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RADIOGRAPHY SOURCE
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2,870,341

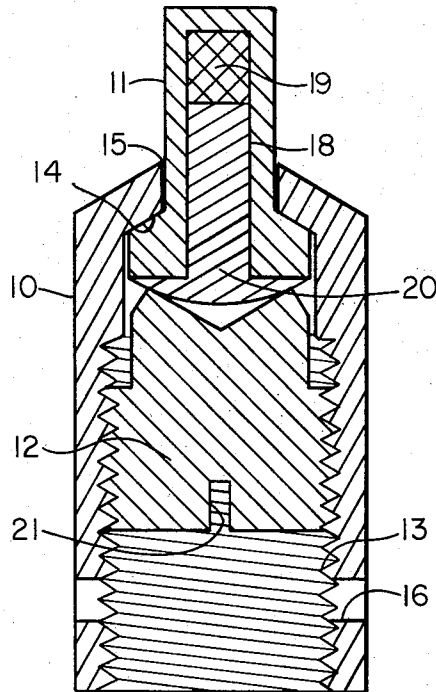


FIG. 1

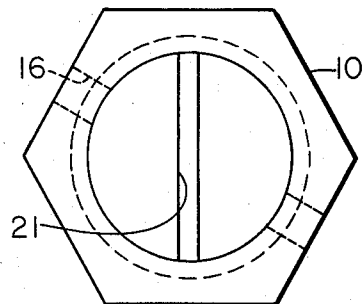


FIG. 2

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1

2,870,341

RADIOGRAPHY SOURCE

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1 Claim. (Cl. 250—106)

This invention relates generally to radioactive sources of the type employed for radiographic purposes, and more particularly to a source holder and a process for the production and use thereof which is particularly adaptable for certain artificially produced radioactive isotopes.

Radiographic methods have become popular in the non-destructive testing of materials, radium having been used to a large extent as the radiographic source because the radiation therefrom has good penetration with minimum scattering and substantially constant activity, the source is simple to use and is readily portable. An early form of radium source included a known amount of radium salt hermetically sealed in a silver container, which in turn, was enclosed in an aluminum alloy capsule. Cords were attached to the capsule to facilitate transferral thereof from the lead container in which it was stored when not in use to the site where the radiograph was to be made. To overcome the problem of handling the source, more recently they have been constructed in two sections, partly of aluminum and partly of magnetic material to permit handling with magnetic remote handling equipment. A source of this type, and a representative handling tool is described in U. S. Patent No. 2,269,458, dated January 13, 1942.

With the availability of artificially produced radioisotopes at a substantially lower cost, the volume of radium radiography has fallen off somewhat, and has been replaced to a large extent by Co-60 which has comparable penetrating powers and is susceptible of encapsulation in a manner similar to radium. In the production of Co-60 sources, cobalt wire is irradiated in a suitable neutron flux, and when the desired level of activity is reached, the "hot" Co-60 wire, of a length necessary to produce the desired source strength is hermetically sealed within a stainless steel capsule. The step of sealing the Co-60 in the capsule is rather hazardous because of the tendency of cobalt to "flake off," and must be done with extreme care. Co-60 has been used with success for some time for the radiography of rather heavy sections, but because of the high energy of the gamma radiation therefrom, there is not sufficient absorption in thin sections to produce radiographs of proper contrast and readability. It is desirable, therefore, to employ other radioisotopes as the source which will give a suitable exposure on thinner sections. It has been found that other isotopes have radiation of energies suitable for this purpose, among them being iridium and cesium. Iridium is particularly useful because of its chemical and mechanical properties, but its half-life, 70 days, is relatively short. The time during which such a source is useful is therefore short, and unless the iridium, which is relatively expensive, can be re-irradiated, or re-used, its cost would be prohibitively high for radiographic purposes. Coupled with the desirability, or necessity, of re-irradiating the iridium, or other comparable isotope, from time to time, it is preferably that

2

the source be conveniently handled, as with magnetic remote handling equipment of the type referred to hereinabove.

In view of the foregoing, the primary object of the present invention is to provide an improved radiography source.

Another object of the invention is to provide a container for the encapsulation of an active element or compound, which permits the convenient periodic re-irradiation of the active element or compound.

Another object of the invention is to provide a radiography source which permits re-irradiation of the active element or compound and yet capable of being handled with magnetic handling equipment.

Another object of the invention is to provide a process for making available to radiographers at low cost radioactive sources employing relatively short half-life isotopes.

Still another object of the invention is to provide a radioactive source having a minimum of self-absorption.

With the foregoing and other objects in view, the source container of the invention is featured by a separable assembly, formed partly of a material having a low atomic number and low neutron absorption cross section, preferably aluminum, in which the active element or compound is sealed, and partly of a magnetic material to permit handling with magnetic handling equipment. In the fabrication of the source, the active element or compound is sealed within the aluminum portion while in the "cold" or non-radioactive state, thus eliminating the hazard to the health of the assemblers, and thereafter, the entire aluminum portion, with the active element encased therein, is subjected to the neutron flux of an atomic reactor. The active element, for example, iridium, is rendered radioactive by the neutron bombardment, and while the aluminum casing is also rendered radioactive to a certain extent, the resulting isotope has a very short half-life so that the chance of dangerous radioactive particles rubbing or chipping off the casing is negligible. After irradiation, the aluminum casing is assembled with the magnetic portion, and the composite placed in a suitable shielded container for storage and shipment. After a period of use such that the active element has decayed to the point where it is no longer useful for its intended purpose, for example one half-life, or 70 days, the source is returned to the manufacturer in exchange for a "fresh" one. The source being easily disassembled, the aluminum casing is removed from the magnetic portion, with little or no attendant hazard, and again subjected to neutron bombardment. The casing is then re-assembled with the magnetic portion, and is again ready for use. Thus it is possible to re-use the same active element several times resulting in relatively low cost, and without ever requiring the handling of an unsealed radioactive substance.

Other features, objects and advantages of the invention will be apparent from the following detailed description when taken in connection with the accompanying drawing in which:

Fig. 1 is an elevation cross-section of the source assembly, greatly enlarged; and

Fig. 2 is an end view of the source assembly.

Referring to the drawing, and more particularly to Fig. 1, the source consists of three separable portions; a capsule body 10, preferably formed of magnetic type stainless steel or other magnetic material; a capsule container 11, formed of low atomic number material having small neutron activation cross-section, preferably 2S aluminum; and a retaining screw 12. Body 10 is preferably of hexagonal, or of other cross-section having at least one flat side, to prevent rolling of the source when placed on its side, and has an internal threaded bore 13.

At the upper end of the bore 13, the body is formed with a shoulder 14, and is provided with an axial opening 15 of somewhat smaller diameter than the threaded portion. At its lower end, capsule body 10 has an opening 16 therethrough for receiving a cord to facilitate handling or suspending the source in particular radiography exposure set-ups.

Capsule container 11 is generally cylindrical in shape having a straight portion of one diameter and enlarged at one end to a diameter slightly smaller than threaded bore 13 and having a tapered annular surface conforming in shape to shoulder 14. Container 11 has an axial opening 18 therein for receiving the active element or compound 19, and an aluminum insert 20 having a flat circular head, secured to container 11, as by welding, retains element 19 in place. Element 19 may be a length of iridium wire, a quantity of europium oxide, or other elemental metal or salt, selected to have suitable radiation characteristics; i. e., energy, type of radiation, and half-life, for a particular radiographic, or other application. Element 19 is hermetically sealed in capsule container 11 in the "cold" or inactive state, consequently presenting no radiation hazard, and remains sealed therein throughout the useful life of the source. After sealing, the capsule container is subjected to neutron bombardment, such as in an atomic reactor, to activate the element 19. Low atomic number material, and particularly 2S aluminum, having a very low neutron cross-section, becomes radioactive to a slight extent, but the resulting isotope has a half-life of only 2.3 minutes, for aluminum, with the result that its activity soon drops to a safe level after neutron bombardment is stopped.

After irradiation, capsule container 11, with the aid of suitable tongs, is inserted in capsule body 10 and secured in place by retaining screw 12, which is provided with a screw-driver slot 21. When assembled, active element 19 is surrounded essentially only by aluminum, with the result that there is little absorption by the source itself of the radiation from element 19, except in the direction of retaining screw 12, but the aluminum is still sufficiently encased by the stainless steel body 10 to be mechanically durable with ordinary handling. Body 10 being formed of magnetic material may be handled with magnetic tools, or by a cord passed through opening 16 as previously mentioned, or by a threaded rod inserted into threaded bore 13 behind retaining screw 12.

After a period of use determined by the half-life of element 19, such that the source strength falls below a useful value, the source is disassembled simply by removing retaining screw 12, and capsule container 11

alone is again subjected to neutron bombardment. After this re-irradiation, the container 11 is again assembled with body 10, and the source is ready for another period of use.

The drawings of the source have been greatly enlarged for clarity, the actual overall size being about $\frac{7}{8}$ inch in length and $\frac{3}{8}$ inch in diameter, the active element being about 2 mm. x 2 mm. in size. It will be understood of course that these dimensions are illustrative only, and not limiting in any way.

While a preferred embodiment of the invention has been illustrated and described, it will be apparent that various modifications may be made therein without departing from the spirit thereof, and it is therefore intended that the invention be limited only as such limitations occur in the appended claim.

What is claimed is:

A radiography source comprising a cylindrical capsule container formed of magnetic material having a bore of one diameter extending from one end for a portion of the length of the container and an opening of smaller diameter than said bore coaxial with said bore extending for the remaining portion of the length of said container, a generally cylindrical capsule formed of aluminum having an enlarged portion of substantially the diameter of said bore and a straight portion of a diameter substantially the diameter of said opening assembled with said container with said enlarged portion disposed within said bore and said straight portion projecting through said opening exteriorly of said container, said straight portion having hermetically and permanently sealed therein a quantity of iridium, and removable retaining means secured in said bore in contact with said enlarged portion of said capsule separably securing said capsule and container together whereby said capsule may be removed from said container and subjected to neutron bombardment to render the therein enclosed iridium radioactive while the aluminum remains safely non-radioactive.

References Cited in the file of this patent

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