OR 3,256,441

SEARCH ROOM

June 14, 1966 W. P. GRASTY 3,256,441

CONTAINER SYSTEM FOR RADIOACTIVE MATERIAL

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FIG. 2

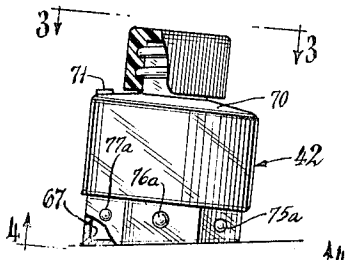


FIG. 4

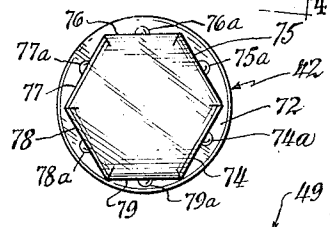
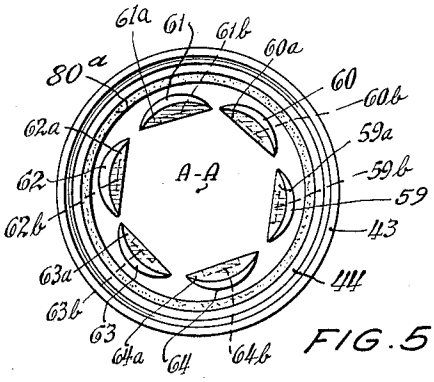


FIG. 5



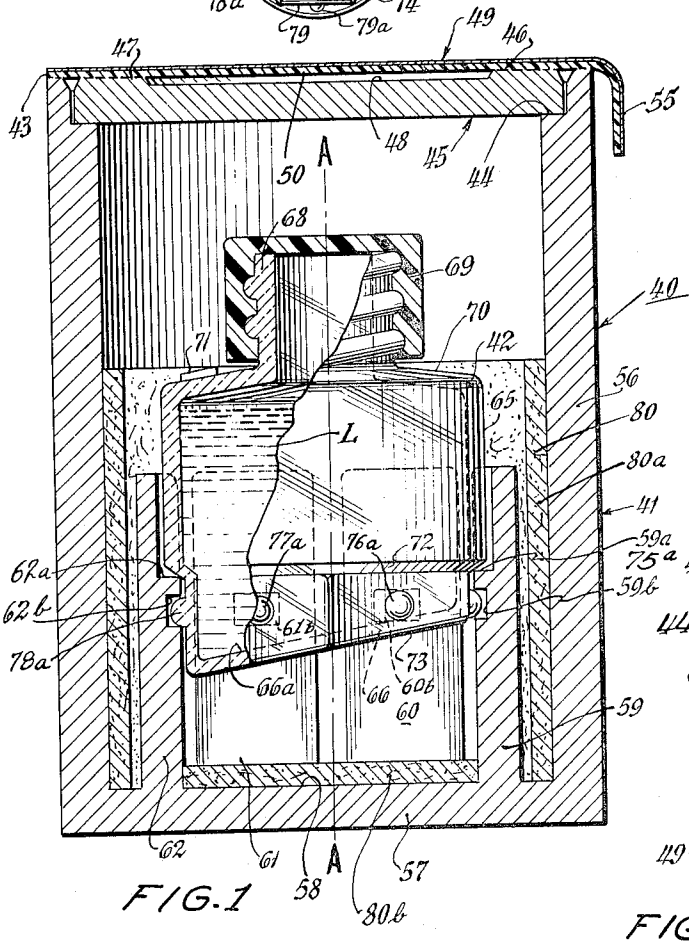


FIG. 1

FIG. 3

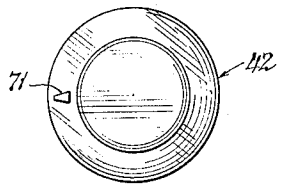
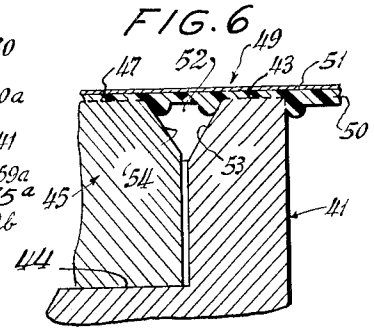


FIG. 6



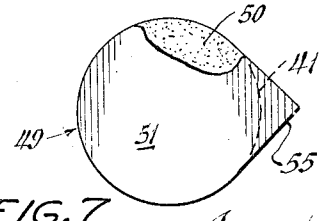


FIG. 7

Inventor:
William P. Grasty
By Joseph J. Grass
Attorney

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FIG.8

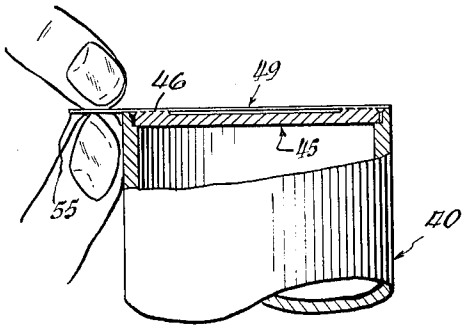


FIG.9

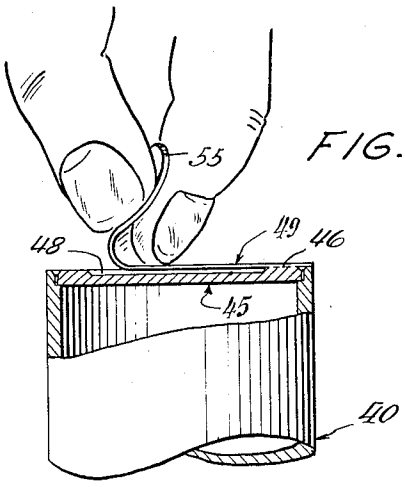


FIG.10

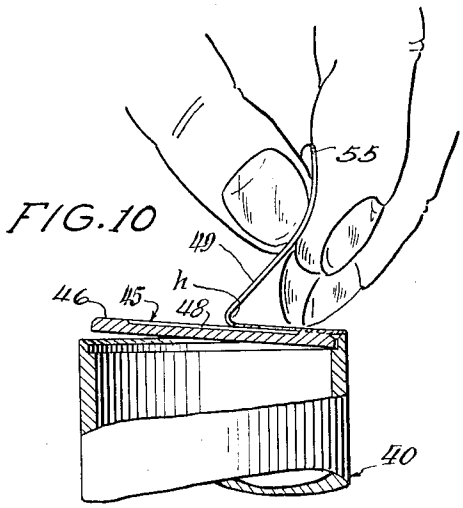


FIG.11

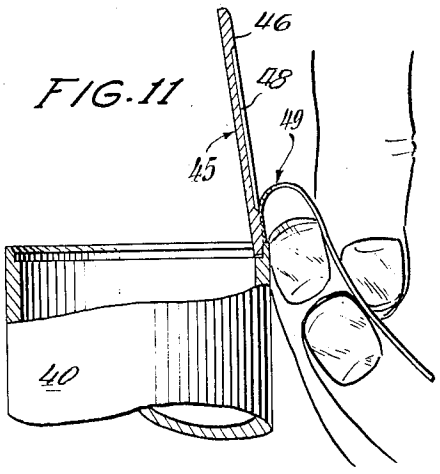
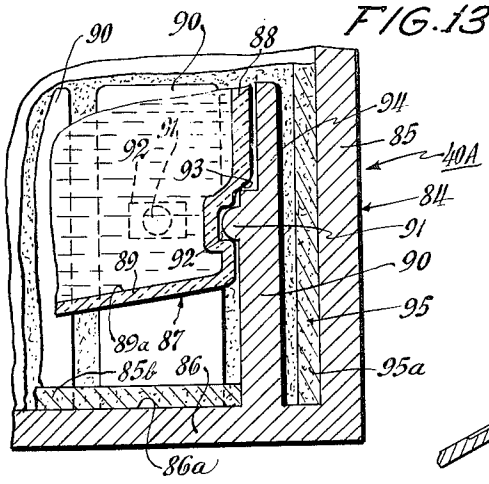


FIG.13



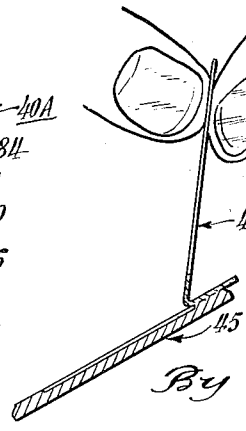


FIG.12

Inventor:
William P. Grasty
By Joseph J. Grass
Attorney

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CONTAINER SYSTEM FOR RADIOACTIVE MATERIAL

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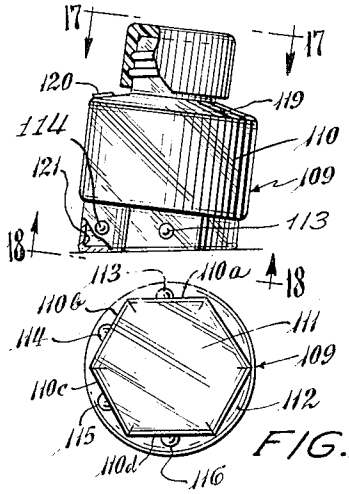
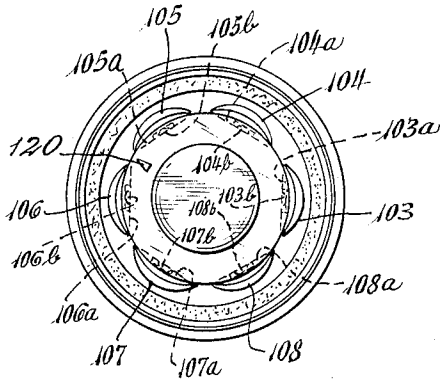


FIG. 16

FIG. 18

FIG. 19



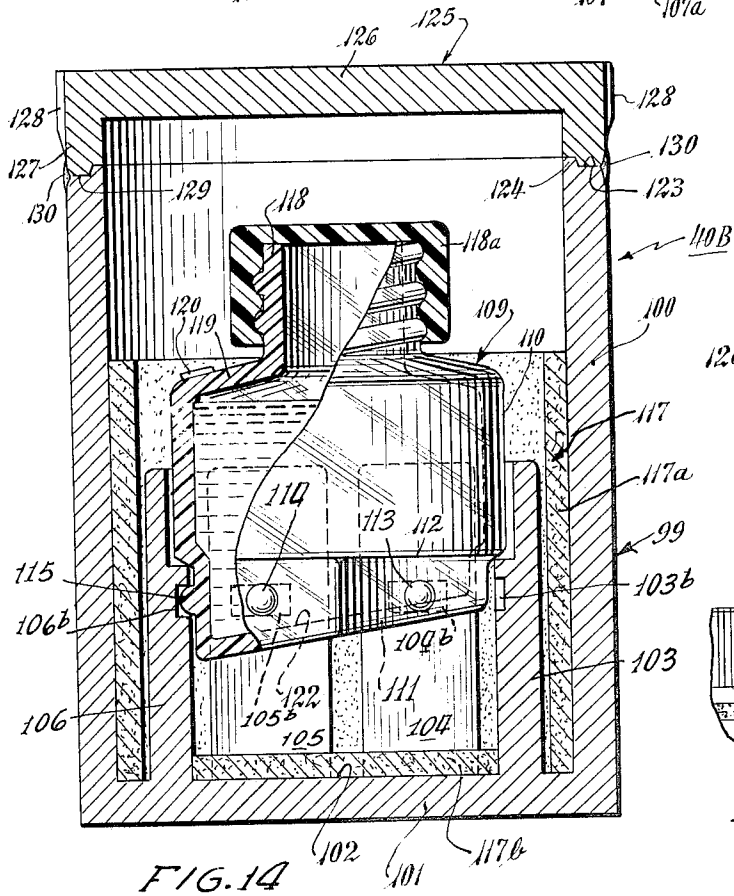
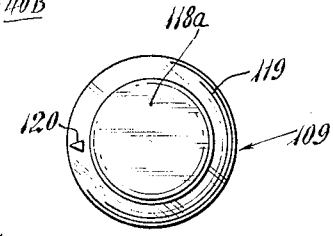


FIG. 14

FIG. 17



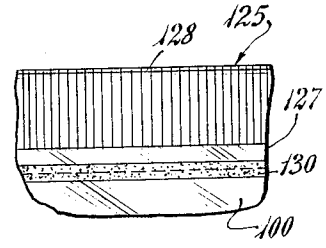


FIG. 15

Inventor:
William P. Grasty
By Joseph J. Grass
Attorney

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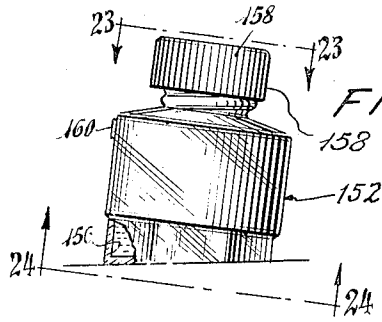


FIG. 22

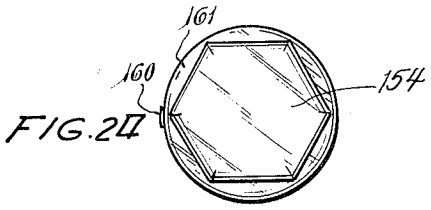


FIG. 24

FIG. 25

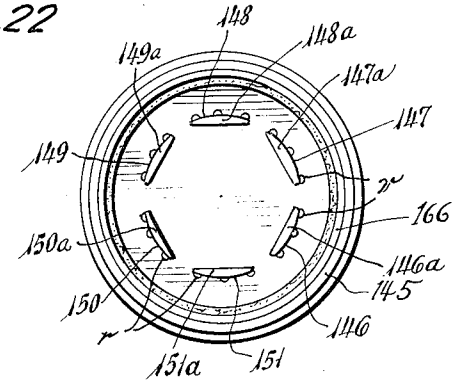
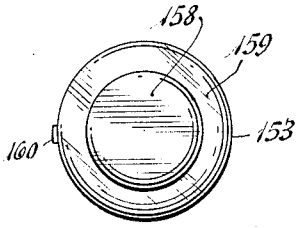


FIG. 23



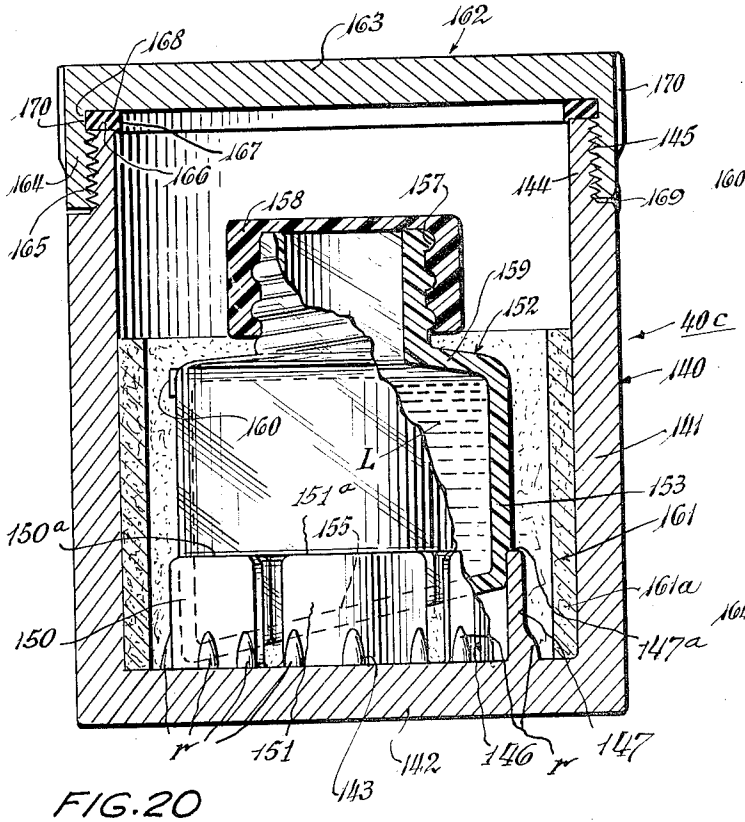
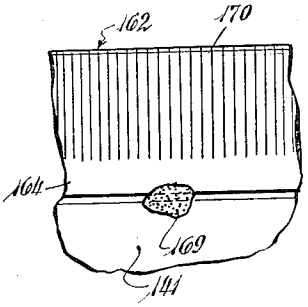


FIG. 20

FIG. 21



Inventor:
William P. Grasty
By Joseph J. Grass
Attorney

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FIG. 27

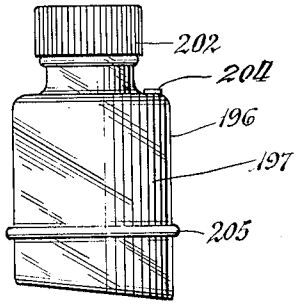


FIG. 28

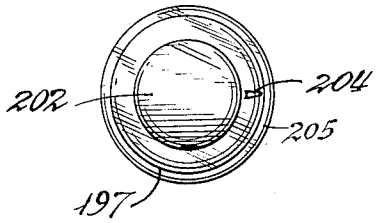


FIG. 29

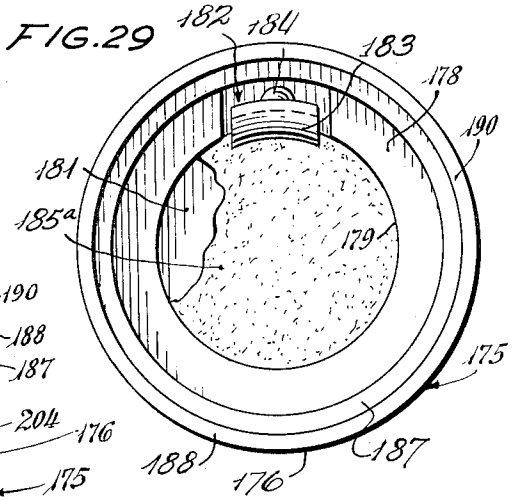


FIG. 26

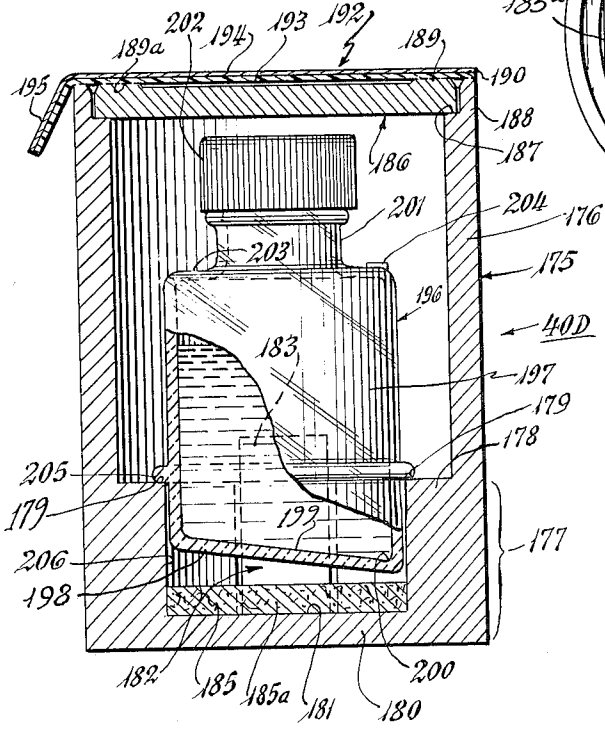
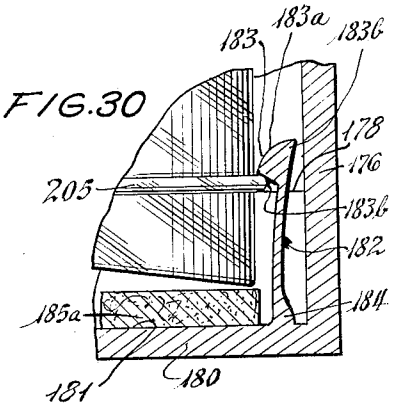


FIG. 30



Inventor:
William P. Grasty
By Joseph J. Grass
Attorney

United States Patent Office 3,256,441 Patented June 14, 1966

3,256,441

CONTAINER SYSTEM FOR RADIOACTIVE MATERIAL

William P. Grasty, Zion, Ill., assignor to Abbott Laboratories, North Chicago, Ill., a corporation of Illinois

Filed Nov. 26, 1962, Ser. No. 239,932
9 Claims. (Cl. 250—108)

This application is a continuation-in-part of Serial No. 115,854, filed May 26, 1961, now abandoned, which is a continuation-in-part of Serial No. 42,164, filed July 11, 1960, now abandoned.

This invention relates to a container system and in particular to a container system which is particularly adapted for the storage, shipment and removal of a radioactive material.

It is one of the purposes of the invention to provide a construction which is simple and relatively economical to manufacture and yet has salient features which enable a radioactive material to be safely stored, shipped and removed.

It is a feature of the invention to provide an outer container and an inner container with the inner container being releasably locked in the outer container.

It is a feature of the invention to provide an outer container composed of a radioactive shielding material which contains a sufficient amount of thermoplastic resin material so that the radioactive shielding material is inherently somewhat resilient. Prior art containers composed of radioactive shielding material have been constructed for example of lead, a lead-antimony alloy or the like which possess negligible resilience. The inherent resilience of the material employed in the subject invention enables the inner container, which is adapted to contain a radioactive material, to be releasably locked in the outer container.

It is another feature of the invention to provide an outer container and an inner container with both the outer container and the inner container having locking portions which mate. Either the outer container or the inner container or both are at least locally sufficiently resilient to enable the inner container to be releasably locked relative to the outer container. Releasable locking enables the user to remove the inner container from the outer container for purposes for example of visual inspection of the radioactive material.

It is another feature of the invention to provide an outer container and an inner container with the inner container being suspended above a floor of the outer container. In the event of a defective inner container, for example one having a pinhole or crack, the radioactive material which leaks therefrom will drip out of contact with the inner container. Should the inner container be removed from the outer container, the outer surface of the inner container will not be drenched with the radioactive material. It is preferable to provide an absorbent material preferably at a stratum between the floor of the outer container and the inner container such that any and all radioactive material which leaks from the inner container will be absorbed.

It is another feature of the invention to provide an inner container which has at least one locking portion and at least one shoulder portion above the locking portion whereby the inner container can be suspended and releasably locked in an outer container.

It is another feature of the invention to provide a container having a side wall and a floor which is disposed obliquely with respect to the side wall so that the last traces of a mobile liquid gravitate to the lowest confines of the floor when the container is disposed in an approximately upright position with indicating means visible from above the container for indicating the lowest confines to which the last traces of the mobile liquid gravitate.

It is another feature of the invention to provide a container composed of a radioactive shielding material containing a sufficient amount of thermoplastic resin material to render the radioactive shielding material readily sealable. An overseal including a thermoplastic resin material can readily be sealed to the container or sealed to the container and a closure so as to provide an effective hermetic overseal. It is readily apparent that the shielding material of which the outer container is composed not only serves the purpose of shielding against radioactivity but also enables an effective, simple and inexpensive overseal to be made. Prior art containers composed of conventional radioactive shielding materials have lacked the feature of ready sealability. Alternatively, a hermetic seal can be formed between the closure and the container itself and a spot seal with a spot seal employed to locally join the closure and container to render the closure tamper-proof.

By another alternative construction, the closure can be joined by a continuous rupturable seal to the container so that not only is the container hermetically sealed against leakage but it is rendered tamper-proof.

It is another feature of the invention to provide a closure and container composed of radioactive shelding material which have a sufficient amount of thermoplastic resin material to render the shielding material readily sealable; the upper terminal end of the container lies substantially in the same plane as the upper surface of the closure. A substantially planer overseal is simply sealed to the upper terminal end of the container or to the upper terminal end of the container and the closure. This simple construction enables an effective overseal to be accomplished with simple and conventional sealing dies. It is preferred that the holding strength of the overseal to the terminal end of the container be weaker than the holding strength of the overseal to the upper surface of the closure so that the overseal and the closure can be removed as a unit from the container.

In the diagrammatic, illustrative drawings:

FIGURE 1 is a side elevational view, mainly in cross-section and partly broken away, showing one embodiment of the container system of the invention;

FIGURE 2 is a side elevational view, partly broken away, showing an inner container which is adapted to contain a radioactive material;

FIGURE 3 is a view taken along line 3—3 of FIGURE 2;

FIGURE 4 is a view taken along line 4—4 of FIGURE 2;

FIGURE 5 is a top plan view showing the outer container and liner;

FIGURE 6 is a fragmentary cross-sectional elevational view, showing the manner in which the overseal appears after it has been sealed to the outer container and closure;

FIGURE 7 is a top plan view of the container system, partly broken away, showing in particular an overseal;

FIGURE 8 is a fragmentary elevational view, partly in cross-section, showing the closure and overseal in position on the outer container, prior to the attempted removal of the overseal by the user;

FIGURE 9 is a fragmentary elevational view, partly in cross-section, showing the preferred manner in which a user would start to peel back the overseal;

FIGURE 10 is a fragmentary elevational view, partly in cross-section, showing an advanced stage of the removal of the overseal with the consequent slight lifting of the closure from its seating position against the outer container;

FIGURE 11 is a fragmentary elevational view, partly in cross-section, showing a highly advanced stage of the

removal of the overseal with the consequent substantial lifting of the closure from its seating position against the outer container;

FIGURE 12 is a cross-sectional view of the closure and overseal after they have been removed as a unit from the outer container;

FIGURE 13 is a fragmentary cross-sectional view of an alternative embodiment of the container system of the invention;

FIGURE 14 is an elevational view, mainly in cross-section and partly broken away, showing another embodiment of the container system of the invention;

FIGURE 15 is an elevational view showing a fragmentary portion of an outer container of the embodiment of FIGURE 14 of the illustrative drawings;

FIGURE 16 is a side elevational view, partly broken away, of the inner container shown in FIGURE 14 of the illustrative drawings;

FIGURE 17 is a view taken along line **17—17** of FIGURE 16;

FIGURE 18 is a view taken along line **18—18** of FIGURE 16;

FIGURE 19 is a top plan view of the outer container, the inner container and a liner;

FIGURE 20 is a side elevational view, mainly in cross-section and partly broken away, showing another embodiment of the container system of the invention;

FIGURE 21 is in an elevational view showing a fragmentary portion of an outer container of the embodiment of FIGURE 20 of the illustrative drawings;

FIGURE 22 is an elevational view of the inner container and the closure;

FIGURE 23 is a view taken along line **23—23** of FIGURE 22;

FIGURE 24 is a view taken along line **24—24** of FIGURE 22;

FIGURE 25 is a top plan view of the outer container and a liner;

FIGURE 26 is a side elevational view, mainly in cross-section and partly broken away, showing another embodiment of the container system of the invention;

FIGURE 27 is a side elevational view of an inner container shown in FIGURE 26;

FIGURE 28 is a top plan view of the inner container;

FIGURE 29 is a top plan view of an outer container; and

FIGURE 30 is an elevational fragmentary view, showing in detail the manner in which the inner container is releasably locked relative to the outer container.

Referring now to the embodiment of FIGURES 1 through 12 of the illustrative drawings, there is shown a container system generally indicated at **40**. The container system **40** includes an outer container generally indicated at **41** and an inner container generally indicated at **42**. The outer container **41** is composed of a composition of lead oxide and polyethylene, with about nine parts by weight of lead oxide and about one part by weight of a thermoplastic resin material, specifically polyethylene. Although this particular composition is preferred, other ratios of these or equivalent constituents which will render the radioactive shielding material readily sealable and resilient are employable to accomplish all the purposes of the invention. Of course, it is to be understood that some of the features of the invention are able to be accomplished with the radioactive shielding material having the property of ready sealability with or without the property of resilience and other of the features of the invention are able to be accomplished with the radioactive shielding material having the property of resilience with or without the property of ready sealability. The outer container **41** is shown to be circular in cross-section, however, other suitable shapes are employable. The outer container **41** has a continuous upper terminal end **43**. An internal shoulder **44** which is spaced downwardly of the upper terminal end of the container **41** provides a seat against which a closure **45** is normally seated. The closure **45** is composed of the same material as that of the outer container **41**. A continuous annular bead **46** of the closure **45** defines an upper surface **47** which lies in substantially the same plane as the upper terminal end **43** of the container **41**. The bead **46** is shown to define a valley **48**; if desired, the upper surface of the closure **45** can be constructed to lie entirely in the plane of the upper terminal end **43** of the container **41**, however, the removal of an overseal generally indicated at **49** is facilitated by the construction shown. The overseal **49** is shown to be composed of a film of thermoplastic material **50**, for example polyethylene which is preferably bonded to a metallic backing **51** composed for example of aluminum. A planer sealing die (not shown) of simple and conventional construction can be brought against the overseal **49** to seal the overseal **49** to the container **41** and the closure **45**. When the seal has been completed, a seal exists between the overseal **49** and the outer container **41** and between the overseal **49** and the closure **45**. A slight recess **52** is formed by a tapering upper inner edge **53** of the container **41** and a tapering upper outer edge **54** of the closure **45** to permit the plastic material **50** to flow by extrusion as the thermoplastic material **50** is being sealed to the upper terminal end **43** of the container **41** and the upper surface **47** of the closure **45** as best seen in FIGURE 6 of the illustrative drawings. As best shown in FIGURE 1 of the illustrative drawings, the bead **46** is shown to be somewhat wider than the upper terminal end **43** of the container **41**. Since the area of the seal between the overseal **49** and the container **41** is less than the area of the seal between the overseal **49** and the closure **45**, the holding force of the overseal **49** to the container **41** is less than the holding force of the overseal **49** to the closure **45**. This enable the overseal **49** and the closure **45** to be removed as a unit from the container **41**. The overseal **49** is provided with a tab **55** which may be readily grasped by the user when it is desired to remove the overseal **49** and the closure **45** from the container **41** by a method later to be described.

The outer container **41** is shown to have an open-ended side wall **56** joined to a floor **57**, with the floor **57** having an upper surface **58**. Extending upwardly from the floor **57** and formed integrally therewith, there are shown to be a plurality of spaced-apart upstanding fingers **59**, **60**, **61**, **62**, **63** and **64** which because of the material of which they are composed and their relative length are inherently resilient. The upstanding fingers **59**, **60**, **61**, **62**, **63** and **64** are spaced from the side wall **56** and are spaced substantially equidistantly from a central axis A—A. Since the upstanding fingers **59**, **60**, **61**, **62**, **63** and **64** are integral with the floor **57**, the outer container **41** is of one-piece construction. The upstanding fingers **59**, **60**, **61**, **62**, **63** and **64** are shown to have upwardly facing shoulders **59***a*, **60***a*, **61***a*, **62***a*, **63***a* and **64***a* which define seats and locking portions in the form of inwardly facing recesses **59***b*, **60***b*, **61***b*, **62***b*, **63***b* and **64***b*, respectively.

The inner container **42** has a longitudinally extending side wall **65** which joins a floor **66** having an upper surface **66***a*. The floor **66** extends obliquely with respect to the longitudinally extending side wall **65** so that the last traces of a mobile liquid L, in this instance specifically a mobile radioactive liquid, within the container **42** will be confined to the lowest confines **67** of the floor **66** at the lowest end of the side wall **65**. The inner container **42** is shown to be provided with a threaded neck **68** which is shown to receive a threaded cap **69**. The neck **68** is connected to the side wall **65** by what is shown to be an annular web **70**. The web **70** contains an integrally formed indicator **71** which is disposed immediately above the lowest confines **67**. It is readily apparent that when the closure **45** is removed, the user, peering at the inner container **42** from above, will be able to tell visually where he should dispose the end of the withdrawing instrument such

as a hypodermic syringe (not shown) in order to withdraw the last traces of the mobile liquid L. The side wall **65** has, at a generally lower portion thereof, what is shown to be a continuous downwardly facing external shoulder **72**. Joining the shoulder **72** and the floor **66** are a plurality of joined sections **74, 75, 76, 77, 78** and **79**. The sections **74, 75, 76, 77, 78** and **79** each have locking portions which are specifically shown to take the form of outwardly extending projections **74***a*, **75***a*, **76***a*, **77***a*, **78***a* and **79***a*, respectively. The shoulder **72** of the inner container **42** is shown to be seated against the shoulders **59***a*, **60***a*, **61***a*, **62***a*, **63***a* and **64***a* and the projections **74***a*, **75***a*, **76***a*, **77***a*, **78***a* and **79***a* are receivable, for example, in mating locking portions **59***b*, **60***b*, **61***b*, **62***b*, **63***b* and **64***b* of the fingers **60**, **61**, **62**, **63** and **64**, respectively. In the embodiment of FIGURES 1 through 12 of the illustrative drawings, the inner container **42** is shown to be composed of a rigid material, more particularly transparent glass. The upstanding fingers **59, 60, 61, 62, 63** and **64** are sufficiently flexible and resilient to enable the projections **74***a*, **75***a*, **76***a*, **77***a*, **78***a* and **79***a* to be resiliently releasably locked into the recesses **59***b*, **60***b*, **61***b*, **62***b*, **63***b* and **64***b* by a snapping action. The upstanding fingers **59, 60, 61, 62, 63** and **64** at the place of the recesses **59***b*, **60***b*, **61***b*, **62***b*, **63***b* and **64***b* move in a transverse outward direction to enable the releasable locking to be accomplished. It is obvious that the inner container **42** is able to be releasably locked in the container **41** in any one of six positions due to the positionment of the six upstanding fingers **59, 60, 61, 62, 63** and **64**. The upstanding fingers **59, 60, 61, 62, 63** and **64** have sufficient length to suspend the inner container **42** at least slightly above the upper surface **58** of the floor **57**. This is extremely desirable because, should the inner container be defective and leak as the result for example of a pinhole or crack, radioactive material will drip downwardly toward the floor **57** and consequently the container will not be drenched in the radioactive material. Absorbent material **80**, specifically shown to include an absorbent liner **80***a*, is shown to extend between the side wall **56** and the upstanding fingers **59, 60, 61, 62, 63** and **64** and extends down into abutment with the upper surface **58** of the floor **57**. It is preferred to terminate the liner **80***a* at or slightly below the lower end of the closure cap **69** so that a gripper device (not shown) disclosed in Patent No. 2,985,045 can be employed to readily remove the closure cap **69**. The absorbent material **80** also includes an absorbent disk **80***b* which is shown to be resting on the upper surface **58** of the floor **57** and is held against movement by frictional engagement with the fingers **59, 60, 61, 62, 63** and **64**. Since a lower surface **73** of the container **42** is suspended above the upper surface **58** of the floor **57**, radioactive liquid which leaks from the container **42** will drip downwardly and be absorbed by the absorbent disk **80***b* and any excess will pass between the spaced fingers **59, 60, 61, 62, 63** and **64** to be absorbed by the absorbent liner **80***a*.

The manner of removing the overseal **49** is best illustrated by referring to the diagrammatic drawings of FIGURES 8 through 12. FIGURE 8 shows a fragmentary portion of the outer container with the overseal **49** in the position it is received by the user. The user first grasps the tab **55**, as shown, with the thumb and index finger of one hand.

Referring now to FIGURE 9 of the illustrative drawings, the overseal **49** is shown to be partly removed and the closure **45** is shown to be in the same position as in FIGURE 8 of the drawings. In FIGURE 10 of the drawings, the overseal **49** is shown to be removed to a somewhat greater extent than shown in FIGURE 9 and the closure **48** is being pulled upwardly to a slight extent. A relatively sharp hinge *h*, formed when the overseal **49** is in the position shown in FIGURE 10, causes great stress to be developed, especially at the seal between the upper terminal end **43** of the container **41** and the overseal **49**. As the user continues pulling on the overseal **49**, the closure **45**, to which the overseal **49** is still partially attached, is swung into the poistion shown in FIGURE 11 of the drawings. As the user continues to pull on the tab **55**, the hinging action causes unbearable stress between the seal at the upper terminal end **43** and the overseal **49**. Finally, the user has removed the closure **45** and the overseal **49** as a unit as best shown in FIGURE 12 of the drawings. Although the user is able to completely remove the overseal **49** from the closure **45** and the container **41** by holding down the closure **45** or by pulling on the overseal **49** in a direction substantially parallel to the plane defined by the upper terminal end **43** of the container **41**, this is not the preferred method.

Turning now to the embodiment of FIGURE 13 of the illustrative drawings, there is shown a fragmentary portion of the container system generally indicated at **40A**. The container system **40A** has an outer container generally indicated at **84** having a side wall **85** and a floor **86** having an upper surface **86***a* and an inner container generally indicated at **87** having a side wall **88** and a floor **89** having an upper surface **89***a*. A plurality of spaced-apart upstanding fingers **90**, spaced inwardly from the side wall **85**, have locking portions specifically in the form of inwardly extending projections **91** which engage mating locking portions in the inner container **87** specifically in the form of recesses **92**. The side wall **88** of the inner container **87** has a downwardly facing shoulder **93** which abuts an upwardly facing shoulder **94** on upstanding fingers **90**. The fingers **90** are sufficiently flexible and resilient and sufficiently long to enable the inner container **87** to be resiliently locked into releasable locking engagement by means of the projections **91** on the fingers **90** and the recesses **92** in the inner container **87**. Absorbent material **95**, suitable for absorbing the radioactive liquid L, is shown to take the form of an absorbent liner **95***a* which is frictionally held in place by the side wall **85** and an absorbent disk **95***b* which rests against the upper surface **86***a* of the floor **85** and which is frictionally held against movement by the fingers **90**. The container system **40A** is exactly the same in construction as that shown in the embodiment of FIGURES 1 through 12 of the illustrative drawings with the exception that the projections **91** are on the fingers **90** and the recesses **92** are in the inner container **87**.

Referring now to the embodiment of FIGURES 14 through 19 of the illustrative drawings, there is shown a container system generally indicated at **40B**. The container system **40B** includes an outer container generally indicated at **99** having a longitudinally extending open-ended side wall **100** joined to a floor **101** having an upper surface **102**. The outer container **99** is preferably composed of the same material as the outer container **41** of the embodiment of FIGURES 1 through 12 of the illustrative drawings. A plurality of spaced-apart upstanding fingers **103, 104, 105, 106, 107** and **108**, spaced inwardly from the side wall **100**, are shown to be provided with upwardly facing shoulders **103***a*, **104***a*, **105***a*, **106***a*, **107***a* and **108***a* and inwardly facing locking portions which specifically take the form of inwardly facing recesses **103***b*, **104***b*, **105***b*, **106***b*, **107***b* and **108***b*, respectively. An inner container generally indicated at **109** is shown to have a longitudinally extending side wall **110** joined to a floor **111**. The floor **111** is shown to be disposed obliquely with respect to the side wall **110** for the purposes described in the embodiment of FIGURES 1 through 12 of the illustrative drawings. The side wall **110** has a downwardly facing external shoulder **112** which is shown to abut the upwardly facing shoulders **103***a*, **104***a*, **105***a*, **106***a*, **107***a* and **108***a*. The side wall **110** is shown to have a plurality of relatively thin, flexible resilient sections **110***a*, **110***b*, **110***c* and **110***d* which join the shoulder **112** and the floor **111** of the inner container **109**. A plurality of locking portions specifically in the form of transverse

outwardly extending projections **113**, **114**, **115** and **116** which are disposed between the sections **110***a*, **110***b*, **110***c* and **110***d*, respectively. Since all of the upstanding fingers **103**, **104**, **105**, **106**, **107** and **108** are preferably somewhat resilient as are the sections **110***a*, **110***b*, **110***c* and **110***d*, the projections **113**, **114**, **115** and **116** are releasably lockable by a snapping action into mating locking portions specifically defined by the recesses **103***b*, **104***b*, **105***b* and **106***b*, for example. It is readily apparent that the inner container **109** is releasably locked relative to the outer container **100** in the position shown in FIGURE 15 of the illustrative drawings. In this embodiment of the invention the inner container **109** is composed of a resilient material, for example, polypropylene. Although the projections **113**, **114**, **115** and **116** have some resilience, the vast majority of the flexible resilient give resides in the sections **110***a*, **110***b*, **110***c* and **110***d*.

Although it is preferred to have the upstanding fingers **103**, **104**, **105**, **106**, **107** and **108** at least somewhat resilient, it is obvious that the sections **110***a*, **110***b*, **110***c* and **110***d* are of a character to be made sufficiently resilient so that the fingers **103**, **104**, **105**, **106**, **107** and **108** can be made rigid.

An absorbent material **117**, which includes an absorbent liner **117***a*, is shown to be disposed between the side wall **100** and the upstanding fingers **103**, **104**, **105**, **106**, **102** and which is frictionally held against movement by the side wall **100**. The absorbent material **117** also includes an absorbent disk **117***b* which rests on the floor **102** and which is frictionally held against movement by the upstanding fingers **103**, **104**, **105**, **106**, **107** and **108**.

The side wall **110** of the inner container **109** is joined to a threaded neck **118** by what is shown to be a continuous annular web **119**. A closure cap **118***a* is shown to be threadably received by the neck **118**. An indicator **120** is shown to be disposed on the web **119** immediately above the lowest confines **121** of the upper surface **122** of the floor **111** at the side wall **110**.

An upper terminal end **123** of the side wall **100** is shown to have a peripheral ridge **124** which enables a closure **125** to be properly centered with respect to the side wall **100**. The closure **125** is shown to have an end wall **126** and a continuously extending side wall **127**. The outer surface of the closure **125** is shown to be roughened by a plurality of flute-like projections **128**. As shown in FIGURES 14 and 15 of the illustrative drawings, the closure **125** and the side wall **100** are hermetically sealed by a continuous seal **130** which extends continuously around the container **101** and the closure **125** across and beyond the upper terminal end **123** of the side wall **100** and a lower end **129** of the closure **125**. The seal **130** is just deep enough so that the contents within the container **100** are hermetically sealed and yet weak enough so that the user may grip the closure **125** and with the aid of the projections **128** twist the closure **125** from the container **100**, thereby rupturing the continuous seal **130**. The seal **130** hermetically seals the closure **125** to the container **100** and it renders the closure **125** tamper-proof with respect to the container **100**.

Referring now to the embodiment of FIGURES 20 through 25 of the illustrative drawings, there is shown a container system generally indicated at **40C**. The container system **40C** includes an outer container generally indicated at **140** which is composed of the same material as the outer container **41** of the embodiment of FIGURES 1 through 12 of the illustrative drawings. The outer container **140** has a longitudinally extending open-ended side wall **141** joined to a floor **142** having an upper surface **143**. An upper marginal end **144** of the side wall **141** is shown to have external threads **145**. A plurality of spaced-apart upstanding fingers **146**, **147**, **148**, **149**, **150** and **151**, spaced inwardly from the side wall **141**, extend upwardly from the floor **142**. The upstanding fingers **146**, **147**, **148**, **149**, **150** and **151** have upwardly facing shoulders **146***a*, **147***a*, **148***a*, **149***a* **150***a* and **151***a*. Each of the upstanding fingers **146**, **147**, **148**, **149**, **150** and **151** is shown to have three small reinforcements *r* at the place where the former are formed integrally with floor **142**. Since the reinforcements *r* are relatively short, the fingers **146**, **147**, **148**, **149**, **150** and **151** are sufficiently flexible for their purpose. The container system **40C** also includes an inner container generally indicated at **152** which is adapted to contain a radioactive liquid L. In this emboiment of the invention, the inner container **152** is preferably composed of a plastic material for example polypropylene. The inner container **152** has a generally longitudinally extending side wall **153** which joins a floor **154** having an upper surface **155**. The floor **154** is disposed obliquely with respect to the longitudinally extending side wall **53** so that the last traces of the mobile radioactive liquid L will gravitate to the lowest confines **156** on the surface **155** of the floor **154** at the lowest end of the side wall **153**. A threaded neck **157** is shown to receive a threaded cap **158**. A continuous web **159** joins the side wall **153** and the neck **157**. An indicator **160** is disposed on the side wall **153** in vertical alignment with the lowest confines **156**. The side wall **153** has a downwardly facing continuous external shoulder **161** which is shown to be supported by the upwardly extending shoulders **146***a*, **147***a*, **148***a*, **149***a*, **150***a* and **151***a* of the upstanding fingers **146**, **147**, **148**, **149**, **150** and **151** as seen in FIGURE 20 of the illustrative drawings. Since the upstanding fingers **146**, **147**, **148**, **149**, **150** and **151** are resilient due to the material of which they are composed and their relative length and because of the snug fit of the side wall **153** between the fingers **146**, **147**, **148**, **149**, **150** and **151**, the inner container is frictionally held in releasable locking engagement thereby. It is, therefore, apparent that once the inner container **152** has been urged into the position shown in FIGURE 20 of the illustrative drawings against the resilient action of the upstanding fingers **146**, **147**, **148**, **149**, **150** and **151**, the inner container **152** is locked against accidental movement relative to the outer container **140** until such time as the inner container **152** is chosen to be removed by the user. An absorbent material **161** is shown to take the form of an absorbent liner **161***a* is disposed between the side wall **141** and the upstanding fingers **146**, **147**, **148**, **149**, **150** and **151**. The liner **161***a* is frictionally held in position against the side wall **141**. The liner **161***a* is shown to abut the upper surface **143** of the floor **142** and is shown to extend to about the lower end of the closure cap **158**. The spaces between the upstanding fingers **146**, **147**, **148**, **149**, **150** and **151** enable any liquid which might possibly drip from the container **152** to flow along the upper surface **143** of the floor **142** into contact with and to be absorbed by the absorbent liner **161***a*.

A closure generally indicated at **162** is shown to have an end wall **163** joined to a continuous side wall **164**. The side wall **164** is shown to have internal threads **165**. A continuously extending terminal end **166** of the longitudinally extending side wall **141** is shown in FIGURE 20 of the illustrative drawings to be in abutment with a continuously extending resilient seal **167** which also abuts a junction **168** of the end wall **163** and the side wall **164**. When the closure **162** is threaded onto the upper marginal end **144** of the side wall **141**, the seal **167** is brought into compression, thereby hermetically sealing the inside from the outside of the container. In order to tamper-proof the closure **162** to the outer container **140**, a spot seal generally indicated at **169** is employed. Due to the material of which the outer container **140** is composed, the spot seal is readily made and it should be borne in mind that the outer container **140** fully serves as a radioactive shield. By an alternative equivalent construction (not shown), a strip of plastic resin material such as polyethylene can be sealed to the side wall **141** of the outer container **140** and the side wall **164** of the closure **162**. Unthreading of the closure **162** from the outer container

140 would serve to rupture that piece of plastic material. Roughening in the form of flutes 170 serves to aid the user in removing the closure 162 from the container 140.

Referring now to the embodiment of FIGURES 26 through 30 of the illustrative drawings, there is shown a container system generally indicated at 40D which includes an outer container generally indicated at 175 which is composed of the same material as the outer container 41 of the embodiment of FIGURES 1 through 12 of the illustrative drawings. The outer container 175 has a longitudinally extending open-ended side wall 176, a lower marginal end 177 of which is shown to have a diameter reducing section 178. The diameter reducing section 178 defines an upwardly facing shoulder 179. The longitudinally extending side wall 176 is joined to a floor 180 which has an upper surface 181. Extending upwardly from the floor 180 is an upstanding finger 182. The upstanding finger is shown to have a projection 183 at its upper end. The upstanding finger 182 is shown to have a small reinforcement 184 at the place where the finger 182 joins the floor 180. An absorbent material 185 in the form of an absorbent disk 185*a* is shown resting upon the upper surface 181 of the floor 180 and to be held against movement by frictional engagement with the diameter reducing section 178.

A closure generally indicated at 186 is shown to be seated against an internal shoulder 187 at an upper end 188 of the side wall 176. The closure 186 has a peripheral ridge 189 defining an upper surface 189*a* which lies substantially in the plane of an upper terminal end 190 of the side wall 176. An overseal 192 is shown to have a film 193 of plastic material such as for example polyethylene bonded to a backing 194 which is preferably composed of a metal for example aluminum. The overseal 192 has a tab 195. The overseal 192 is identical in construction and is removable by the same method as that taught in the embodiment of FIGURES 1 through 12 of the illustrative drawings.

The container system 40D also includes an inner container generally indicated at 196 which is shown to have a longitudinally extending side wall 197 joined to a floor 198. The floor 198 extends obliquely with respect to the longitudinally extending side wall 197 so that the last traces of a mobile radioactive material gravitate to the lowest confines 200 on an upper surface 199 of the floor 198 at the side wall 197. The inner container 196 has a threaded neck 201 which is shown to receive a closure cap 202. A continuous web 203 is shown to join the side wall 197 and the neck 201. An indicator 204 is disposed on the web 203 vertically above the lowest confines 200 of the container 196. The side wall 197 has at its outer surface a continuously extending rounded peripheral bead 205. The bead 205 is shown to be in supporting abutment against the upwardly facing shoulder 197 in FIGURES 26 through 30 of the illustrative drawings. The upstanding finger 182 has a camming surface 183*a* at its upper end to enable the bead 205 to flex the finger 182 as the bead 205 is forced against the camming surface 183*a*. The projection 183 is shown to have a camming surface 183*b* which is resiliently urged against the upper portion of the rounded bead 205 in the position best shown in FIGURE 30 of the illustrative drawings, thereby constantly urging the bead 205 against the shoulder 179. Due to the material of which the upstanding finger 182 is composed and its relative length, the upstanding finger 182 is sufficiently resilient to enable the inwardly facing projection 183 to be resiliently snapped over the bead 205, thereby releasably locking the inner container 196 inside the outer container 175. There is little clearance between an inwardly facing surface 206 of the diameter reducing section 178 and the lower end of the side wall 197.

The neck 68 is of substantially lesser in transverse extent than the side wall 65, the neck 118 is substantially lesser in transverse extent than the side wall 110, and the neck 201 is substantially lesser in transverse extent than the side wall 197 so that the indicator 71 on the web 70, the indicator 120 on the web 119, and the indicator 204 on the web 203, respectively, in each case are readily visible from above.

Although the outer container 41 and its closure 45, the outer container 84 and its closure, the outer container 99 and its closure 125, the outer container 140 and its closure 162, and the outer container 175 and its closure 186 are each composed of a readily sealable, radioactive shielding material preferably a composition of about nine parts by weight of lead oxide and about one part by weight of a thermoplastic resin material, specifically polyethylene, it will be readily apparent to one skilled in the art that the outer container, as well as the inner container, are able to be composed of other equivalent materials than those to which reference was made. For example, the container system of the invention has features which adapt it for the shipment and/or storage of other than radioactive materials, and hence the outer container need not, in such case, be composed of a radioactive shielding material. When the container system is employed for the handling and storage of radioactive material, the outer container and its closure are required to be composed of a radioactive shielding material.

The inner container has been variously described in some embodiments as preferably being composed of either a rigid inert material such as glass or an inert resilient plastic material such as polypropylene. One skilled in the art will realize that in accordance with the invention, resilience must reside in either the outer container, the inner container, or both. Accordingly not only the inner container but also the outer container is composable of a combination of materials which will lend the required resilience to enable the inner container to be releasably locked relative to the outer container. Since the inner container is most preferably composed of glass, the resilience is most preferably employed in connection with the outer container.

The absorbent liners 80*a*, 94*a*, 117*a* and 161*a* are preferably cut into predetermined lengths from a web of absorbent material. The liners 80*a*, 94*a*, 117*a* and 161*a* are then formed into a tubular configuration and slipped downwardly along the inside of the side walls 56, 85, 100 and 141, respectively. Since, in each case, the liner tends to return to its original flat shape due to a memory effect, the liner urges itself against the side wall and is thereby frictionally held against movement.

The above-described embodiments being exemplary only, it will be understood that modifications in form or detail can be made without departing from the spirit and scope of the invention. Accordingly, the invention is not to be considered as limited save as is consonant with the scope of the following claims.

What is claimed is:

1. A container system, comprising: an outer container and a closure therefor each composed of a radioactive shielding material, said outer container having a floor, at least one upstanding flexible resilient finger extending upwardly from said floor, said flexible resilient finger having a locking portion, and an inner container disposed in said outer container, said inner container having a mating locking portion engageable with said locking portion of said finger.

2. A container system, comprising: a one-piece outer container having at least one integral resilient finger, a closure for said outer container, said outer container and said closure being composed of radioactive shielding material, said finger having a locking portion, and an inner container disposed in said outer container, said finger being sufficiently flexible and resilient to enable said inner container to be releasably locked relative to said outer container.

3. A container system, comprising: an outer container having a side wall and a floor, at least said side wall and

said floor being composed of a radioactive shielding material, an inner container adapted to contain a radioactive material and disposed in said outer container, means for suspending said inner container above said floor, and means at least partly disposed at a stratum between said inner container and said floor for absorbing liquid radioactive material.

4. A container system, comprising: an outer container having a side wall and a floor, at least said side wall and said floor being composed of a radioactive shielding material, an inner container adapted to contain a radioactive material and disposed in said outer container, means for suspending said inner container above said floor, and said suspending means including at least one upstanding finger joined to said floor, said upstanding finger disposed inwardly of said side wall, said floor having an upper surface, a space on each side of said upstanding finger at said upper surface of said floor, and an absorbent material disposed between said upstanding finger and said side wall, said absorbent material extending down to said upper surface of said floor.

5. A container system comprising: an outer container having a floor, said floor having an upper surface, an inner container in said outer container, and means for both suspending said inner container above said surface of said floor and for releasably locking said inner container relative to said outer container, said outer container being composed of a radioactive shielding material.

6. A container system, comprising: an outer container, a plurality of spaced-apart upstanding fingers in said outer container, a seat on each of said upstanding fingers, and an inner container disposed in said outer container, said inner container having a floor, said inner container having a shoulder upwardly of its floor, said shoulder of said inner container being seatable against said seats of said upstanding fingers, said fingers holding said inner container against accidental movement relative to said outer container.

7. A container system, comprising: an outer container, a plurality of spaced-apart upstanding fingers in said outer container, a seat on said upstanding fingers, an inner container disposed in said outer container, said inner container having a floor, said inner container having a shoulder upwardly of its floor, said shoulders of said inner container being seatable against said seats of said upstanding fingers, and means for releasably locking said inner container relative to said outer container.

8. In combination, a container and a closure therefor each composed of a radioactive shielding material, said shielding material containing a sufficient amount of thermoplastic resin material to render said shielding material readily sealable, and an overseal including a thermoplastic material sealed to said closure and sealed to said container by a continuously extending seal.

9. In combination, a container and a closure therefor each composed of a radioactive shielding material, said shielding material containing a sufficient amount of thermoplastic resin material to render said shielding material readily sealable, said container having an upper terminal end, said closure having an upper surface which is substantally in the plane of said upper terminal end of said container, and an overseal including a thermoplastic material sealed to the upper surface of said closure and sealed to the terminal end of said container by a continuous seal, the holding force of said overseal to said upper terminal end of said container being less than the holding force of said overseal to said closure, whereby the seal between said thermoplastic material and said container is capable of being manually completely destroyed while the seal between said thermoplastic material at least partially remains to enable said overseal and said closure to be removed as a unit.

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RALPH G. NILSON, *Primary Examiner.*

ARCHIE R. BORCHELT, *Examiner.*