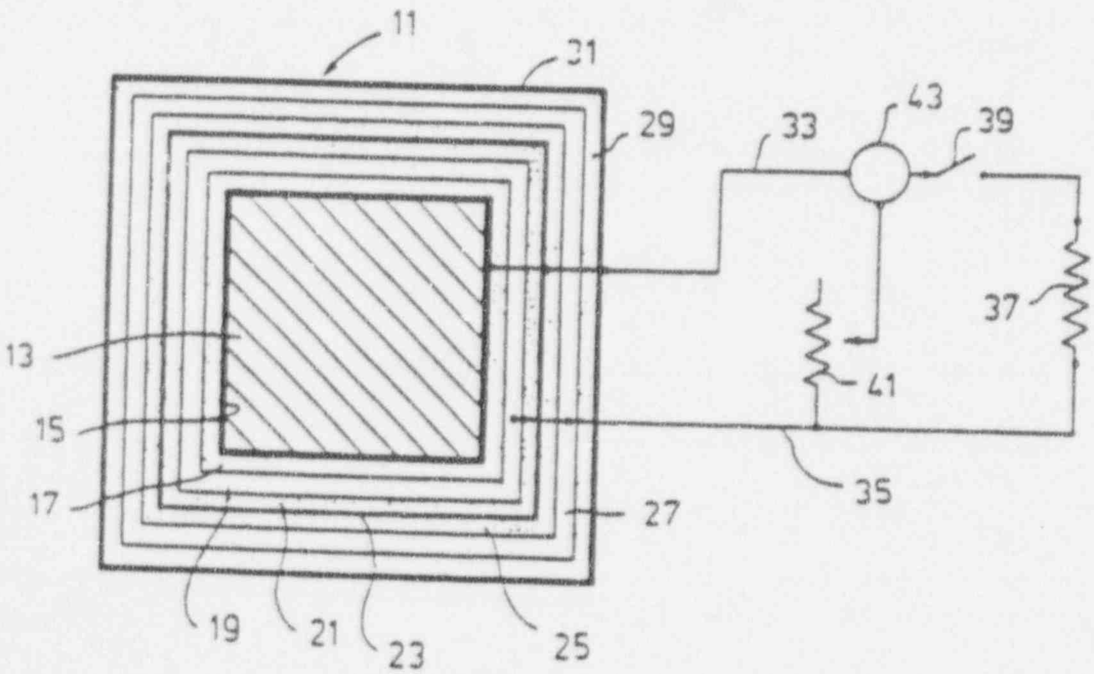

Fig. 1

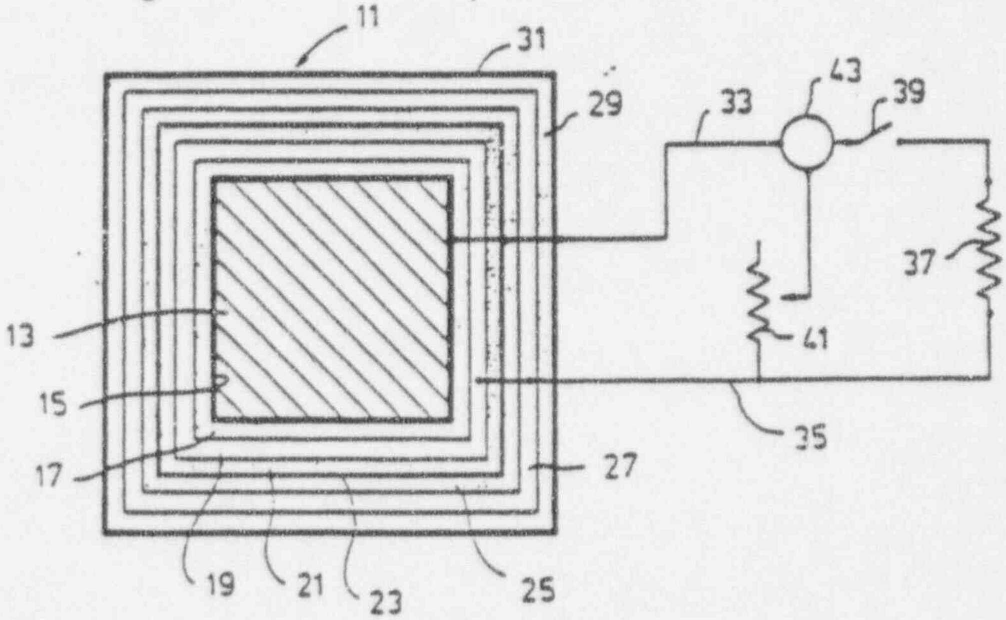
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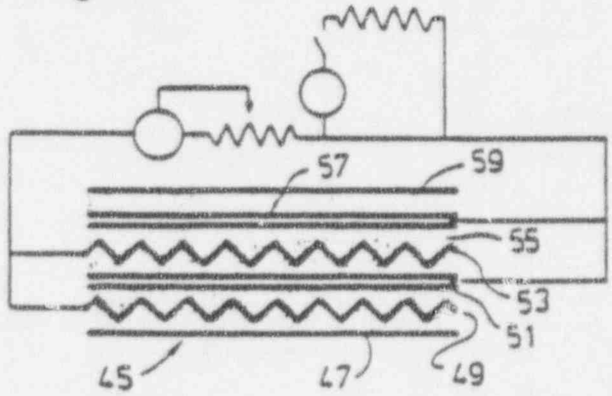
Fig. 2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PROTECTING ORGANISMS AND THE ENVIRONMENT FROM HARMFUL RADIATION BY CONTROLLING SUCH RADIATION AND SAFELY DISPOSING OF ITS ENERGY

This application is a continuation of application Ser. No. 07/320,787, filed Mar. 9, 1989, which was a continuation of application Ser. No. 06/427,161 filed Sept. 29, 1982, which is a C-I-P of Ser. No. 05/933,529 filed Aug. 14, 1978, which is a continuation of Ser. No. 05/781,503 filed Apr. 13, 1977, all abandoned.

INTRODUCTION

Prior to the present invention it had been widely considered in the scientific community that gamma radiation could not be successfully directly converted to electricity. Subsequently, in U.S. Pat. No. 4,178,524, issued Dec. 11, 1979 but identified as a continuation-in-part of an application filed Sept. 1, 1976, Ritter taught that a nuclear electrical battery could be made, using a monoenergetic gamma ray source, which source would emit no high-energy charged particles. The present application traces back to one filed after Ritter's earliest date but it claims an effective invention date earlier than that of Ritter. The present invention distinguishes over Ritter in concept and in processing steps. It relates to protecting organisms and the environment from radiation by controlling such radiation, and does not relate merely to the production of an electrical battery, utilizing a source of nuclear energy. Further, the invention is applicable to use with various sources of radiant emissions, including those of heterogeneous radioactive wastes, and it helps to stabilize electrically conductive shielding materials which may be employed.

SHORT DESCRIPTION OF EMBODIMENTS OF THE INVENTION

The present apparatus and process include:

A. Shielding the source and emissions of radiation;
B. Establishing a radiation gradient between a part of the device absorbing considerable radiation and a part of the device absorbing less radiation;
C. Converting energy of this radiation gradient into electrical energy or voltage by direct conversion, photo-voltaic action, Compton effect, ionization by pairing, or other known means of conversion;
D. Conducting this energy outside the shielded area to a load or loads where it is consumed;
E. Monitoring the flow of current and/or voltage and adjusting a variable resistance or other load so it will consume most of such radiation energy as it is produced.

This invention controls the emissions of radiation, prevents dangerous build-up of voltage which can cause cold emission and perhaps, flash-overs, accidents or leaks in the shielding. It is for the purpose of protecting organisms and the environment, and is an improvement over existing methods of radiation-emitting devices and materials.

FEATURES OF THE INVENTION AND DISTINCTIONS OVER PRIOR ART

This invention is an improvement in present shielding methods for sources of harmful radiation. It shields the source of the radiation and the emissions, and at the same time converts the energy of the radiation absorbed by the shielding or auxiliary devices into electrical energy, which it controls and consumes outside the shielded area, thus substantially reducing random emissions of radiation to the environment, and preventing energy build-up, flash-overs, and consequent tendency of the shielding to deteriorate, thereby preventing accidents and damages to the shielding. Of significant importance is the "safety valve" effect of the invention, which protects the shielding, helps to prevent damage to the container, and thus prevents leakage.

The purpose of this invention is to protect the environment from harmful radiation from emitters of such radiation, particularly from nuclear wastes in their many forms. It cannot be tenably maintained that this process was obvious to anyone knowledgeable in the field of nuclear physics because there were many years when the need for the invention was great but it did not occur to others. In 1950 Samuel Glasstone's classic "Sourcebook on Atomic Energy" said:

> "The problem of shielding sources of radiation has been studied extensively from both experimental and theoretical points of view. It is of course a matter of the utmost importance."

but his book recited other means of shielding and made no mention of the method employed in this invention. Twenty-eight years later the Union of Concerned Scientists was advocating shut-down of construction of nuclear power plants until some solution to the nuclear waste problem was found. Billions of dollars were being spent studying safe disposal of nuclear wastes but none of the studies mentioned the process described herein as a possible solution. In 1978 Dr. Cunningham, in charge of nuclear wastes for the Energy Research and Development Administration (ERDA) and later for the Department of Energy (DOE), wrote:

> "The process of converting the energy from radioactivity into electricity has been demonstrated but never been applied to heterogeneous nuclear wastes."

Processes for safely disposing of nuclear wastes were directed to recycling the wastes in reactors, treating them chemically, burying them, shooting them into space, dispersing them, changing their physical forms into gases, liquids or solids, cooling them in water or air and releasing the heat and other radiation to the environment, and just placing them in shielded containers. These methods treated the whole radioactive molecule, while the method of the present invention treats the emissions from the molecules, while confining the molecules. The present process not only shields the environment from the radioactive wastes but it also provides a circuit that collects the radiated emission energy and conducts it through an electrical circuit where the excess energy can be consumed in environmentally acceptable forms. This is an entirely new way of shielding radioactive material.

There have been patents for nuclear batteries, designed as power sources for use in remote areas, generally in satellites, where releases of harmful emissions do not seen to constitute as great an environmental problem. These batteries, and their construction and use differ from the present invention in the following ways:

1. Few, if any attempts were made to protect the environment, and no attempts were made to control secondary emissions from shielding or to carry off and consume excess energy from the radiation.

2. The purpose was to produce maximum power with the least weight. The purpose of the present invention is to protect the environment by improving methods of

shielding and by controlling excess emissions of radiation.

3. Many nuclear batteries are considered hazardous to health. According to existing patents, when a nuclear battery is brought to an area it may increase the harmful radiation in the area. With the present process excessive radiation inside the shielding is decreased, thus protecting the shielding, improving functioning thereof, and protecting the environment outside the shielding by consuming the excess harmful radiation in environmentally acceptable ways.

4. Existing nuclear batteries require specific isotopes for their source of radiant energy. The use of the present invention is not limited to a specific source but will also allow a considerable reduction in the amount of radiation emitted to the environment, and thus protects the environment.

5. Present devices provide no safety-valve or similar mechanism to prevent flash-over, or to prevent damage to the shielding. Shielding failures have already caused leaks and pollution of earth, air and ground water.

6. Prior art devices provide no mechanism to protect against any cold emissions, which occur when a voltage gradient reaches about 10^6, while the instant process prevents such build-up of voltage.

7. Prior art devices provide passive shielding, such as layers of lead, concrete, earth, carbon steel, etc. Such shielding allows the escape of some harmful gamma rays and the conversion of others into heat. This heat could build up and cause problems for the shielding. Such passive shielding is often subjected to more radiation than it can successfully absorb, which can cause damages from drying, cracking, etc., allowing emissions of radioactive materials that are more dangerous to living organisms than simple radiation, because the radioactive molecules may be deposited on or taken into the human body where they continue to radiate. The present invention is concerned with limiting the amount of radiation buildup contained in the shielding and with protecting the shielding from deterioration due to the radiation, thereby preventing breaks and leakage developing in the shielding.

8. Most nuclear batteries establish a voltage difference between the source of radiation and other parts of the device but the present invention also employs the voltage created between layers of shielding. Additionally, unlike the instant invention, existing nuclear batteries do not provide for varying the loads or resistances to use the electricity as it is produced.

9. Devices like that described by Ritter are limited to a small amount of a certain type of radioactive material of limited energy while apparatuses and processes of the present invention apply to widely variable amounts and types of radioactive materials. Such quantities may be millions of times the amounts cited in the Ritter patent, and may include individual emitters with energies of ten times (or more) the limit mentioned by Ritter. It cannot be justifiably said that what applies to small amount of nuclear waste also applies to millions of times as much. It is well known that only slight changes in mass convert a relatively safe amount of potentially fissionable material into a nuclear device.

DISTINCTIONS OVER CLOSEST REFERENCE

The alleged "prior art" patent which appears to be most relevant to the present invention is U.S. Pat. No. 4,178,524, of James C. Ritter. The earliest filing date of this patent or any parent application is Sept. 1, 1976, which was after experimentation that the present inventor had conducted. In such work she had demonstrated that nuclear waste emanations could be converted to electricity, so as to change the radiation energy to electrical energy, using foils of different metals as shields, after which such energy was consumed. Thus, the radiant energy from nuclear waste had been controlled.

Although it is considered that the present inventor's work preceded the filing of Ritter's earliest patent application, various important differences between this invention and that of Ritter will be set forth below to further establish patentability of this invention.

1. Although there has been a definite need in the nuclear field for a solution to the nuclear waste problem, Ritter's process does not provide any solution of the nuclear waste problem. Ritter never suggested that his invention was useful in solving this problem, and this was at a time when solving such problem was a major research effort of scientists throughout the world. The purpose of the present invention is to protect the environment by converting nuclear emanations to electricity and consuming the energy in environmentally acceptable forms, thereby preventing emissions of radiation to the environment. Such is an important distinction between this patent application and all others.

2. Ritter's invention does not allow for working with heterogeneous wastes. He applies it only to gamma rays of energy less than 1 Mev, thus barring alpha particles, beta rays and gamma rays from 1 to 10 Mev. The invention of this patent application treats all of these.

3. Most collections of nuclear wastes contain high energy emitting materials, as do the tanks of waste at West Valley, N.Y., for example, but Ritter's patent specifically states that his radioactive sources "have the desirable characteristic that they emit no high-energy charged particles."

4. The Ritter patent discloses that the value of his resistance will be chosen to maximize the power delivered to the electrical load. According to the present invention the emissions from the radiation source determine the power, which is consumed as it is produced.

5. Ritter's patent does not even mention the load being adopted to consume all the "gradient" energy produced, as it is produced.

6. Ritter describes his invention as "remote". The present invention is not remote. In fact, it may desirably be located next to power plants or hospitals or other places that generate nuclear wastes, and electrical energy can be fed back into the system, avoiding the dangers of transporting nuclear wastes).

7. A very important aspect of the present invention is improving the shielding of sources of radiation by drawing off and consuming the build-up of energy in the shielding and in the field around the shielding. Ritter's invention shows no concept of this and does not suggest it. All Ritter says about shielding is "In order to prevent an outside radiation hazard, the radioisotope source and plates can be contained within a lead housing 13." and "The thickness of the lead housing must be sufficient to attenuate the radiation emitted by the source or sources." A preferred embodiment of the present invention includes shielding which surrounds a mass of nuclear waste mass. In FIG. 1 of Ritter's patent the radioactive source is located at the left, next to the lead housing, and thus this device does not shield the environment from the source left side except through the passive lea shielding. FIG. 2 of Ritter's patent shows the absorbing material to be arranged so that it does not

enclose the source, "radiating" out from the source in such manner as to leave far more open space than shielding about the source.

8. Ritter limits the radioactive source to less than 1 Mev. Tank 8D2 at West Valley, N.Y. contained 117,200 watts of radiation (Western New York Nuclear Service Center Companion Report). Clearly the Ritter patent cannot be considered as suggesting treatment of the West Valley waste with the present process, which is a main objective of the present invention.

9. Ritter's patent is also very different from the present invention in that it is very specific about the particular combinations of elements to be employed. The present invention does not require use of two different metals. Thus, if one metal is used, which is possible, Ritter's teaching would not apply. The present invention allows the plates to be of the same material or of several different materials. Furthermore, Ritter's teaching does not apply to uses of metals of:

1. Z of 23 through 46, and Z above 46;
2. Z of 23 through 46, and Z below 23;
3. Z of 23 through 46, and Z of 23 through 46.

Thus, Ritter does not include such material as copper, nickel, manganese, chromium, iron, ruthenium or other such materials that are conductive, available and relatively inexpensive, or pairs of metals such as aluminum and copper, copper and lead, or layers of aluminum and copper, covered with layers of copper and lead. Yet, all such combinations of metals are operative within the present invention.

Until very recently, harmful radiated emissions from high power electrical transmission lines, television and visual display equipment, X-ray machines, microwave devices milliwave devices and other such emitters have had only passive shielding, if any, applied to them, with no attempt being made to control any random emissions to the environment by cutting down the electromagnetic field near the source by shielding with conductive materials and at the same time collecting the energy absorbed from the radiation by the shielding, and consuming and controlling this energy, thus preventing such random emissions to the environment and improving performance of the shielding and of the equipment. Furthermore, no patents describe applying the present invented apparatuses and processes to such equipment.

There has been growing concern about better shielding for such devices, especially since recent tests have shown that long term low level radiations can cause cancer. Accordingly, application of the present invention to shielding and protecting the biosphere (organisms and their environment) from such radiation emitters is also useful.

THE NEED FOR THE INVENTED PROCESS

Experts in the nuclear field have recently stated that there is no known process for reducing the toxicity of radioactive wastes to such a level that they would be safe and would not pollute the environment. At present treatment of the waste is by treating the chemicals which are radioactive. Nuclear wastes are separated and dispersed, concentrated and confined, transported and buried. Dispersal merely spreads out the radioactivity. Concentration makes it more intense. Changing chemical molecules by chemical processes does not eliminate it, nor does transporting it nor burying it. The invented process does not affect only chemical and/or physical changes. It actually controls and consumes the energy of the harmful radiation in environmentally acceptable ways.

The need for the present invention to protect the environment from radiation, whether from high power transmission lines, television and visual display devices, X-ray machines, gamma ray devices, nuclear batteries, microwave and milliwave devices and other such wave and particle emitters, is not yet clearly understood by the public or the experts in this field. However, as evidence of harm to organisms and the environment from such sources continues to accumulate it is believed that such need will be established.

NUCLEAR WASTE TREATMENT

The most crucial need for the invented apparatuses and processes is to protect organisms, especially humans, and the environment from the hazards of nuclear wastes. There are many different applications of the invention possible and the applications can be changed, as the nuclear wastes change, with time.

This invention is directed to shielding organisms and the environment from radioactive materials, especially radwaste. Any materials employed are for shielding, collecting energy of emissions, converting to electrical energy, and conducting and consuming this energy in environmentally acceptable form. It is considered that storing such energy in transportable electrical batteries, or establishing other chemical or electrical gradients in material than can be stored or transported is the equivalent of use or consumption of energy.

ILLUSTRATIVE EXAMPLE

It appears that the high-level wastes at the West Valley Demonstration Project are to be "solidified in a form suitable for transportation and disposal by vitrification or by such other technology which the Secretary of DOE determines to be the most effective for solidification."

There are certain limitations it is desirable to meet in applications of the invention to the treatment of radwaste, especially solidified nuclear wastes. There should be a collector of sufficiently low atomic number and sufficiently high electrical conductivity so that it interacts with the lowest energy alpha and beta rays and with low energy gamma rays. A sufficient amount of total shielding is preferably connected into the conductive circuit so that a near zero quantity of gamma rays can be detected outside the shielding. The total mass of metal in the collector and of dielectric between different metal layers should be sufficient to slow down gamma rays and collect their energy into the circuit. Among processes that apply are direct conversion of some alpha and beta rays, the photoelectric effect, the Compton effect and electron-positron pairing. The embodiment illustrated is efficient for collection of energy from gamma rays. Such rays striking the shields of lead or "higher density material" are likely to reflect electrons back to the aluminum or lower Z metal where they are absorbed and give a negative charge to the circuit. Gamma rays of energy greater than 1.02 Mev can react with matter in the pair-production process, losing their energy to electron-positron pairs. Later the positron combines with an electron to produce gamma rays which can react photoelectrically with the less dense shielding. Thus, there is a reasonable probability for complete conversion of gamma rays to ionization energy if the block is large enough to permit the multiple processes to occur. In the Compton effect the gamma ray loses its energy to an electron and a photon of lesser energy which can then react again with the less dense shielding.

With heterogeneous wastes, it is difficult to predict the voltage that will be produced. Some alpha particles and beta particles negate each other's charges, giving off heat that can be converted to electricity by semiconductor cells in the shielding. Some particles get trapped in the medium and do not add to the voltage initially. There is more variation from a norm if the blocks are small because there are so many different time periods for emission, and there may be times of few emissions and times when many emissions occur simultaneously. Therefore, if the blocks are small it is best to combine the leads from the different blocks so that these differences are averaged out. Also a temporary opposing voltage can be applied to stimulate initial current flow.

To estimate the voltage to be produced one may employ the following equation:

$$\text{Voltage} = \frac{h \cdot \text{frequency}}{\text{charge of electron}} - \text{work function},$$

and may total the voltages for all the emissions normal for the materials.

Ideally the intensity outside the shielding should be 0, indicating no radiation energy is escaping. To estimate intensity one may use the equation:

$$\text{Intensity}_{outside} = \text{Intensity}_{in} e^{-\mu x}$$

where

e = base of natural logs

x = path length

μ = linear attenuation coefficient characteristic of specific material.

The intensity loss through the various thicknesses of shielding and dielectric materials can be estimated for the maximum energies of gamma rays expected and sufficient total shielding may be provided to halt the highest energy gamma rays. It is preferred for surfaces of the shielding to be slightly irregular in form. Thus, they can be corrugated or honeycombed, and normally they will not be perfect spheres, thus preventing too intense focusing of the radiation.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention is illustrated by the accompanying drawing, in which:

FIG. 1 is a schematic representation, partially in horizontal section, of an embodiment of the invention in which radioactive waste is shielded and its energy is drawn off; and

FIG. 2 is a similar representation, in partial vertical section, of a shielding "blanket" of this invention.

In FIG. 1 shielding installation 11 for radioactive waste 13, shown as solidified in block form, includes, in order, starting with the location adjacent the waste, enveloping materials which are: thin relatively high density (and relatively high atomic number) metal collector 15 (which may be copper or silver, for example, or a combination of both); molded dielectric 17, thicker low density metal collector 19, e.g., aluminum, which is in honeycomb form and may be imbedded in the dielectric; dielectric 21; collector 23 like that of 15; dielectric 25; collector 27 like that of 19; dielectric 29; and lead shielding 31. The thin sections of metal mentioned above are preferably less than an electron range thick and the thicker sections are greater in thickness. The material of lower density tends to collect more electrons and so becomes more negative.

The various sources of relatively positive and relatively negative electrical potentials may be separately connected, as illustrated (but with the + and − out of contact), or pairs of + and − potentials may be transmitted to a load where the energy is consumed. Thus, referring to FIG. 1, lines 33 and 35 connect the various sources of electricity from the radiation to resistor 41. The load may be varied, depending on the energy level, which may be read by meter 43 (a combination ammeter/voltmeter). Resistor 41 may be of the automatically adjusting type so that it draws off the maximum energy flow. If the energy level is sufficiently high switch 39 is closed and a large load 37 is introduced.

In FIG. 2 the protective blanket 45 comprises dielectric layer 47 with a relatively thick (and honeycombed) layer 49 of aluminum or "lower density" material molded into it, a relatively thin layer 51 of "higher density" metal, such as copper, aluminum 53 in dielectric 55, lead 57 and dielectric 59. Like the absorber of FIG. 1 the blanket apparatus also includes variable and fixed resistors, a switch and meters, as illustrated, and the various collectors may be similarly connected, as shown.

Various modifications of the apparatuses and methods may be made and employed. Additional loads may be introduced into the circuit by an automatic switch responding to increases in current flow and/or voltage, as shown by the ammeter/volt-meter. Other methods of conversion to electrical energy, such as semi-conductors, may be embedded in the shielding. The conductive materials, particularly the less dense materials are desirably honeycombed for greater absorption, and may be embedded in a dielectric. Also, diodes or other electrical aids may be employed to prevent back-flows of current inside the shielding.

With differently shaped blocks of wastes and with various forms of solidified nuclear wastes (or liquid wastes) various shapes of shielding may be used which are best adapted to the shape of the waste. How adequately the solid wastes are shielded also depends on cost and on where they will be stored. There are less expensive ways of making energy withdrawing circuits, as by including conductive circuits in blocks of solid waste, such as by use of a thin mesh of a material like copper that converts emissions by direct conversion and may establish a voltage difference with the lead casing or an outside sink. If only one kind of conductive material is used in the active area, it may last longer than two different materials that interact but it might produce a lower voltage and could draw off less radiation energy. There can also be wires in spiraling shapes or otherwise dispersed throughout the block, for example, as a wire mesh. When two metals are used in proximity the amount of power produced may increase but the conductive materials may not be as long lasting. In determining what form of the invention to use and what materials to employ several things should be considered:

(a) Cost;

(b) Required length of life for shielding;

(c) Location and criticality of shielding required;

(d) Suitability of absorbing materials for absorptions at predominant emission energies; and

(e) Cost of shielding vs. potential costs from harmful radiation

In any event this invention provides a means for collecting and consuming radiant energy and thus improves the shielding of radiation emitters.

The present invention has been considered by the Department of Energy to be feasible but not cost-efficient. However costs of not protecting the environment sufficiently are not yet fully known and are mounting daily. In choosing applications of the invention, the object should be to get the most absorption and conduction of energy emissions from the vitrified waste material (or other deposit) while considering the cost and useful life of the shielding. Much study has been given to the kind of material to bind the nuclear wastes into blocks so this does not have to be mentioned except to say that it may be useful to have a thermal conductor located in the dielectric to prevent damage to the dielectric. Of course, opposing electrodes should be sufficiently far apart to prevent short circuiting. Also the circuit should be capable of tolerating alternating current, such as sometimes may be generated by a surge of alpha particles or powerful gamma rays being absorbed and converted to electricity. There are many nuclear waste problems to be solved: what to do with nuclear plants being decommissioned; what to do after an accident has occurred, and what to do with liquid wastes, gaseous emitters, etc. The application of the present invention to these problems will be described following the subsequent discussion of another embodiment of the invention, blanket shielding.

In FIG. 2 the top layer is of dielectric and subsequent layers are: a thin layer of lead; a thicker layer of dielectric, a layer of low density conductive material thick enough to absorb beta rays and electrons from gamma ray reflections and reactions; and a dielectric. Then there are repeated layers of higher density conductors, dielectric, thicker, less dense conductors, and dielectric. In making the blankets films can be used or layers of foil can be fixed by a castable and curable dielectric. In the blanket form the invention does not require as long lasting a dielectric as in the block form, because the blankets can be more easily replaced. Such materials as polyacrylate, mylar, castable polystyrene, teflon and polyisobutylene can be used. Epoxies, polystyrene, silicones, polyethylene, polypropylene and polyurethanes can also be used.

As with the apparatus shown in FIG. 1, the best choice of dielectric and conductive shielding materials will be based on the type of emitter and the estimated maximum energy of radiation, balanced against cost. Where there has been a nuclear accident the highest efficiency of shielding would be needed over the immediate area, perhaps several layers of blanket shielding ranging from thick aluminum levels alternated with thin copper levels, through aluminum and nickel and aluminum and silver to aluminum and lead, in repeated pairs. If the heat is too intense for aluminum, copper could be the thicker, more absorbent and less dense metal and could be alternated with thinner layers of a dense metal with high melting point. Away from the immediate area of the accident fewer layers of shielding would be needed and aluminum would probably be satisfactory. Further away it would be well to lay layers of aluminum foil on the ground at night with electrical connections and loads to pick up stray radiations and to consume the electrical energy created from the emissions. This aluminum would be washed off at appropriate intervals to clean it of radioactive molecules that might have adhered to it.

The various blankets, after use, should be treated as contaminated with nuclear wastes, and in very radioactive situations they would be cleaned or replaced after a set period. However, in accordance with the invention the shielding would not only physically hold back the molecules of radioactive material but it would also be connected so as to consume the energy of the emissions, thus preventing energy build-ups in the area, preventing further accidents and limiting harm to the environment. In extreme cases it might be necessary to let some of the heat go through the shielding to the outside atmosphere. In such a case the blanket shielding can be in the form of honeycombed mesh shielding, with tortuous paths therein.

OTHER ASPECTS AND USES OF THE INVENTION

Nuclear Accidents

Domes or Quonset huts can be constructed in accordance with this invention and can be installed over nuclear accidents, over nuclear plants being decommissioned, or over nuclear processing plants. They have the advantage over blanket shielding of allowing many layers of the dielectric air to slow down the emissions and ionize some of their energy, and they provide a larger volume of air to contain the heat emitted. Blanket shielding and dome shielding can be combined with mesh blanket shielding, such as is shown in FIG. 2, which can be dropped over the accident, carrying off and consuming much of the energy liberated. Then dome shielding may be placed on the blanket shield, carrying off and consuming more of the energy, and additional blanket shielding may be placed on top the dome.

Decommissioning Nuclear Power Plants

If plants to be decommissioned are to be left in place it is not enough to encase them in concrete. They should be contained in a structure or covered with blanket shielding as described herein. Firm plates of the shielding forced under the plant will extend the life of the shielding and protect the environment from seepage, leakage and emissions into the ground. Above-ground shielding may have to be replaced as it ages. For example, at first there may be active cobalt 60 present and later there may be isotopes of nickel and niobium emitting their characteristic radiations. Each metal has a peak frequency for emissions so in determining the type of shielding to use this should be taken into consideration along with cost and structural properties.

Wastes Immersed in Liquid

In the United States there are presently storage area and dumps containing millions of gallons of liquid wastes emitting high-level radiation. Included among such wastes are 600,000 gallons at West Valley; pools at power plants; caches at hospitals; and miscellaneous sources. Water tends to neutralize the positive emissions of alpha rays and the negative emissions of beta rays and in this way helps hold down the build-up of energy in the radwaste containers. However, there will be preponderances of negative charges or positive charges at given moments, or over a period of time, which might cause an accident. It is important that such wastes be shielded as in this invention. In many cases the electricity produced by this invention can be fed back into the power supply, with care being taken that diodes, and/or other devices prevent any back flow of energy from the power supply to the container. The containers should be shielded physically as well as "electrically" to prevent the wind and evaporation carrying radioactive particles into the air.

Wastes Being Transported

Radioactive wastes should be transported in containers that use this invention in the shielding and the electrical load should be in the conveyance. For example, the electrical energy may be fed into the power system with proper precautions; it may be used for lights on the conveyance which will blink on and off and constitute a warning; or it may be used to sterilize material or dry material that is being transported.

Processing Nuclear Wastes

When nuclear wastes are processed, particularly when evaporation occurs as in glassification, encapsulation in a resin, and in making calcines or other dry forms, it is most important that the processing area be shielded with this invention. If not, the air can become ionized and accidents may occur, unless the energy is consumed. If the processing area is not shielded properly not only emissions but actual radioactive molecules may escape to the atmosphere, and be inhaled or ingested. This is particularly true when liquid nuclear wastes are poured into absorbers, such as vermiculite, for shipping to a yet-to-be-found permanent depository. The processing area should be shielded by dome or blanket shielding, the containers should be a part of the shielding and the transport means should include a load for consuming excess energy, as in this invention.

Using Nuclear Wastes as an Auxiliary Source of Power

The circuit that conducts the potential difference from inside the shielding to a load can be connected with a source of power in a power plant. Thus, while nuclear power plants are cooling their wastes they can apply this invention, using shielding that collects the energy being radiated in the form of heat, alpha, beta and gamma rays, and other radiation, and transmits it back into the power system so the energy from the wastes contributes to the power supply while the power plant continues to operate steadily. For efficient operation auxiliary electrical equipment will bring the power supply from the wastes into synchronization with the major power supply and will prevent backflows.

Nuclear Batteries

This invention should be used around nuclear batteries because they are often emitters of harmful radiaton: If the radioactive material is very small the device can be encapsulated like a pill in the shielding and the power drawn from the shielding can be returned to the battery. Thus, any harmful emanations are collected, controlled and consumed, and do not harm the environment, which may be an organism, such as a human being, utilizing the nuclear battery.

Other Emitters

The present invention may be similarly applied to harmful radiation emitters other than radioactive materials, such as high power transmission lines, television and visual display equipment, X-ray machines, gamma

crowave and milliwave devices, and other such emitters. The invention is of a special process of shielding the device and of an apparatus for practicing the process. For example, X-ray machines are normally shielded by a certain thickness of lead but it is important to collect and control secondary emissions from the lead and to prevent buildups of ionization within the shielding by utilizing the present invention and consuming the electrical energy created by the energy of the X-rays and radiation.

With high power lines the carrier lines can be enclosed in the present shielding and the voltage collected can be added to the system. With visual display machines the invention can be incorporated into the usual shielding and the energy can be used to run heating coils or charge batteries outside the shielding or connected to the power supply. It may the supply of power will be small, but the protection to young children will be significant. The same is true for other radiation emitters. They need the described shielding so that the energy of the radiations may be controlled and may be prevented from harming organisms, including people, and the environment. There will be more and more electronic devices being used in the future and radiation from them should be shielded. Bare or primitively shielded radioactive and other radiation emitting sources should not be used to dry grains, sterilize milk, stimulate heart beats, etc. but the energy collected by this invention can be converted into safe radiation and with this invention, such devices may be used safely.

The invention has been described with respect to illustrations of preferred embodiments thereof but is not to be limited to these because it is evident that one of skill in the art, with the present specification before him, will be able to utilize substitutes and equivalents without departing from the [illegible]

What is claimed is:

1. A process for reducing present and potential harm caused by emissions from a radiation source comprising the steps of:

(a) substantially shielding the environment from said radiation source with a first layer of conductive material which absorbs a relatively great amount of radiation;

(b) providing a dielectric material against a surface of said first layer facing away from said radiation source;

(c) providing a second layer of conductive material outwardly of said dielectric material with respect to said radiation source, said second layer absorbing a considerably smaller amount of radiation than said first layer to create an electrical potential difference between said first layer and said second layer;

(d) connecting said first and second layer through an insulated circuit for conducting the potential energy between said first and second layer, said circuit including

a variable external load outside the shielded area; and

(e) automatically increasing the variable load when a flow of current increases between the first and second layer so that the load is sufficient to consume and convert to safe, environmentally acceptable forms, most of the electrical energy as it is produced from the radiation, thus, accomplishing the purpose of protecting the environment and living organisms by controlling emissions of radiapreventing accidents from dangerous buildups of energy near the source thereof.

2. A process in accordance with claim 1 wherein (a) and (c) are used to contain the source in or are bound by multiple layers of conductive shielding separated by a dielectric or air, as in roughly spherical, cubic, or cup-like forms, or under dome-like structures, blankets of shielding, film-like encasements of shielding, or over underlying plates.

3. A process in accordance with claim 2 wherein the source is a source of nuclear wastes emitting alpha rays and a potential difference is created between a thin layer of conductive shielding closest to the source and which is capable of absorbing alpha rays, and other layers of shielding absorbing more beta and gamma ray energy.

4. A process according to claim 1 wherein (a) and(c) shield the source and the source is radioactive material, as in mill tailings, nuclear devices, such as batteries, emitting secondary emissions to the environment, heterogeneous nuclear wastes, all or part of decommissioned nuclear plants, (a) is a layer of relatively low density conductive material of sufficient thickness to absorb electrons from gamma rays and beta rays, and (a) is alternated with (c) which is a layer of conductive material of higher density and of thickness less than one electron range, so that a potential difference is created between the electrically connected layers of low density material and high density material.

5. A process according to claim 4 wherein the source is a source of heterogeneous nuclear wastes and alpha, beta and gamma rays are emitted from it and processed.

6. A process according to claim 5 wherein at least one of the alternate layers is a metal or an alloy or amalgam of a metal of atomic number greater than 23 and less than 46, as in combinations such as aluminum and copper, copper and lead, copper and silver, aluminum and phosphor bronze, carbon steel alloys and copper, carbon steel alloys and lead, nickel and lead, aluminum and nickel and phosphor bronze and lead.

7. A process according to claim 2 wherein at least some of the potential difference is created between the outermost layer of shielding (farthest away from the radiation source) and a layer of shielding absorbing more radiation energy.

8. A process in accordance with claim 1 wherein the source is shielded by an expanse of shielding and in which (a), (b) and (c) are of sufficient flexibility to cover the particular source, which may range from a few grams of radioactive powder to a whole area where a nuclear accident has occurred.

9. A process in accordance with claim 8 wherein (a), and (c) are in the form of metal cloth, film, tight mesh, coil, or thin layers of metal, which may be embedded in the dielectric material.

10. A process in accordance with claim 8 wherein (a) is conductive material of relatively low density but sufficient thickness to efficiently absorb electrons from gamma rays and electrons inside the shielding, and (c) is a layer of conductive material of relatively high density of thickness less than one electron range and which is less likely to absorb electrons, so that a potential difference is created between the electrically connected layers of (a) and of (c).

11. A process according to claim 1 wherein the source is liquid nuclear wastes, (a) is the metal lining of the container and any filaments or plates that may be attached to it, and (c) is a sink or ground outside the container so that the electrical energy which may build up inside the container where the liquid acts as a conductor is carried through the circuit and removed from the highly radiant area.

12. A process according to claim 1 wherein (a) is honeycombed.

13. A process according to claim 1 wherein the load includes feeding electrical energy into an electric power system with diodes to prevent backflow of current into the shielding and source areas.

14. A process according to claim 1 wherein the load includes running electric current through water to separate hydrogen and oxygen.

15. A process according to claim 1 wherein the load includes energy produced to heat matter and to sterilize it, as in sterilizing sludge, milk, soil, fertilizer or seeds, or in drying wood or concrete.

16. A process according to claim 1 wherein monitoring devices automatically increase the load when the flow of current increases or when the temperature inside the shielded area increases.

17. A process according to claim 1 wherein the source is shielded or the area to be protected is shielded.

18. A process according to claim 17 wherein the source is a device that emits microwaves and the shielding is around the source, as in ovens, or screens a protected area.

19. A process according to claim 17 wherein the source is an electrical transmission line and the shielding is molded into insulation of the line.

20. A process according to claim 17 wherein the source is a television, oscilloscope or other visual display equipment.

21. A process according to claim 17 wherein the source is a device that emits X-rays.

22. A process according to claim 17 wherein the source is an electrical generator.

23. A process according to claim 17 wherein the source is an emitter of gamma rays.

24. A process according to claim 1 wherein the source is a source of radioactive wastes from medical processes.

25. A process according to claim 1 wherein the source is a source of radioactive wastes from nuclear power

26. A process according to claim 2 wherein the source is a source of mill-tailings.

27. A process according to claim 2 wherein the source is a source of heterogeneous nuclear wastes.

28. A process according to claim 1 wherein the source is a high speed computing or print-out device and the purpose of the process is to improve the performance of the device as well as to protect the environment.

29. A process according to claim 1 wherein the source is a nuclear battery.

30. A process according to claim 1 wherein the source is an electronic control device.

31. A process in accordance with claim 1 wherein the material separating the conductive materials is air, the source of radiation is heterogeneous nuclear waste, the conductive materials and the separating air are in blanket form, adaptable to shield the environment from radiation emitted by the heterogeneous nuclear waste, and the external load, connected by the insulated circuit to the conductive materials, consumes the electrical energy generated from the nuclear radiation and prevents dangerous voltage buildup in the conductive materials.

* * * * *

United States Patent [19]

Russell

[11] Patent Number: 4,663,115

[45] Date of Patent: May 5, 1987

[54] PROTECTING PERSONNEL AND THE ENVIRONMENT FROM RADIOACTIVE EMISSIONS BY CONTROLLING SUCH EMISSIONS AND SAFELY DISPOSING OF THEIR ENERGY

[76] Inventor: Virginia Russell, 435 Crescent Ave., Buffalo, N.Y. 14214

[21] Appl. No.: 426,824

[22] Filed: Sep. 29, 1982

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 933,529, Aug. 14, 1978, abandoned, which is a continuation of Ser. No. 781,503, Apr. 13, 1977, abandoned.

[51] Int. Cl.⁴ G21D 7/00

[52] U.S. Cl. 376/320; 310/304; 136/202

[58] Field of Search 310/301, 304, 305; 429/5; 136/202, 253; 376/320, 321

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Primary Examiner—Donald P. Walsh

Attorney, Agent, or Firm—Raymond F. Kramer

[57] ABSTRACT

An apparatus for protecting personnel and the environment from harmful emissions of radiation from a source thereof includes a plurality of shielding parts so located as to be in the path of the radioactive emissions and to absorb them (one such part being located farther away from the source of emissions than the other) so that an electrical potential difference between the shielding parts is established, due to different absorptions of radiation by them, means for consuming electrical power at a location remote from the radioactive source, and electrical conductors communicating the consuming means (or load) with such shielding parts. Although the invention is primarily intended for protecting personnel and the environment against emissions from radiation sources, such as radioactive wastes, it is also useful for shielding other sources of harmful radiated emissions. Also within the invention are processes for protecting personnel and the environment against radiation hazards.

9 Claims, 4 Drawing Figures

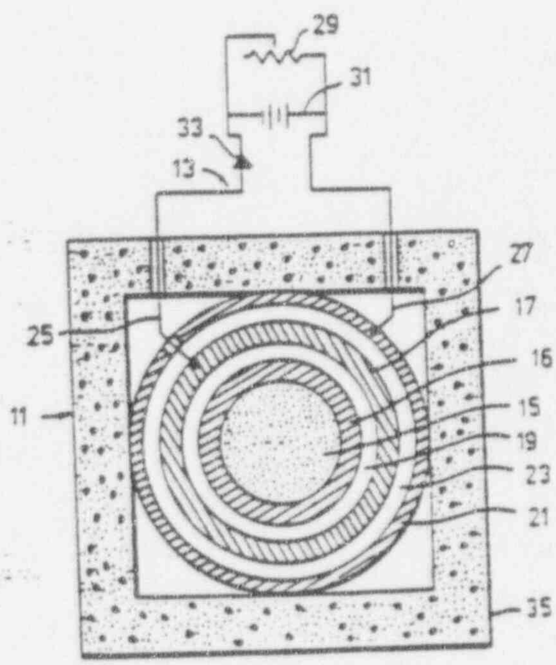

Fig. 3

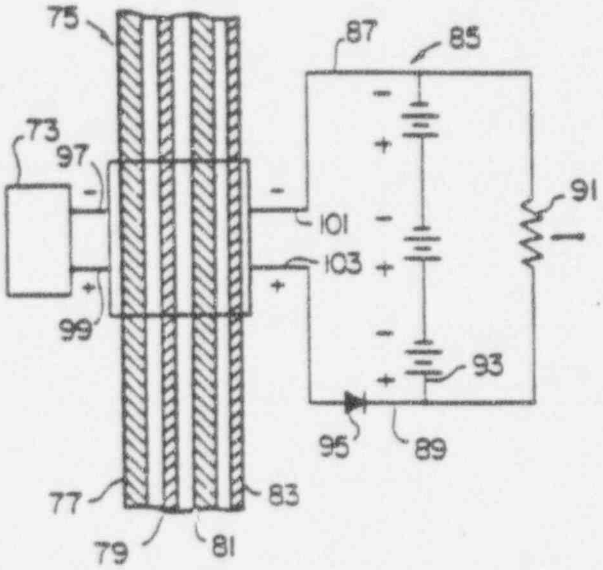
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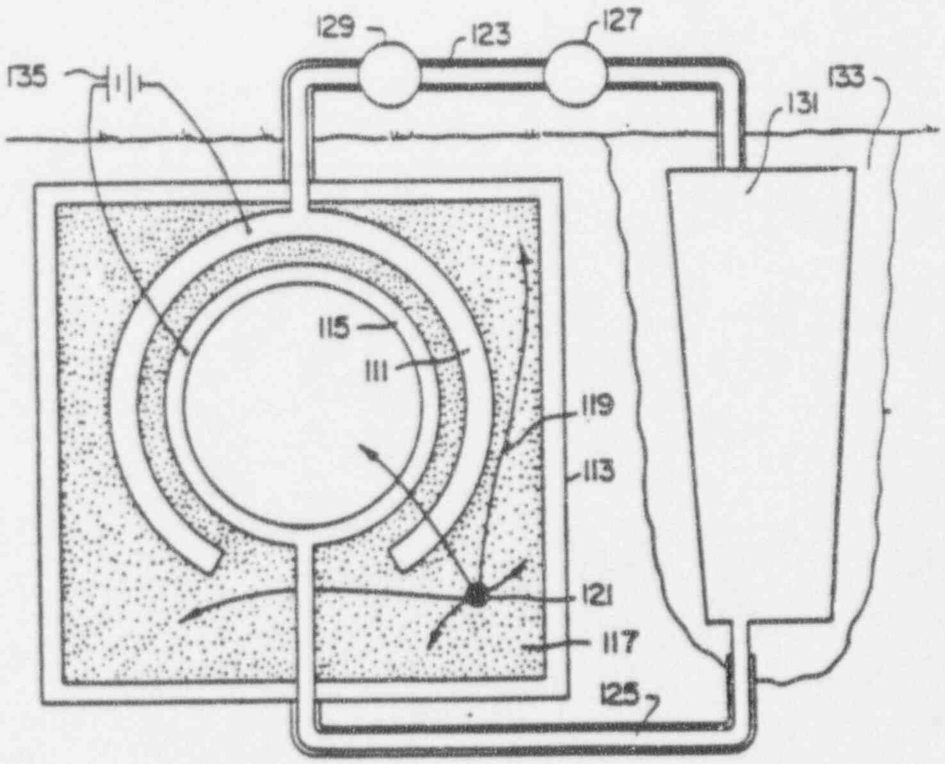
Fig. 4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the Ritter apparatus, which has no part in the electrical functions thereof, is the means by which he prevents harmful radiation from the radioactive source from reaching any personnel and the environment. Certainly, the environment is not protected by Ritter's "battery". Thus, it is seen that the present invention is novel, useful and unobvious from the "prior art" mentioned. It is not conceded that the Ritter patent is part of the prior art, in view of applicant's conception of the invention at a date prior to Sept. 1, 1976, the filing date of the Ritter et al. parent application Ser. No. 719,532, and applicant's claimed diligence until the filing of her grandparent application on Apr. 13, 1977 (papers deposited on Mar. 24, 1977).

The invention will be readily understandable from the following description, taken in conjunction with the drawing, in which:

FIG. 1 is a schematic representation, substantially like a central vertical sectional view, of an apparatus of this invention;

FIG. 2 is a front vertical sectional view of a modification of a portion of the apparatus shown in FIG. 1;

FIG. 3 is a schematic representation of a modified apparatus of this invention, partially in cross-section, in which plural shielding apparatuses are employed to consume the energy of radioactive material; and

FIG. 4 is an elevational view, partially in crosssection, of another embodiment of the apparatus of this invention.

In FIG. 1 numeral 11 represents the emissions absorbing portion of an apparatus of this invention, and the remainder of the apparatus, for carrying off and consuming the energy generated in portion 11, is designated by numeral 13. In portion 11 radioactive waste material 15, suitably shaped in spherical form (although other forms may also be employed and held in a suitable interior container 16, preferably of compatible material, is positioned inside an inner spherical shell of electrically conductive material (such as aluminum), and is separated from such material by dielectric 19, which may be a suitable dielectric, solid or gaseous, e.g., alumina, mica, air. An enveloping sphere 21 surrounds sphere 17 and is separated from it by dielectric 23. Sphere 21 is preferably of an electrically conductive material, such as a metal of higher atomic number than the material of sphere shell 17. Suitable such materials are copper and silver, with copper normally being preferred, but other metals may also be used. When solid dielectrics are utilized they may be the sole means for separating the spheres but when gaseous dielectrics, such as air (or a high vacuum) are employed, mechanical means (not shown), preferably of electrically insulating material, will be employed. Electrical conductors 25 and 27, which will usually be insulated copper, and/or silver wires, conduct electricity to a variable resistance 29 and/or a battery 31. Diode 33 is provided to act as a check switch on current flow, preventing battery 31 from delivering electricity to part 11 of the apparatus. Other switches (not shown) may also be provided to separate the variable resistance and the battery from the rest of the system, if desired, and the variable resistance may be made automatically variable to draw a relatively small current, due to the difference in the electrical potentials of the spherical shells 17 and 21, drawing more current when the potential difference is sufficiently high and being of decreased resistance so as to allow and promote current flow when the potential difference is lower. Also, means may be provided for automatically reversing the polarity of the battery so as initially to stimulate or induce electrical current flow between spherical shells 17 and 21.

While spherical shells are shown, these may be of other suitable shapes, such as cylindrical, cubical, tetrahedronal and ellipsoidal too, and in some instances the shells may desirably be perforated to allow release (through suitable absorbers or safety means, not shown) of gaseous materials generated from the radioactive waste or generated by expansion of gases present, as heat is released from the waste. Sometimes the inner shells may be perforated to permit some radiant energy flow through such openings, as when plural pairs of shields or electrodes are employed, e.g., 4 to 200 concentric metal spheres, with separating dielectrics. In the illustration a single apparatus is illustrated but banks of such devices may be connected together, with the current produced flowing through single or multiple resistances and/or being employed to charge one or more batteries.

In FIG. 1 the nuclear waste is in a suitable metal container 16 but it is contemplated that other materials of construction may be employed and sometimes it can be omitted. Concrete enclosing container 35 encloses the waste, the container for the waste, and the pair of spherical shells of electrically conductive material,but other suitable exterior containers may also be utilized.

While this invention is not bound or limited by the following theory of operation, it is considered that alpha particles emitted by the radioactive waste (which usually is a complex mixture of various radioactive isotopes) tend to make the charge of the first metal absorber positive whereas beta particles and gamma rays, being more penetrating, tend to make the charge of the next contacted electrically conductive material negative, as illustrated in FIG. 1. When plural pairs of absorbers are employed the metals of low density will tend to be negative relative to the high density metals. Metals of low density, if sufficiently thick, will react with more beta particles reaching them than will metals of higher density because the high density metals, if sufficiently thin, will reflect some of the lower frequency radiation back to the more absorbing low density metal and transmit some to the next set of shielding levels. If the wastes emit gamma rays there should be several layers of combinations of insulator, low density conductor, insulator, high density conductor, etc. For example, aluminum and copper may be employed, as may be other metals and alloys, and combinations of metals (or alloys) outside the ranges specified in the Ritter patent. Magnesium, aluminum and/or titanium may be employed as the low atomic number metal, together with vanadium, chromium, manganese, iron, cobalt, nickel, copper or zinc as the higher atomic number metal. Similarly, magnesium or aluminum may be used with titanium. Also, for example, vanadium, chromium, manganese or iron may be used with cobalt, nickel, copper or zinc, with preference being to employing such combinations with atomic numbers further apart within such groups. Other such combinations that are useful include vanadium, chromium, manganese, iron, cobalt, nickel, copper or zinc with molybdenum, silver, tin, platinum, gold, mercury and/or lead. In some applications alloys or amalgams may be employed. Also, with respect to the higher atomic number materials, silver, cadmium and tin may be used with lead. Thus, while, within the broader aspects of this invention it is possible to utilize as the absorber or shield materials absorption of such radiation. When containment is the only effect of the shielding dangerous energy levels can be produced and when conversion of the shielding material takes place due to energy absorption, the nature of the material may change, leading to deterioration thereof.

Before the present invention it was known that certain types of radiation could be converted into electrical energy (but many experts refused to believe that gamma rays could be so transformed). Still, the prior art did not teach the use of any of such conversion mechanisms for shielding the environment from dangerous emissions. In fact, such apparatuses could leak primary emissions and could generate dangerous secondary emissions. Also, for satisfactory operation of various prior art nuclear devices for producing electrical energy, such as that of the Ritter patent, purified sources of radioactivity had to be used, rather than heterogeneous wastes such as usual nuclear wastes. The present invention allows the treatment and shielding of such wastes and also allows the protection of various sources of complex radioactive emissions, such as decommissioned nuclear plants, pools of highly radioactive materials, radioactive mill tailings, nuclear wastes being transported, nuclear wastes being processed, and stored solidified wastes that have been "vitrefied", encased in a synthetic organic resin, or embedded in ceramics or concrete.

The present invention also incorporates several safety features not suggested by the prior art. For example, by drawing off radiant energy from shield material the invention allows for stabilization of such material and thereby increases its shielding life. Also, whereas in the Ritter patent an object has been to build up high voltages, thus putting a strain on the shielding and increasing the danger of accident, such is not necessary nor is it an object of the present invention, which allows for regulation of the resistance to maintain a current flow and thereby to aid the conversion of radioactivity to electricity. In other words, there is no "back pressure" on the system due to any requirement to produce a high voltage, and the present apparatus acts as a safety valve, allowing the flow of more electricity in response to any flare-ups or sudden emissions of radioactivity.

The embodiment of the invention described uses formretaining electrically conductive metal shields but such shields may also be made in the form of a flexible blanket which can be easily placed over a source of radiation or over a subject to be protected from such radiation. In such and other instances the intervening dielectric material, which will then preferably be a solid, may be molded or otherwise attached to the electrically conductive materials. Of course, in such blankets suitable conductors will be provided to carry off electricity from the shielding metals to an electrical load, where it is consumed.

In employing the invention modifications may be made depending on the particular type of heterogeneous waste being utilized and its state of "decay". If the predominant emission is of alpha particles the load should be across contacts with the first layer of shielding and the rest of the shielding. If the predominant emission is of beta rays it is considered best to have a high Z outermost shielding layer and/or a ground as one electrode and all the other layers as the other electrode. When gamma rays are the principal radiation it is considered best to employ thin layers of relatively high Z material with thicker layers of relatively low Z material, in repeating pairs, with the current flow being between such high Z and low Z layers. Usually the various shield layers are at different distances from the radioactive source but it is also within the invention to utilize different shield electrodes at the same distance from such source. For conversion of gamma rays to harmless electricity a honeycomb form of shielding is considered to be efficient, and it is also effective for absorption of beta rays. However, in some cases, as when the metal shields deteriorate after use (some reduced amount of deterioration may be observed) only a single type of metal shielding material may sometimes be best employed, with dependence being on direct conversion, photoelectricity, Compton effect and ion pair formation for conversion of the radiation energy. Normally, as when a source of radiation is aboveground, as in a decommissioned nuclear power plant, the shielding may have to be changed as time goes by. Such changing may also be dictated by the changing nature of the radiation source, and it will be preferable to utilize shieldings for greatest effects versus various types of radiation, for example, radioactive cobalt 60 during the first years after decommissioning, and isotopes of nickel and niobium many years later (each having different peak frequencies of radiation). As described, shields may be used around a nuclear reactor or installation, and above the installation they may be in staggered form to allow air circulation (but any air emitted will be filtered and monitored for leakage of radionuclides).

Liquid wastes may be shielded by means of the present invention, as may be radioactive wastes being transported in containers. Such containers may be made of shielding materials and the electrical load may be a part of the electrical system of the transporting vehicle. For example, the electricity generated from the waste being carried may be used to operate electric lights on a truck or trailer being employed, which lights will blink on and off to act as a warning that radioactive material is present.

The present invention is useful for protecting humans and the environment. Even if it had been known that electricity could be produced from heterogeneous radiation including gamma rays, such "new use" of such process would be patentable, especially in the absence of any suggestion thereof in the art. Especially in view of the long felt need for such a process and the great number of researchers attempting to invent it it is considered that the process was not merely inherent in the prior art and was not obvious to those of ordinary skill in such art.

Apparently the closest "prior art" to the present invention is U.S. Pat. No. 4,178,524, to Ritter. Ritter does not mention the employment of his apparatus to absorb radiation and protect the environment. In fact, he utilizes a lead housing to attenuate the radiation emitted by the source thereof. It may be inferred that the Ritter apparatus creates additional emissions. Ritter uses particular types of radioactive sources, emitting energies less than a million electron volts. Such radioactive sources of Ritter appear to be relatively pure isotopes, not heterogeneous nuclear wastes emitting large amounts of radiations of different types. Ritter specifies the employment of his particular high and low-Z materials whereas the present invention allows the use of a wide variety of such materials, for example, nuclear wastes include alpha and beta radiation emitters, but Ritter's device is limited to a source of gamma rays with less than 1 Mev power. Ritter tries to produce maxi-

May 2), 1994

The Honorable Amo Houghton
United States House of
Representatives
Washington, D.C. 20515-3231

Dear Congressman Houghton:

I am responding to your letter of April 12, 1994, to Ms. Elizabeth Cecchetti of the U.S. Department of Energy, which was forwarded to me for response. In your letter, you asked for suggestions to aid your constituent Virginia Russell, in marketing the use of specially designed nuclear shielding which could dissipate the absorbed energy from radioactive emissions as electricity.

As an independent regulatory agency, the U.S. Nuclear Regulatory Commission does not promote the commercial development of individual technologies. However, without making any judgment as to the merit of Ms. Russell's idea, I suggest that your constituent contact a technical consultant or business manager familiar with the nuclear material or power generating industries. These sources should be familiar with current industry practices and requirements for designing shielding for shipping and storage casks, and other shielded nuclear components. Some professional organizations that may be helpful to your constituent in finding such a consultant or business manager include the American Nuclear Society (ANS), the Electric Power Research Institute (EPRI), or the Nuclear Energy Institute (NEI).

I trust that this reply has been helpful.

Sincerely, Original signed by James M. Taylor

James M. Taylor
Executive Director
for Operations

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