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APPARATUS FOR STORING, HANDLING AND/OR UTILIZING HIGHLY RADIOACTIVE MATERIALS

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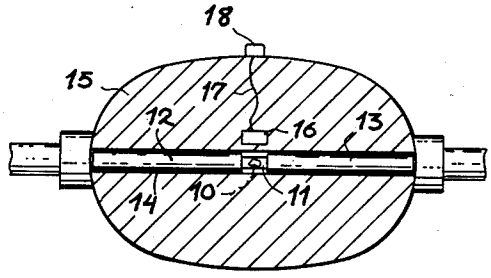


Fig. 1

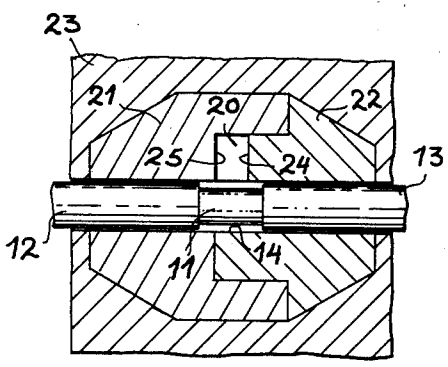


Fig. 2

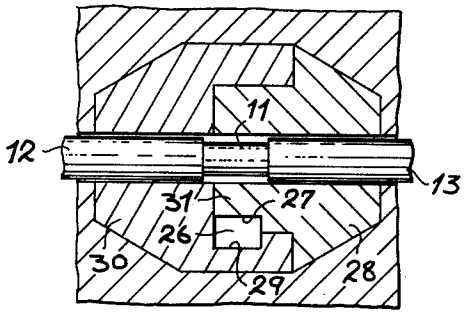


Fig. 3

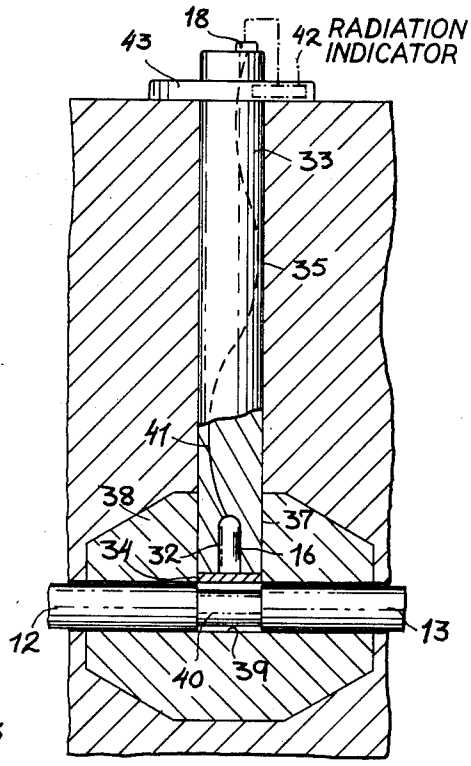


Fig. 4

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APPARATUS FOR STORING, HANDLING AND/OR UTILIZING HIGHLY RADIOACTIVE MATERIALS

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This invention relates to improvements in apparatus of the type used in order to facilitate the storage, handling and/or use of radioactive materials, including a body of substance that is highly absorbent of radiation enclosing within it a recess or cavity for receiving the radioactive substance (hereinafter sometimes referred to as the source) thereby to retain such substance in a protected position, means being provided for moving said substance between its said protected position and a position of exposure, or use.

The invention is more especially, though not exclusively, applicable to apparatus of the above type wherein the radiation emitter or source, in moving from its protected to its exposed position and vice versa, is passed through a duct formed in the protective body or mass.

In any such apparatus the precise position at which the radioactive material is located at a given time is more or less uncertain. It has been suggested in order to obviate this, in apparatus including a duct or channel through which the source is moved, to provide a series of electric contacts alongside the channel so that as the source support or carrier moves past such contacts corresponding signal lamps are lighted, thereby indicating the position of the source. Such a device, however, will yield erroneous indications should the source material for any reason become separated from its carrier; the operator may then be made to believe mistakenly that the source has been restored to its protected position while it has actually remained in a more or less exposed position in which it may be emitting dangerous radiation into surrounding space.

It is an object of the invention to provide means for positively and reliably indicating that the source is actually in its protected position. Another object is to provide means that will yield an effective and usable indication should the source material become for any reason divided or separated. It is, consequently, a further object to provide a device which will considerably reduce the hazards involved in the handling and utilization of highly radioactive materials.

The apparatus according to the invention comprises, close to the point at which the radioactive source material is located when in its prescribed protected position, means responsive to radiations emitted by said source, the sensitivity or responsiveness of said means being so predetermined that the means will not indicate the presence of radiation when the source is not located at its prescribed protected position but will only yield such indication when the source is located exactly at said prescribed protected position or at a position sufficiently close thereto as to ensure that effective protection is provided by the absorbent material surrounding the source cavity.

It has already been proposed to use radiation-responsive means for detecting the presence, absence, and/or relative proximity of a radioactive substance. In this connection the prior art has made available various types of detecting devices or cells having degrees of sensitivity varying in increments over a wide range.

However, my present system in contradistinction to these prior detecting devices employs such a disposition of the detecting means within the radiation-absorbing mass

that the sensitive detector or cell used therein can be subjected to radiation only from the radioactive material emitted by the source within the apparatus, so that a positive reading given by the detector constitutes a reliable indication that the radioactive material actually is in its prescribed protected position, and the absence of a positive reading shows that the substance is not in its prescribed protected position, either because it is in use or because of some accidental mishap or other occurrence.

The invention further includes an embodiment in which the sensitivity of the apparatus can be adjusted by interposing a filter made of radiation-absorbing material, whereby the apparatus may be adapted for use in various practical applications, including different ranges of energy rates of the radiations emitted by the radioactive materials used.

In the ensuing description reference will be made by way of example to the accompanying drawings, wherein:

FIG. 1 is a diagrammatic sectional view of one embodiment;

FIG. 2 is a diagrammatic sectional view on a larger scale and taken near the detector cell;

FIG. 3 is similar to FIG. 2 and relates to a modified embodiment; and

FIG. 4 is a partial sectional view of another embodiment.

A radioactive material or source **10**, such as an isotope, is contained within a carrier **11** forming part of a movable assembly which further includes, on each side of the carrier, an elongated plug or rod, respectively designated **12** and **13**, made of absorbing material. The assembly is slidably received in a duct or channel **14** formed through a mass **15** of absorbent material, this duct being consequently straight and of uniform cross-section to enable the sliding displacement of rods **12, 13** therein. The apparatus further includes conventional means for passing the radioactive source material **10** from its prescribed protected position, shown in FIG. 1, where it is located in the center of the mass **15**, to an exposed position exteriorly of said mass, and back to its protected position as desired.

In accordance with the invention a detector unit or cell **16** responsive to radiation from the source material **10** is positioned within the mass **15** near the prescribed protected position of said source, and the sensitivity of the detector **16** is so selected or adjusted that the detector cell will furnish a positive reading only when the source **10** is actually in its prescribed protected position, or near enough to that position to ensure that the mass **15** will properly exert its protective function.

Between the detector cell **16** and the position selected as the protected position for the source **10**, a radiation filter or attenuator, such as a screen of selected thickness made from a radiation-absorbent material, may be interposed.

The detector unit is desirably of the "radio-resistive" type, that is, its resistance to electric current is varied with the rate of radiation striking it. In such case the previously indicated condition can be restated as implying that the resistance of the detector cell must remain constant so long as the radiation received by it from the source has not attained a value corresponding to that received by it when the source is in, or in immediate proximity to, its prescribed protected position, as explained above. Satisfactory results have been obtained when using radiation-resistive cells comprising cadmium sulfite; gadolinium cells are also satisfactory. The dimensions should be small enough to ensure that the cavity receiving the cell will not substantially impair the protective capacity of the absorbing mass or body **15**.

The detector cell is connected with the exterior circuit

by conductor means 17 leading to a terminal 18 on the outer surface of the body 15.

Reference now will be made to FIG. 2. In this embodiment, the cavity 20 receiving the radio-sensitive detector cell is defined between two cores 21 and 22 of tungsten or other heavy metal, constituting the central part of the protective mass the remainder of which, shown at 23, is made of lead. In the embodiment of FIG. 2, the cavity 20 is defined between the inner front face 24 of core 22 and an inner end surface 25 formed in the core 21.

In the modification of FIG. 3, the cavity 26 for the detector cell is formed between the outer surface 27 of one core 28 and the inner surface 29 of the other core 30. In this construction an annulus 31 forming the inner end of the core 28 may be regarded as constituting a filter screening the detector cell from the radiations from the source supported by carrier 11.

In the modified construction of FIG. 4, the cell 16 is placed in a recess 32 defined at the end of a rod 33 made of lead or other heavy metal, and the opening of the recess 32 is sealed by a partitioning plate 34. The rod 33 is pushed into a channel or well 35 which is formed in the mass 36 of lead or the like and registers with another channel 37 formed in the core 38, of tungsten or the like, constituting the central core of the protecting assembly. Removable means may if desired be used for attachment to the rod 33. In a modified construction, the core 38 may be omitted, and the chimney 35 through the protecting mass may then be made to open directly into the channel 14. The channel 37 registers with the recess 39 receiving the radioactive material 40 in protected position, and the plate 34 may be made from a material providing a partial screen for the cell 16 against radiation emitted by source 40. The detector cell 16 could also be incorporated in the sealing plate 34. A conductor 41 extending along a sinuous path is imbedded in the rod 33 and is connected with a terminal 18 at the end of the rod for connecting detector 16 with an electric measuring circuit 42 for indicating the variations in resistance of the detector cell when the latter is exposed to the radiation from the source.

The rod 33 is shown carried by a base 43 which incorporates the measuring circuit 42 serving to indicate the variations in resistance.

What I claim is:

1. An apparatus for the storing and handling of a radiation emitter, comprising a protective mass adapted to shield the operating personnel from said radiation upon the lodging of said emitter substantially at the center of said mass, said mass being provided with a straight duct of uniform cross-section open at its ends and passing substantially through said center, a carrier for said emitter movably disposed in said duct, a pair of elongated plugs slidably fitting within said duct on opposite sides of said carrier, said plugs being composed of a material adapted to absorb radiation from said source, thereby substantially blocking the passage of radiation from said source through said duct in a position of said source within said mass, said carrier and said plugs being displaceable within said duct between a shielded position near said center and an exposed position remote therefrom in which said carrier lies outside said mass, a radiation-sensitive cell positioned within said mass in the vicinity of said shielded position adjacent the path of displacement of said carrier, and electrical circuit means connected to said cell for providing externally of said mass an indication of the intensity of irradiation of said cell by said emitter.

2. In an apparatus for the storing and handling of a radiation emitter, in combination, a body of protetcive material adapted to shield said emitter upon the withdrawal of the latter during periods of non-use into a shielded position substantially at the center of said body, said body being provided with a straight duct of uniform cross-section open at its ends and passing substantially through said center, a carrier for said emitter movably

disposed in said duct, a pair of elongated plugs slidably fitting within said duct on opposite sides of said carrier, said plugs being composed of a material adapted to absorb radiation from said source, thereby substantially blocking the passage of radiation from said source through said duct in the shielded position of said source, said body being provided with a channel extending substantially transversely to said duct and opening into same at said shielded position, a rod of heavy metal tightly fitting into said channel and substantially filling same while having an outer end substantially level with the exterior of said body, said body being provided at its opposite end with a recess facing said duct, a cell sensitive to the radiation of said source in said recess, electric connector means extending from said cell to the exterior of said body, and indicator means coupled to said connector means externally of said body for signaling the intensity of radiation impinging upon said cell.

3. The combination according to claim 2 wherein said rod is provided at its outer end with a base rigidly attached thereto, said indicator means being mounted on said base.

4. An apparatus for storing and handling a radioactive source, comprising a carrier for said source; a mass for protecting surrounding premises from radiation emitted by the source when not in use; said mass being provided with an elongated straight duct of uniform cross-section open at its ends for permitting movement of said carrier and said source from a protected position wherein said source is disposed within said mass to an exposed position wherein said source is disposed exteriorly of said mass and vice versa; a pair of elongated plugs slidably fitting within said duct on opposite sides of said carrier, said plugs being composed of a material adapted to absorb radiation from said source, thereby substantially blocking the passage of radiation from said source through said duct in the protected position of said source, said mass further having a recess located adjacent said duct at said protected position; an element sensitive to the radiation of said source in said recess; and indicating means connected to said element for providing externally of the mass a first indication when the source is at said protected position and another indication when the source is not at said protected position.

5. An apparatus for storing and handling a radioactive source comprising a carrier for said source; a protective mass provided with a straight duct of uniform cross-section open at its ends for permitting movement of said carrier and said source; a pair of elongated plugs slidably fitting within said duct on opposite sides of said carrier, said plugs being composed of a material adapted to absorb radiation from said source, thereby substantially blocking the passage of radiation from said source through said duct in a position of said source within said mass; a first heavy-metal core portion and a second heavy-metal core portion jointly constituting a core for said protective mass traversed by said duct, said portions defining between each other a recess communicating with said duct; an element sensitive to the radiation of said source in said recess; and indicating means located externally of said mass and connected with said element to provide different indications varying with the distance of said source substantially at the center of said core.

6. An apparatus for storing and handling a radioactive source, comprising a carrier for said source; a protective mass provided with a straight duct of uniform cross-section open at its ends for permitting movement of said carrier and said source through the mass; a pair of elongated plugs slidably fitting within said duct on opposite sides of said carrier, said plugs being composed of a material adapted to absorb radiation from said source, thereby substantially blocking the passage of radiation from said source through said duct in a position of said source within said mass; a first heavy-metal core portion and a second heavy-metal core portion jointly constituting a core for said protective mass traversed by

said duct, said portions defining between each other a recess separated from said duct by a part of said core and located adjacent to a prescribed source-storage position substantially at the center of said core, an element sensitive to the radiation from said source disposed in said recess; and indicating means located externally of said mass and connected with said element to provide different indications varying with the distance of said source from said source-storage position.

7. An apparatus for storing and handling a radioactive source, comprising a carrier for said source; a protective mass provided with a straight duct of uniform cross-section open at its ends for permitting movement of said source between a protected position located substantially at the center of said mass and an exposed position exteriorly thereof; a pair of elongated plugs slidably fitting within said duct on opposite sides of said carrier, said plugs being composed of a material adapted to absorb radiation from said source, thereby substantially blocking the passage of radiation from said source through said duct in the protected position of said source; a slidable member extending through said mass between the exterior thereof and said duct, said member being provided with a recess at one end thereof adjacent said duct; a plate of heavy-atomic material sealing the opening of said recess adjacent said duct; an element sensitive to the radiation of said source in said recess; conductor means imbedded in said member and connected to said element; and indicating means connected to said conductor means and controlled by said element.

8. An apparatus for the storing and handling of a radiation emitter, comprising a protective mass adapted to shield the operating personnel from said radiation upon the lodging of said emitter substantially at the center of said mass, said mass being provided with a straight duct of uniform cross-section provided with an open end passing substantially through said center, a carrier for said emitter movably disposed in said duct, an elongated plug slidably fitting within said duct between said carrier and said open end, said plug being composed of a material adapted to absorb radiation from said source, thereby substantially blocking the passage of radiation from said source through said duct in a position of said source within said mass, said carrier and said plugs being displaceable within said duct between a shielded position in which said carrier lies near said center and an exposed position remote therefrom in which

said carrier lies outside said mass, a radiation-sensitive cell positioned within said mass in the vicinity of said shielded position adjacent the path of displacement of said carrier, and electrical circuit means connected to said cell for providing externally of said mass an indication of the intensity of irradiation of said cell by said emitter.

9. An apparatus for storing and handling a radioactive source, comprising a carrier for said source; a mass for protecting surrounding premises from radiation emitted by the source when not in use; said mass being provided with a straight duct of uniform cross-section provided with an open end for permitting movement of said carrier and said source from a protected position wherein said source is disposed within said mass to an exposed position wherein said source is disposed exteriorly of said mass and vice versa; an elongated plug slidably fitting within said duct between said carrier and said open end, said plug being composed of a material adapted to absorb radiation from said source, thereby substantially blocking the passage of radiation from said source through said duct in the protected position of said source, said mass further having a recess located adjacent said duct at said protected position; an element sensitive to the radiation of said source in said recess; and indicating means connected to said element for providing externally of the mass a first indication when the source is at said protected position and another indication when the source is not at said protected position.

References Cited in the file of this patent

UNITED STATES PATENTS

Re. 24,544	Morganstern	Sept. 30, 1958
2,315,819	Schlesman	Apr. 6, 1943
2,456,233	Wolf	Dec. 14, 1948
2,594,970	Monk	Apr. 29, 1952
2,597,535	Serge	May 20, 1952
2,640,936	Pajes	June 2, 1953
2,843,753	Meeder	July 15, 1958
2,916,628	Prest	Dec. 8, 1959
2,937,275	Thourson et al.	May 17, 1960
2,971,089	Haywood	Feb. 7, 1961
2,998,519	Tunnicliffe et al.	Aug. 29, 1961
2,998,522	Martin et al.	Aug. 29, 1961

FOREIGN PATENTS

793,905	Great Britain	Apr. 23, 1958