United States Patent

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[73] Assignee **To the United States of America as represented by the Secretary of the Department of Health, Education and Welfare**

[54] **INTERLOCKED RADIUM SHIPPING CONTAINER**
10 Claims, 13 Drawing Figs.

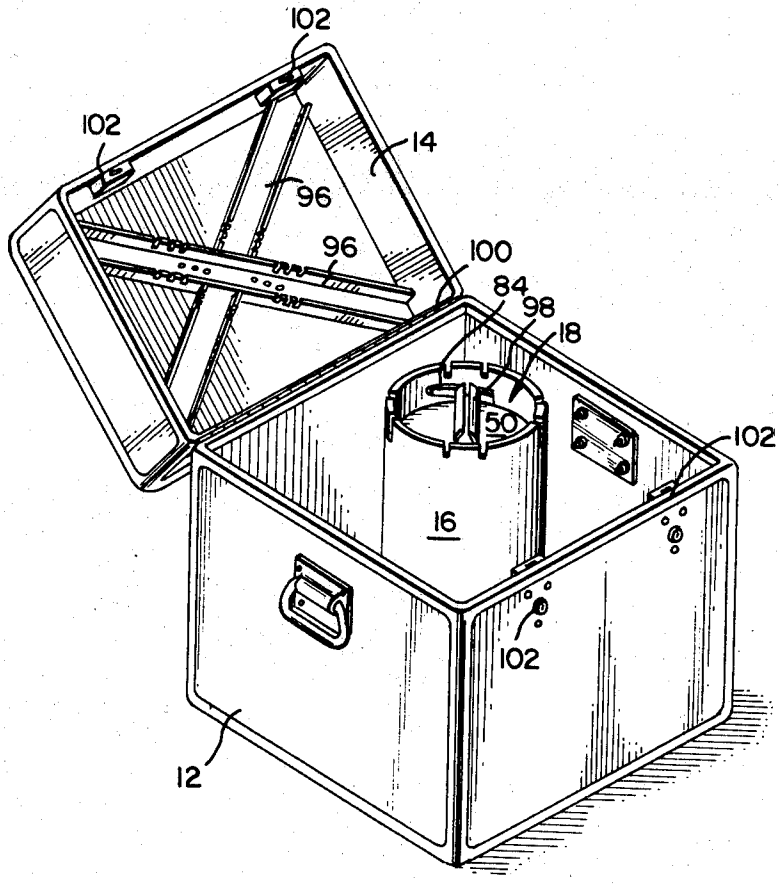
[52] **U.S. Cl.** **250/108,**
250/106; 220/17, 220/55
[51] **Int. Cl.** **G21f 5/00**
[50] **Field of Search** 250/106S,
106, 108; 220/17, 55, (Inquired)

[56] **References Cited**
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Primary Examiner—Ralph G. Nilson
Assistant Examiner—Morton J. Frome
Attorneys—Norman J. Latker and Browdy and Neimark

ABSTRACT: A reusable interlocked radium shipping container, sized to meet radiation exposure limitations of transportation regulatory agencies, includes a fireproof inner container designed to accept limited quantities of radium needles or capsules and to prevent leakage of radioactive material, a middle container for shielding, including a means to prevent insertion of the inside container therein where the shield is designed for higher or lower capacities and a means for preventing the insertion of a closure plug for the middle shielding container unless the proper inner container is in place, a locking means for locking the middle shielding container in closed position, an outer hinged shipping case including a means to prevent closure of the lid of the shipping case unless the shield closure is in locked position, and a readily releasable spring-loaded lock for the shipping case lid.



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SHEET 1 OF 5

Fig. 1.

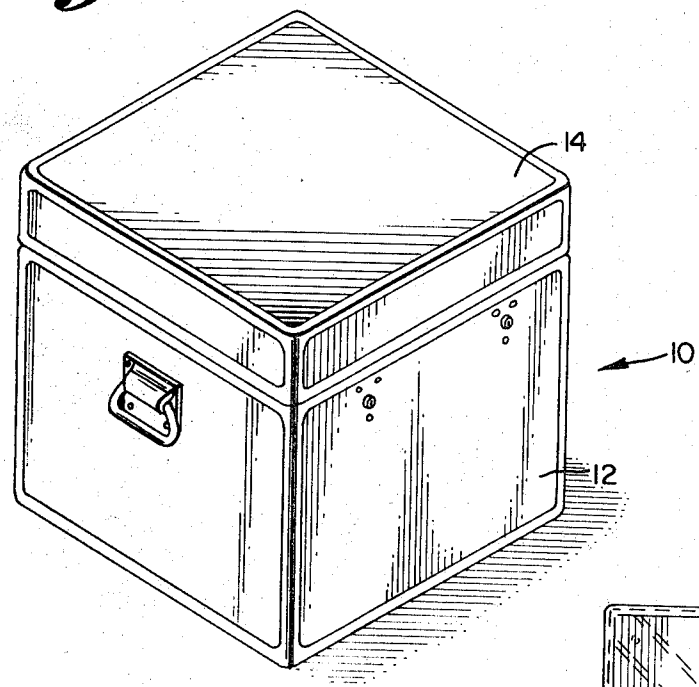


Fig. 2.

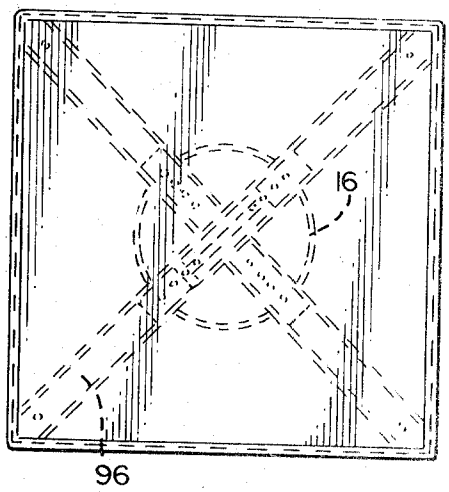
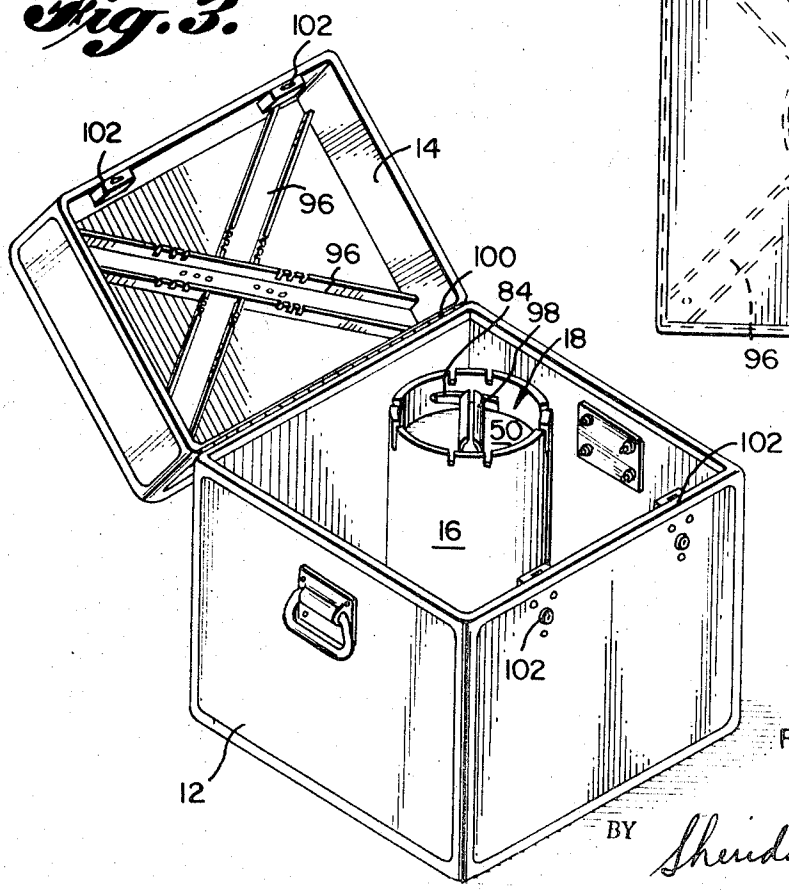


Fig. 3.



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Fig. 4.

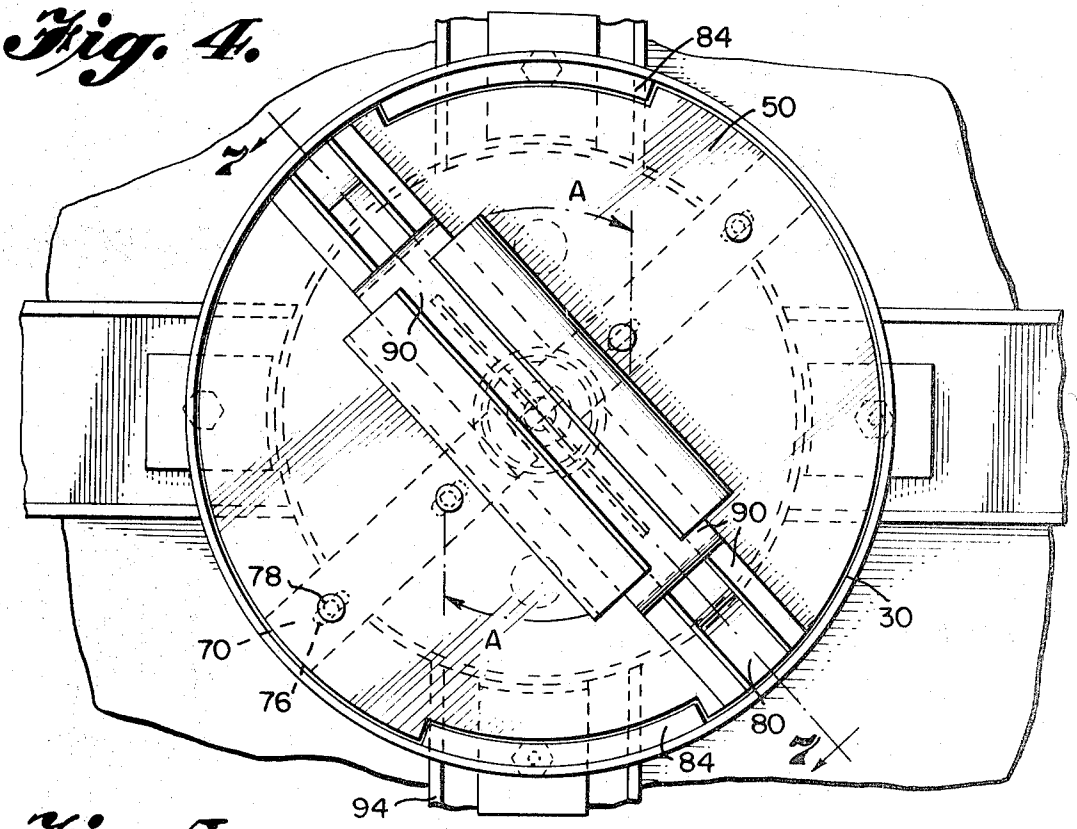
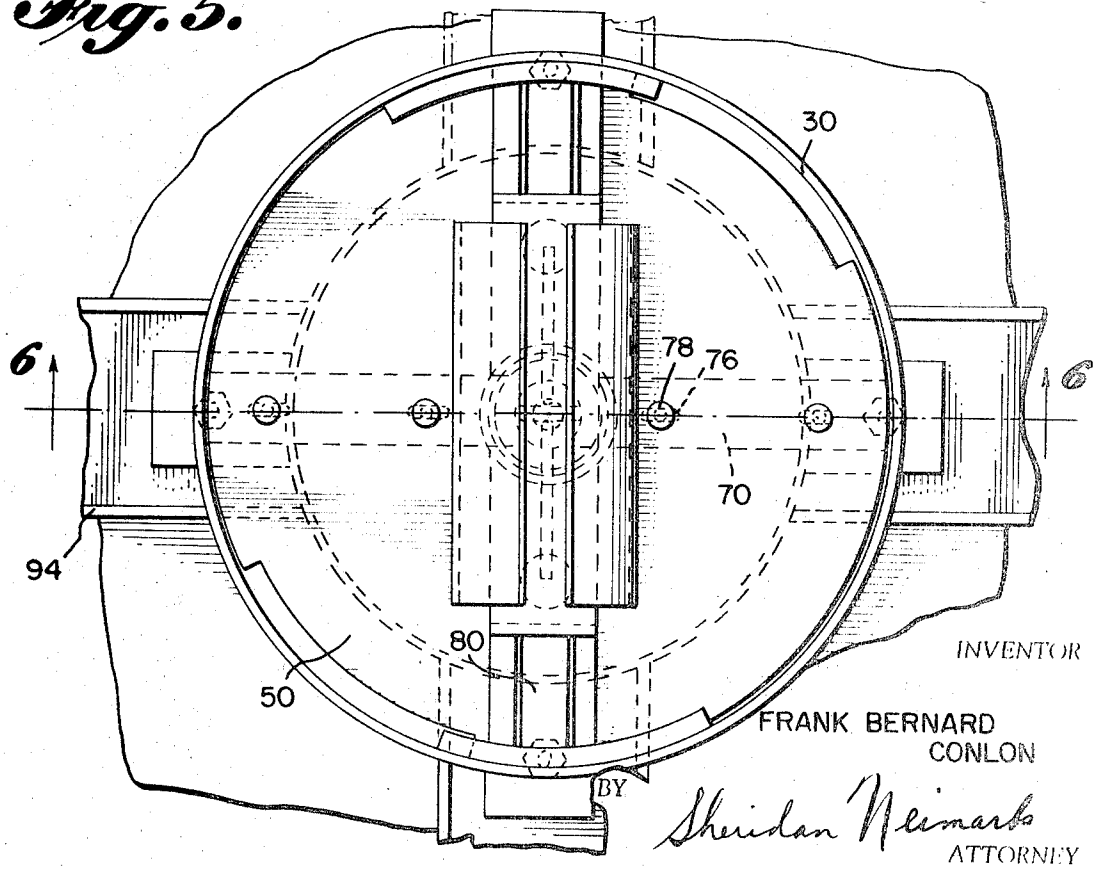


Fig. 5.



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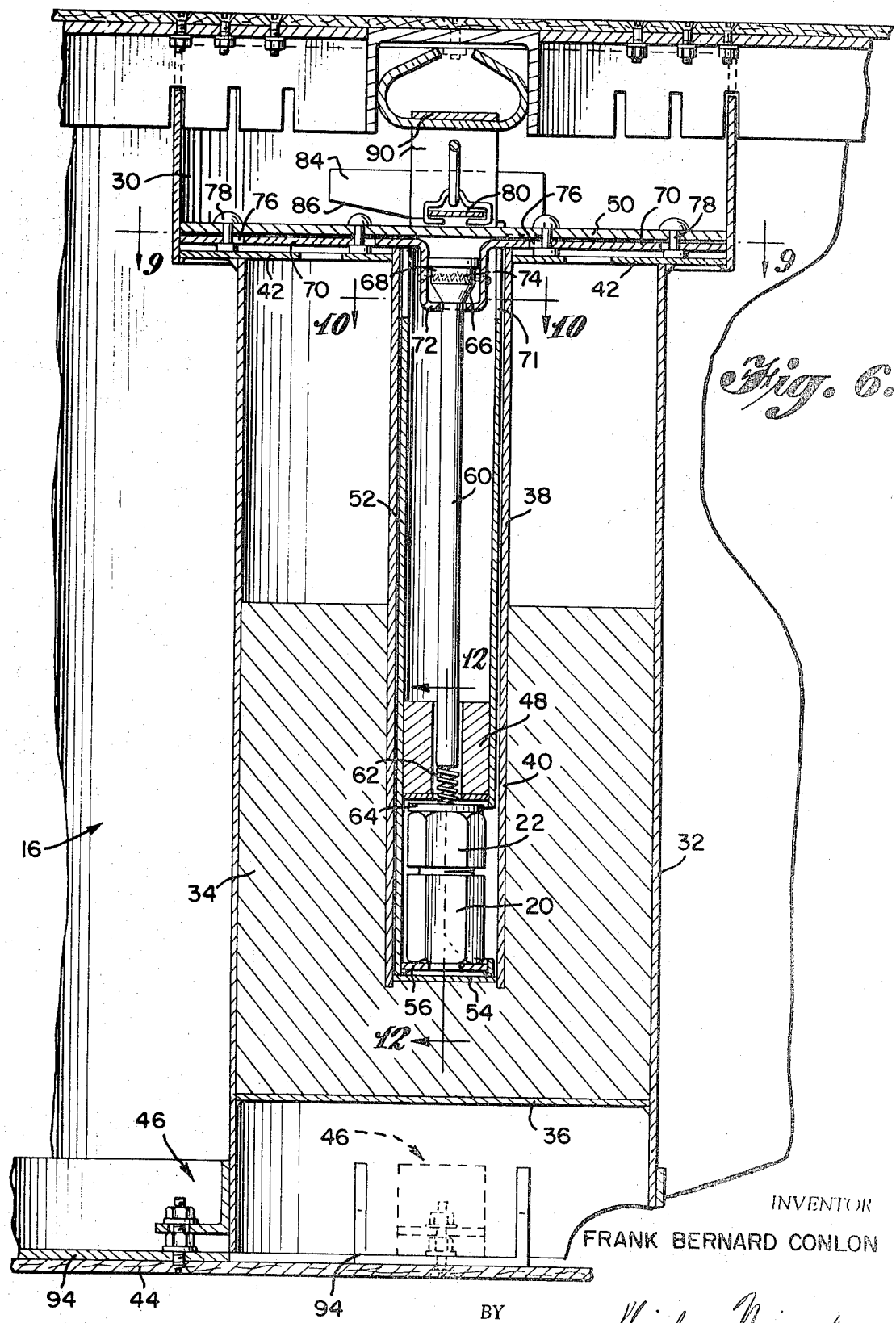


Fig. 6.

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Fig. 7.

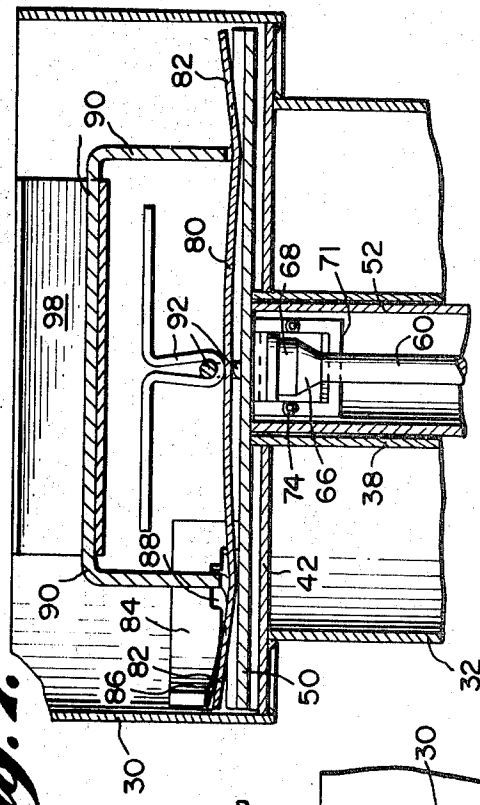


Fig. 8.

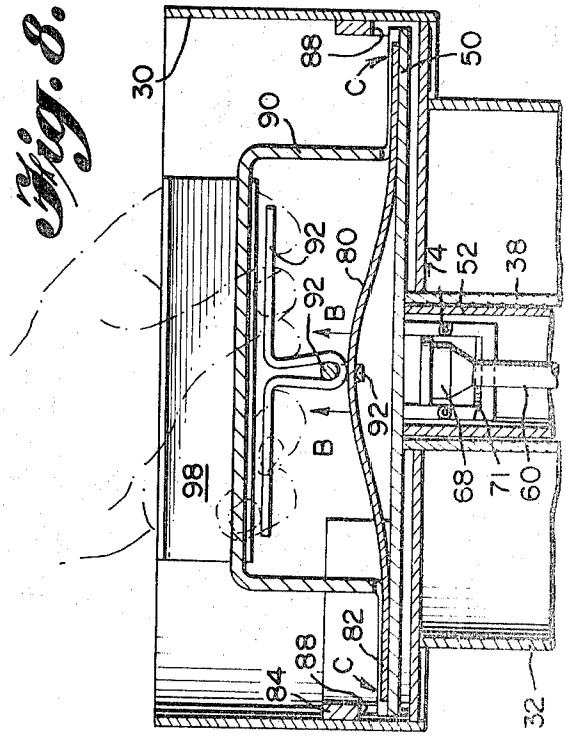
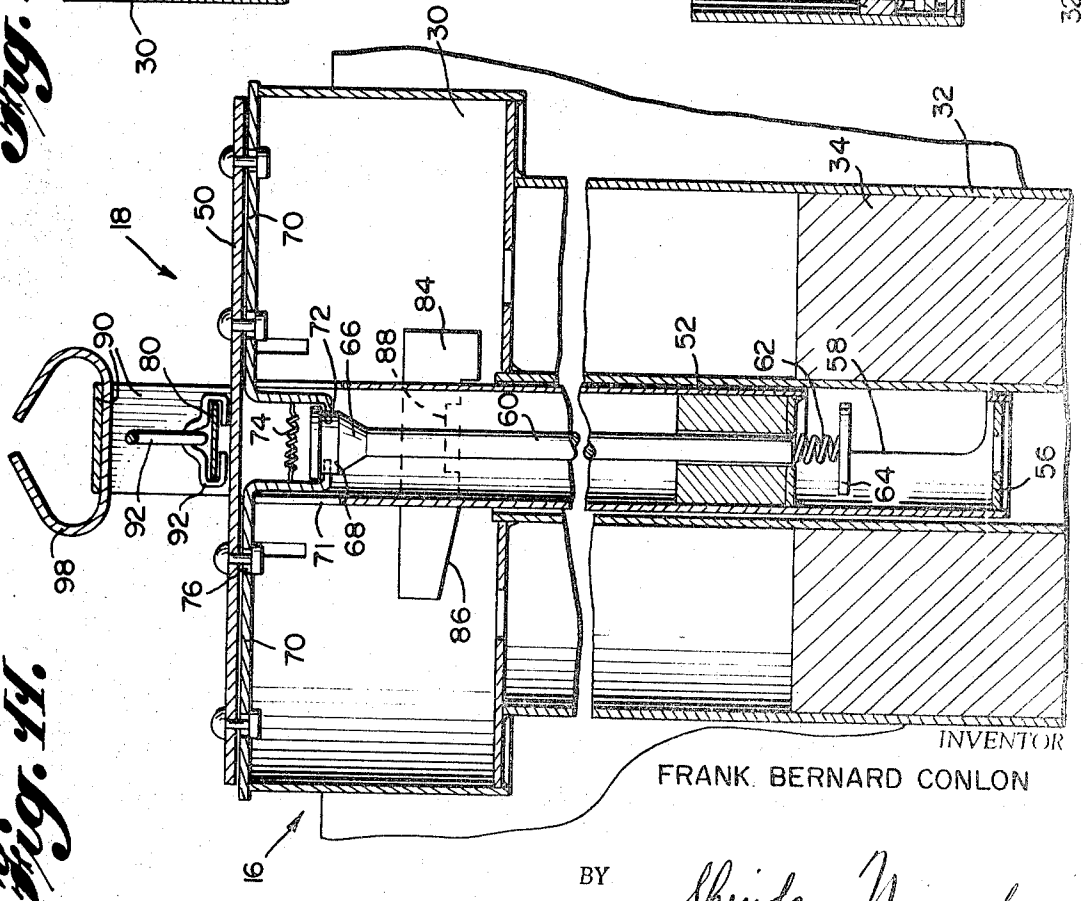


Fig. 11.



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Fig. 9.

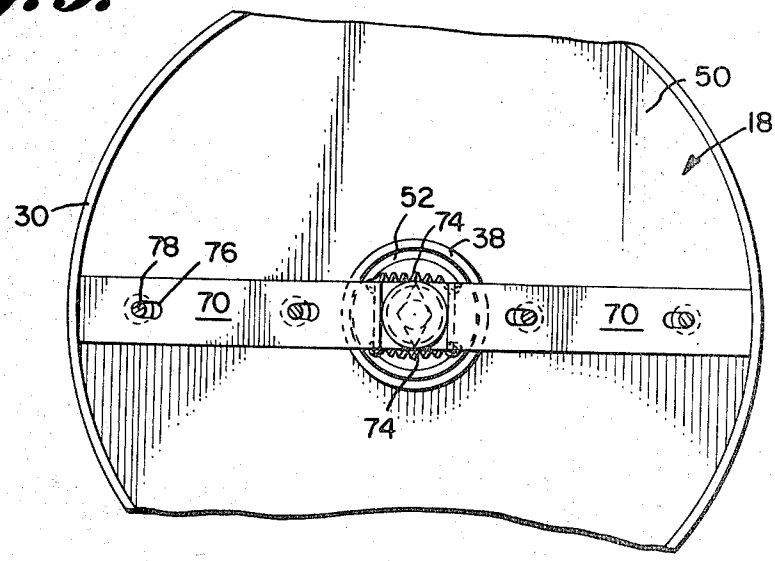


Fig. 10.

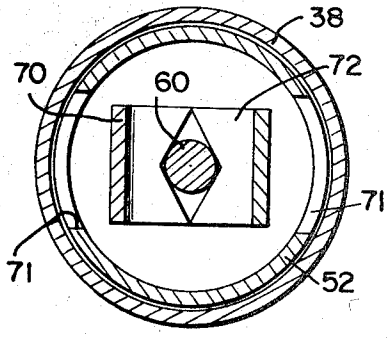


Fig. 12.

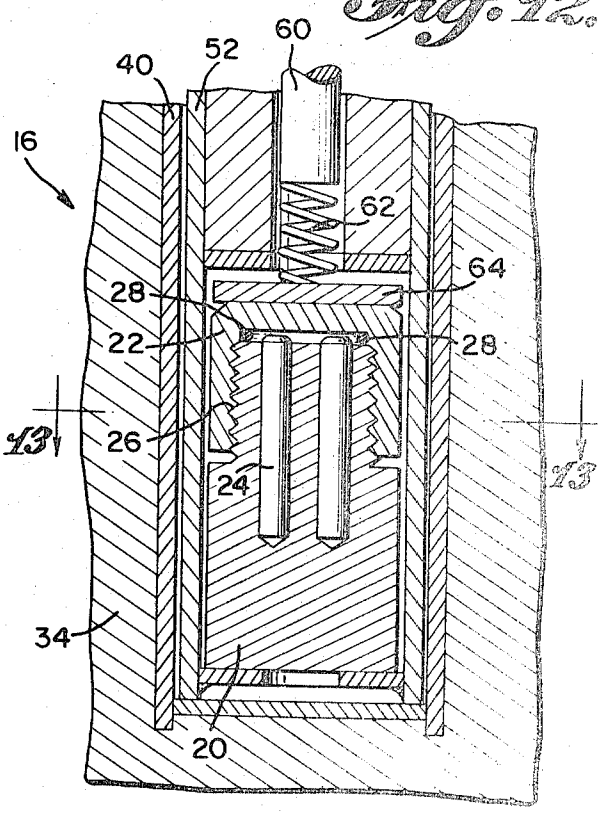
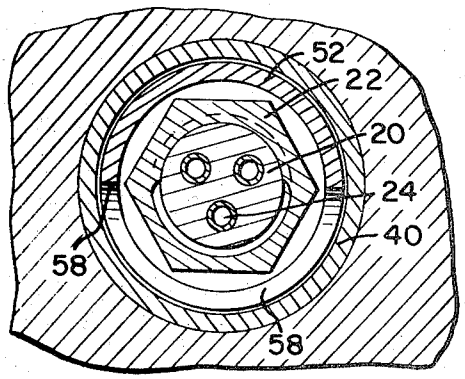


Fig. 13.



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INTERLOCKED RADIUM SHIPPING CONTAINER

The present invention relates to a container for radioactive charges and, more particularly, to a safety shipping container for radium needles or capsules.

Because of their extreme danger, it has been found desirable to sacrifice simplicity for insured safety in the handling of radioactive charges. As a result, a number of complex radium shipping containers have previously been designed. In spite of the use of some of these previously designed containers, accidents have continued to occur.

The loss of two radium sources during a recent shipment has necessitated further safeguards. In each case it was indicated that improper packaging for the lost shipment was a major cause of the loss. Because of the possible hazard to the health of the general public from lost radioactive sources, a more positive method of packaging such items has, accordingly, been required.

It is therefore an object of the present invention to overcome the deficiencies of the prior art, such as indicated above.

It is another object of the present invention to provide for an ultrasafe shipping container for radioactive charges.

It is another object of the present invention to provide an interlocked radium shipping container which is relatively foolproof and in which radioactive charges can be reliably shipped without loss or spilling.

These and other objects and the nature and advantages of the instant invention will be more apparent from the following detailed description taken in conjunction with the drawings showing an embodiment wherein:

FIG. 1 is a perspective view of the outside of a radium shipping container in accordance with the present invention;

FIG. 2 is a plan view of the shipping container of FIG. 1;

FIG. 3 is a perspective view of the device of FIG. 1 showing the outer container lid in open position;

FIG. 4 is a plan view of the device in open position as shown in FIG. 3 with the middle container in unlocked position;

FIG. 5 is a view similar to FIG. 4 showing the middle container in locked position;

FIG. 6 is a vertical sectional view taken along line 6–6 of FIG. 5;

FIG. 7 is a partial vertical sectional view taken along line 7–7 of FIG. 4;

FIG. 8 is a view similar to FIG. 7 showing the middle container being unlocked;

FIG. 9 is a partly broken away view taken along line 9–9 of FIG. 6;

FIG. 10 is a view taken along line 10–10 of FIG. 6;

FIG. 11 is a vertical sectional view of the middle container and its closure in "locked-out" position;

FIG. 12 is a partial vertical sectional view taken along line 12–12 of FIG. 6; and

FIG. 13 is a sectional view taken along line 13–13 of FIG. 12.

A safety shipping container 10 in accordance with the present invention is shown generally in FIG. 1 and comprises an outer container 12 and a cover lid 14 therefor. Rigidly disposed within the outer container 12 is a middle container 16 having an integral closure shown generally at 18 (see FIG. 3). Disposed within the middle container 16 is an inner container 20 having a cover 22; radioactive charges such as radium capsules or needles 24 are placed within recesses or cavities within the inner container 20 as shown (FIGS. 12 and 13).

More specifically, the inner container 20, preferably formed of a suitable metal, such as brass, is provided with one or more recesses or cavities (preferably two, three or six) for the receipt therein of radium capsules or needles. Depending upon the particular capacity of radium to be contained, such inner container 20 will be formed of a different size, which size is standardized to relate to the amount of shielding provided in the middle container 16. As an example, where the device is designed to handle 50 mg. capacity radium needles, the inner container may have two cavities and have an overall height, including the cover 22 of 2¾ inches, and a width (or diameter) of five-eighths inches.

Where the device is designed to hold 150 mg. capacity radium capsules, three cavities may be provided and the dimensions of the inner container 20 may be 2 inches in height and seven-eighths inches in width. Where the device is designed to hold 300 mg. capacity radium capsules, six cavities may be provided and the dimensions of the inner container 20 may be 1½ inches in height and 1⅛ inches in width.

As illustrated, it is preferred that the inner container 20 be provided with a hexagonal cross section, along with the cover 22. The hexagonal shape is preferred to facilitate closing of the container 20 which, with the cover 22, is provided with interlocking screw threads 26, so that the cover 22 can be tightened over the container 20 by means of hexagonal wrenches. Other cross sections, such as circular or rectangular, may also be used. In addition, a gasket 28, preferably but not essentially metal, may be used between the cover 22 and the top surface of the inner container 20 thereby providing a gastight, fireproof assembly.

The middle container 16 is provided with an upper portion 30 and a lower portion 32. In the illustrated embodiment, the upper portion 30 and the lower portion 32 comprise shells, preferably cylindrical and formed of metal, which are disposed along a common axis. The lower portion 32 of the middle container 16 is provided with a suitable quantity of radioactive shielding 34, such as lead, supported at the bottom by a bottom wall 36. Passing downwardly from the upper portion 30 is a conduit 38, preferably cylindrical, the bottom portion 40 of which constitutes a shielded cavity within the shielding material 34. For supporting the conduit 38 at its upper end there may be provided, if desired, a rigid annular plate 42. The middle container 16 (FIG. 6) is located within the outer container 12 by being rigidly attached to the bottom wall 44 of the outer container by suitable rigidifying and structural supporting members shown generally at 46.

The closure means 18 for the middle container 16 comprises, integrally connected, a shielding plug 48 for the lower portion of the middle container and a top cover 50 for the upper portion 30 of the middle container 16, such top cover 50 preferably being in the form of a circular plate. The shielding plug 48 and the top cover 50 are interconnected by a hollow elongated chamber 52, preferably having an outer configuration complementary to the conduit 38, e.g. cylindrical. As is seen, the shielding plug 48 is located near the bottom of the elongated chamber 52. In the preferred embodiment, when the closure 18 is in place within and locked to the middle container 16, the elongated chamber 52 goes to the very bottom 54 of the cavity 40. In this case, the chamber 52 is provided with a bottom wall 56, upon which the inner container 20 is placed through an opening through the side wall of the chamber 52 is defined by a peripheral edge 58. It will be understood, of course, that the inner container 20 and its cover 22, with the radium charges therein, may be placed directly within the cavity formed by the cavity portion 40, in which case the side wall portions of the chamber 52, extending below the shield plug 48 and the bottom 56, may be eliminated from the structure of the middle closure means 18.

It will be clearly understood that because of the standardized sizes of the inner container 20, the fixed depth of the cavity 40 and the location of the shield plug 48 fixed by the elongated chamber 52, that if a too tall inner container 20 is placed within the cavity 40, the device will not close. It is also clear that an inner container of too great a diameter or thickness will not fit within the cavity 40.

To insure against the insertion into the cavity of an inner container 20 which is too small, an additional safety feature is provided in the present container. As illustrated, a vertically movable rod 60, preferably cylindrical, is provided within the hollow elongated chamber 52 and passes along the center thereof through the shielding plug 48. At the low end of the rod 60 is provided a compression spring 62 which terminates in a flat horizontal plate 64. The rod 60 is provided, at its upper end, with a frustoconical portion 66 terminating in another cylindrical portion 68 which is of greater diameter (or

thickness) than the lower body portion of the rod 60. It will, of course, be understood that the rod 60 may take a shape other than cylindrical and that the frustoconical portion 66 is not essential.

At least one, and preferably two, horizontal arm elements 70 are provided which preferably have a generally L-shape terminating in an additional flange 72. The elongated chamber 52 is provided with cutout portions 71, through which the arms 70 pass to contact the rod 60. The flange 72 is provided with a transversely extending V-groove therein as best seen in FIG. 10 (note also FIG. 9 in phantom), the rod 60 being trapped between the facing V's of the two facing flanges 72. As illustrated, the arms 70 are disposed from one another at 180°.

The arms 70 are urged toward one another about the rod 60 by a pair of springs 74, the arms 70 being permitted to slide radially along the top cover 50 by means of slots 76 therein, through which rivets 78 or other suitable fasteners pass to connect the arms 70 to the top cover 50. It will be understood that the length of the arms 70 is such that when the V-grooves contact the narrow portion of the rod 60, the terminal ends of the arms will fit within the upper portion 30 of the middle container (the end of the arms will extend to the periphery of the top cover 50 as shown in FIGS. 6 and 9), but that when the V-grooves contact the thicker portion 68 of the rod 60, the ends of the arms 70 will extend beyond the periphery of the cover 50 and will prevent the insertion thereof into the top portion 30 of the middle container (note FIG. 11).

The rod 60, being free to move vertically, will act in a cam-like manner to control the location of the arms 70. Before insertion of the inner container below the horizontal plate 64, the rod 60 is placed in the position shown in FIG. 11. If the inner container is too small (too short) it will not exert enough upward force on plate 64 to act through the spring 62 on rod 60 to move such rod 60 upwardly so that the V-groove of the arms 70 will slide down the frustoconical portion 66 to the narrow portion 60. When this sequence fails to occur, the terminal ends of the arms 70 prevent insertion of the cover 50 within the top portion 30, as shown in FIG. 11. If, on the contrary, the inner container 20 is a proper height, the rod 60 will be forced upwardly, causing the suitable camming action with the resultant movement of the arms 70 inwardly due to the force of the spring 74, thereby permitting the insertion of the top cover 50 into the upper portion 30 of the middle container 16, as shown in FIG. 6.

The top cover 50 of the closure 18 for the middle container 16 also comprises a suitable locking arrangement. In the embodiment shown, such locking arrangement comprises a generally horizontal spring strip 80, preferably formed of spring steel, which extends across the top of the cover 50, preferably disposed 90° from the underlying arms 70, such spring strip extending to the periphery of the top cover 50. As best shown in FIG. 7, in untensioned position the ends 82 of the spring strip 80 are inclined slightly upwardly. For providing interlocking relationship with the spring strip 80, there is provided attached to the inner wall of the upper portion 30 of the middle container 16, a locking ramp 84, such locking ramp having a sloped portion 86 for sliding contact with the inclined end 82 of the spring strip 80, and also a recessed portion 88 into which the inclined end 82 of the spring strip 80 fits for locking.

Extending above the top cover 50 is a generally U-shaped handle element 90 by which the closure 18 for the middle container 16 is handled. Directly beneath the handle 90 is provided a gripping element 92, a portion of which is grippable with the hand (see FIG. 8) and another portion of which encircles the spring strip 80.

When locking the top cover 50 in place, the cover is fit into the upper portion 30 as shown in FIGS. 4 and 7 (the periphery of the top cover 50 being configured with cutout portions to pass the inwardly extending ramps 84) and the cover 50 is rotated as shown by the arrows A in FIG. 4, causing the inclined portions 82 of the spring strip 80 to ride along the sloped portion 86 of the locking ramp until the inclined ends 82 snap into place within the recesses 88 in the position shown in FIG. 5. When it is desired to unlock the closure 18 for removal from the middle container 16, the handle 90 is grasped along with the element 92 to tension the spring as shown in FIG. 8 to pull up the center part of the spring 80 as shown by the arrows B and thereby flatten and withdraw the previously inclined end portions 82 as shown at the arrows C. When the ends 82 of the spring strip 80 are flattened and withdrawn as shown in FIG. 8, the cover 50 may then be rotated the direction opposite to the direction of arrows A in FIG. 4 so that the closure 18 may be withdrawn from the middle container 16.

As mentioned above, the middle container 16 is mounted within the outer container 12 and is connected by suitable means 46 to the bottom 44 thereof. The outer container 12 and its cover lid 14 are preferably formed of sheet metal, plywood, or other suitable material and are reinforced by crisscrossing U-shaped rails 94 on the bottom thereof and similar crisscrossing U-shaped rails 96 within the cover lid 14. It will be seen from FIG. 3 that slots are provided along the upper periphery of the middle container 16 for interlocking with complementary slots along the reinforcing rails 96 within the cover lid 14. It will also be noted that in the rails 96 a series of slots are provided and these are adapted to receive different sized middle containers 16 (having different shielding for different sized inner containers) which may be anchored by the means 46 within the single sized outer container 12. In conjunction with the U-shaped rails 96, one additional safety feature is provided. Projecting upwardly from the handle 90 of the middle closure 18 is an additional handle element 98. It will be understood that the element 98 is of such a width that it will fit within the flanges of the U-shaped reinforcing rail 96. The handle 90, 98 is so arranged on the middle container closure 18 that it is parallel to the rail 96 when the middle container 16 is locked. Accordingly, unless the closure 18 for the middle container 16 is locked in place, the element 98 will interfere with the flanges of the U-shaped rail 96 and will prevent complete closure of the cover lid 14.

The outer container 12 and the cover 14 are attached by a suitable hinge 100 along one side thereof, and on the opposite side are provided a pair of suitable cabinet locks 102 which may be key type locks, or which may simply be spring loaded push button type locks.

It will be obvious to those skilled in the art that various changes may be made without departing from the scope of the invention and that the invention is not to be considered limited to what is shown in the drawings and described in the specification.

I claim:

1. A safety shipping container for radioactive charges and the like comprising:

an inner container having a cavity therein adapted to receive a radioactive charge of given size, and a cover for said inner container, said container and cover having standardized outer dimensions dependent upon the size of the radioactive charge said inner container is adapted to receive;

a middle container having an upper portion and a lower portion, said lower portion comprising radioactive shielding having a shielded cavity therein for receipt of said inner container and cover;

integral closure means for said middle container comprising a shielding plug for said lower portion of said middle container to hold said inner container in place tightly within the cavity of said lower portion, a top cover for receipt into said upper portion of said middle container and including locking means for interlocking with said middle container, and means interconnecting said shielding plug and top cover for preventing the insertion of said top cover into said upper portion for interlocking therewith unless said inner container of said given size is in place within the cavity of said lower portions and said shielding plug loads against said inner container; and

an outer container in which said middle container is rigidly mounted, a cover lid for said outer container, means to lock said cover lid on said outer container, and means for preventing the closure and locking of said cover lid unless said integral closure means for said middle container is locked in place.

2. A device in accordance with claim 1 wherein said inner container and cover are provided with interlocking screw threads, said cover being closed over said inner container by being screwed thereon.

3. A device in accordance with claim 1 wherein said means preventing insertion of said top cover into said upper portion of said middle container comprises a rigid member passing downwardly from said top cover and carrying said shielding plug near its lower end, the distance between the lower end of said shielding plug and the lower end of the shielding cavity being equal to approximately the height of said inner container of said given size, whereby placement in the shielding cavity of a too tall inner container will prevent said integral closure means from proper seating.

4. A device in accordance with claim 3 wherein said downwardly passing rigid member comprises an elongated hollow chamber having an outside configuration complementary to the shape of the cavity in said middle container; and wherein said means preventing insertion of said top cover for interlocking further comprises a vertically movable rod passing downwardly from said top cover within said elongated chamber and through a bore passing through said shielding plug, said rod having at its upper end a portion of greater thickness and therebelow a portion of lesser thickness, a compression spring extending downwardly from the bottom of said rod, a horizontal plate connected to the bottom of said spring and extending adjacent the bottom surface of said shielding plug, a horizontal arm passing along said top cover adapted to engage said rod at its upper end, said arm being free to move a short horizontal distance along said top cover toward and away from said rod, said arm extending beyond the periphery of said top cover when its end contacts said rod portion of greater thickness but lying within the periphery of said top cover when its end contacts said rod portion of lesser thickness, and means to bias said arm toward said rod, whereby placement in said cavity of a proper height inner container will cause said rod to move upwardly, thereby causing the lesser thickness portion of said rod to contact said arm, thereby moving said arm horizontally inwardly so as not to extend beyond the periphery of said top cover so that said top cover may be seated and locked.

5. A device in accordance with claim 4 wherein said elongated hollow chamber is generally cylindrical, said vertically movable rod is generally cylindrical and has a frustoconical portion between its portion of greater thickness and its portion of lesser thickness, and wherein two said horizontal arms are provided spaced apart 180° wherein said means to bias said arm toward said rod comprises a spring connecting the ends of the two arms together between which is located said rod.

6. A device in accordance with claim 4 wherein said elongated hollow chamber is provided at its lower end beneath said shielding plug and said horizontal plate with a bottom wall adapted to lie adjacent the bottom of the shielding cavity, the space between said horizontal plate and said bottom wall being adapted to receive said inner container.

7. A device in accordance with claim 1 wherein said top cover including said locking means comprises a generally horizontal spring strip extending along the surface and to the periphery of said top cover, the ends of said spring strip being inclined slightly upwardly in untensioned position; a locking ramp connected to said upper portion of said middle container for interlocking with said spring strip, said locking ramp having a sloped portion for sliding contact with the inclined end of said spring strip and a recessed portion into which the inclined end of said spring strip fits for locking; and means to tension said spring strip to effect flattening of the inclined end thereof and movement of said end out of the recessed portion of said locking ramp for unlocking said integral closure means.

8. A device in accordance with claim 7 wherein said means to tension said spring strip comprises a handle for said top cover overlying said spring strip and an upwardly projecting element passing about said spring strip and grippable with said handle for movement of said element toward said handle with the consequent deformation of said spring strip, thereby causing said flattening of the inclined end of said spring strip.

9. A device in accordance with claim 8 wherein the inside of said cover lid for said outer container is provided with a recess therein adapted to receive said handle for said top cover of said middle container only when said closure means for said middle container is locked, said cover lid and said handle thereby comprising said means for preventing the closure and locking of said cover lid unless said integral closure means for said middle container is locked in place, thereby aligning said recess and said handle.

10. A device in accordance with claim 1 wherein said cover lid for said outer container is hingedly attached to said outer container and said means to lock said cover lid on said outer container comprises a key type lock.