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PROCESS FOR OPENING CONTAINERS OF RADIOACTIVE AND TOXIC MATERIALS

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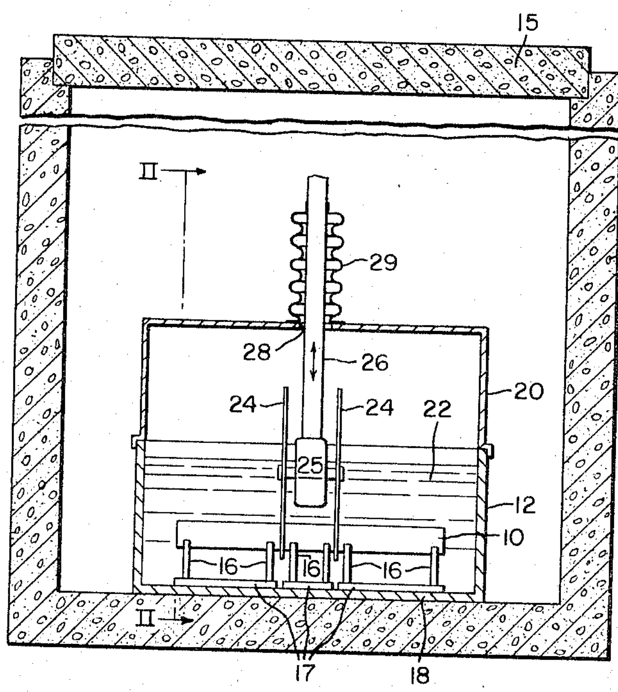

FIG. 1.

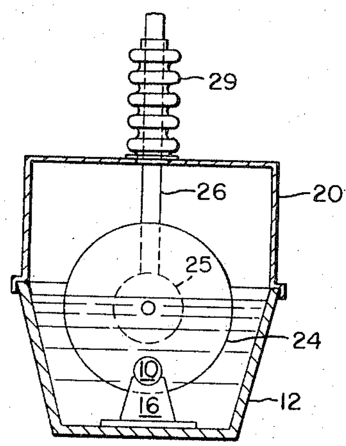

FIG. 2.

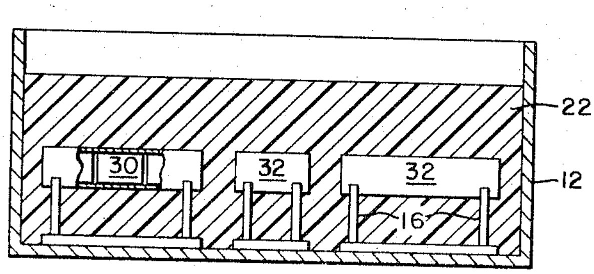

FIG. 3.

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PROCESS FOR OPENING CONTAINERS OF RADIOACTIVE AND TOXIC MATERIALS

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ABSTRACT OF THE DISCLOSURE

A process for opening containers of radioactive or toxic materials including the steps of immersing a container of said material completely within a polymerizable liquid resinous composition, cutting through the container while maintaining said resin in the liquid state, and then polymerizing the liquid to form a solid resinous casing about each severed container portion.

This invention relates to means for opening containers having readily airborne radioactive or toxic materials without the release of the contents.

The technical examination and investigation of highly toxic materials has been difficult and costly due to the necessity of preventing the spread of the material through the air. In the nuclear field, alpha emitting materials such as fuel rods of plutonium and uranium-233 are outstanding examples of materials that present this type of problem. For nonirradiated materials of this type in limited quantities, totally enclosed boxes called "alpha facilities" have been used. For large quantities of such materials, or when irradiation shielding must be provided in addition to protect personnel from direct or secondary radiations, the combination of these safety requirements which include the provision of shielding and extreme control of airborne contamination, becomes extremely difficult and costly.

It has been found that the foregoing disadvantages and problems may be overcome with regard to airborne materials by preventing cutting and/or grinding residues from scattering from the cutting area by enclosing the body such as a fuel element to be cut in a casing of resinous material. Where the body is radioactive, precautions are taken by using hot cell techniques whereby the radioactive body is placed in a receptacle within which it is encased within a resinous substance and subsequently cut at desired locations.

Accordingly, it is an object of this invention to provide a relatively economical and safe method for opening a container containing radioactive or toxic materials by preventing the airborne scatter of cutting and grinding residues resulting from the cutting and opening of the container.

It is another object of this invention to provide an apparatus and method for opening a container of radioactive or toxic material.

Finally, it is an object of this invention to satisfy the foregoing problems and desiderata in a simple and effective manner.

These and other objects and advantages of the present invention will become more apparent when considered in view of the following detailed description and drawings, in which:

FIGURE 1 is a vertical longitudinal sectional view through a radiation hot cell showing the manner in which an irradiated fuel rod may be mounted within a cutting trough for cutting a rod into smaller sections;

FIG. 2 is a transverse sectional view taken on the line II—II of FIG. 1; and

FIG. 3 is a longitudinal cross-sectional view through

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the cutting trough showing the segments in spaced relation with respect to each other after being cut.

Broadly, the procedure of the instant invention involves the steps of placing a container or can containing radioactive or toxic material into a receptacle or trough having dimensions substantially greater than that of the container and filling the trough with a polymerizable liquid resin such as a liquid epoxy resinous composition so as to completely immerse the container. The container is then cut into desired segments for testing by a conventional means such as a saw. The liquid resin serves to entrap and contain the cuttings and other residue and prevent them from being carried away by air currents which would be normally created by the movement of the saw. The liquid resin is then solidified, as by heating or adding a hardener or catalyst, with the cuttings and other residue being completely entrapped. Thereafter, the solid resin casing may be removed such as by dissolving in a solvent or in any other manner.

In FIG. 1, a fuel rod 10 is placed within a receptacle such as a trough 12 all being located within a hot cell 14 having a removable cover 15. The rod 10 is located substantially centrally within the trough 12 by a number of spaced brackets 16 resting upon the bottom wall 18 of the trough 12. A hood 20 is mounted on the upper edge of the trough 12, to fit tightly thereon. The trough is filled with the polymerizable liquid resin 22 to completely immerse the rod 10. As is shown, pairs of brackets are mounted on individual bases 17 which can be moved by suitable external means such as a remotely controlled rod (not shown). Also each bracket 16 is fastened as by a set screw to hold the rod 10 or a severed segment, firmly therein.

As shown in FIG. 1, cutting means such as one or a pair of disk saws 24 with a motor 25 are mounted on the lower end of a hollow shaft 26 which extends through an opening 28 in the upper side of the hood 20. The shaft 26 is suspended from movable support means (not shown) within the cell 14 such that the shaft and saws may be lowered and raised vertically to permit the disk saws 24 to cut through the rod 10. Bellows 29 are provided between the hood 20 and shaft 26 to prevent escape of any resin 22 through the opening 28 as it is caught by the saw and sprayed around.

The fuel rod 10 is an elongated member for example of a circular cylindrical cross section which contains, for example, a plurality of fuel pellets 30. The trough 12 is preferably composed of metal and has an interior of sufficient size to accommodate a convetnional disk saw 24 such as shown in FIG. 2.

In practice, the saws are set to rotate and are slowly lowered so as to cut through the fuel rod, after which the saws are raised entirely out of the liqiud resinous composition. A single rod may be cut into many segments by repeating the process.

The fuel pellets 30 are composed of fissionable material such as U-235 and are disposed in end to end abutment between the ends of the fuel rod 10.

As shown in FIG. 3, after the fuel rod 10 is cut into segments, the segments are separated by operating the means such as threaded rods, within the trough 12 on spaced pairs of mounting brackets 16 so that the liquid resin 22 occupies the space between the separated segments.

The liquid resin 22 is preferably a polymerizable monomer e.g. diallyl phthalate or a liquid polymer such as Hysol-3404 or epoxy resinous composition and is preferably transparent, or a solution of a polyester resin, such as a maleic anhydride-ethylene glycol, in a reactive vinyl monomer such as monostyrene or diallyl phthalate, and the catalyst being a peroxide such as benzoyl peroxide.

The resin 22 may be a polymer, a monomer, or mixture thereof. After the fuel rod 10 is cut into the desired segments the resin is caused to harden and thereby retain the cuttings or residue entrapped in the solidified resin. The hardening or polymerization of the resin into a solid may be accomplished either by heating or by adding a hardener or catalyst such as phthalic anhydride, phenylene-diamine or boron trifluoride, such as product sold under the trade name Hysol-6020. (Hysol-3404 and Hysol-6020 are products of the Hysol Corporation of Olean, N.Y.) Both thermosetting and thermoplastic polymers may be employed. Moreover, a resin may be employed that is hardenable upon exposure to irradiated material.

After the resin has hardened, samples of the fuel rod 10 and pellets 30 may be obtained by cutting through the solidified resin as by a knife or thin saw (such as saw 24) to obtain a specific segment such as the fuel rod portion 32 which is completely encased in a transparent resinous jacket (FIG. 3). The encasing resin may be subsequently removed mechanically or dissolved, for the purpose of making metallurgical examinations or chemical analyses of a fuel rod segment 32 or the pellets 30 therein. Removal of the resin casting may also be enhanced by applying a liner of polytetrafluoroethylene to the inner surface of the receptacle.

Accordingly, the device and method of the present invention permit the opening of fuel rods without spreading easily airborne contaminants such as saw cuttings that are usually blown around by action of air currents created by the rotating saw blade. Such contaminants include iorn-59, cobalt-60, chromium-51, and nickel in the cladding. In addition, contaminants in the fission pellets include plutonium-239 and -240, cesium-147, strontium-90, zirconium-95, and cerium-144. By providing a resinous casing which is easily applied by pouring the liquid polymerizable resin composition around the fuel element and then polymerizing it, the fuel element may be examined and cut for testing under relatively simple radiation control conditions without contaminating the surrounding area.

It will be appreciated that in some cases, an opaque resin may be employed. While a saw has been specifically shown, other cutting means such as a thin grinding wheel or the like may be employed. Reciprocating saws may also be used.

Various modifications may be made within the spirit of the invention.

What is claimed is:

1. A method for opening a container containing radioactive or toxic material without releasing contaminating material comprising the steps of placing the container containing said material into a receptacle, filling the receptacle with a polymerizable liquid resinous composition so as to completely immerse said container, cutting through the container while maintaining said resin in the liquid state, and polymerizing the liquid to form a solid resinous casing about each severed element.

2. The method of claim 1 in which the polymerizable liquid is selected from a group consisting of monomers, polymers, and mixtures thereof.

3. The method of claim 2 in which the liquid is an epoxy resin.

4. The method of claim 1 in which the liquid is solidified by adding a hardening agent.

5. The method of claim 1 in which the resin is transparent.

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