

July 17, 1962

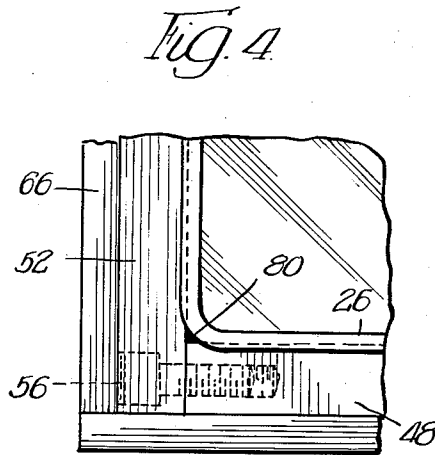
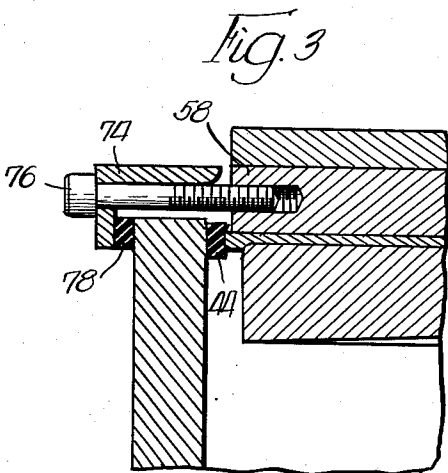
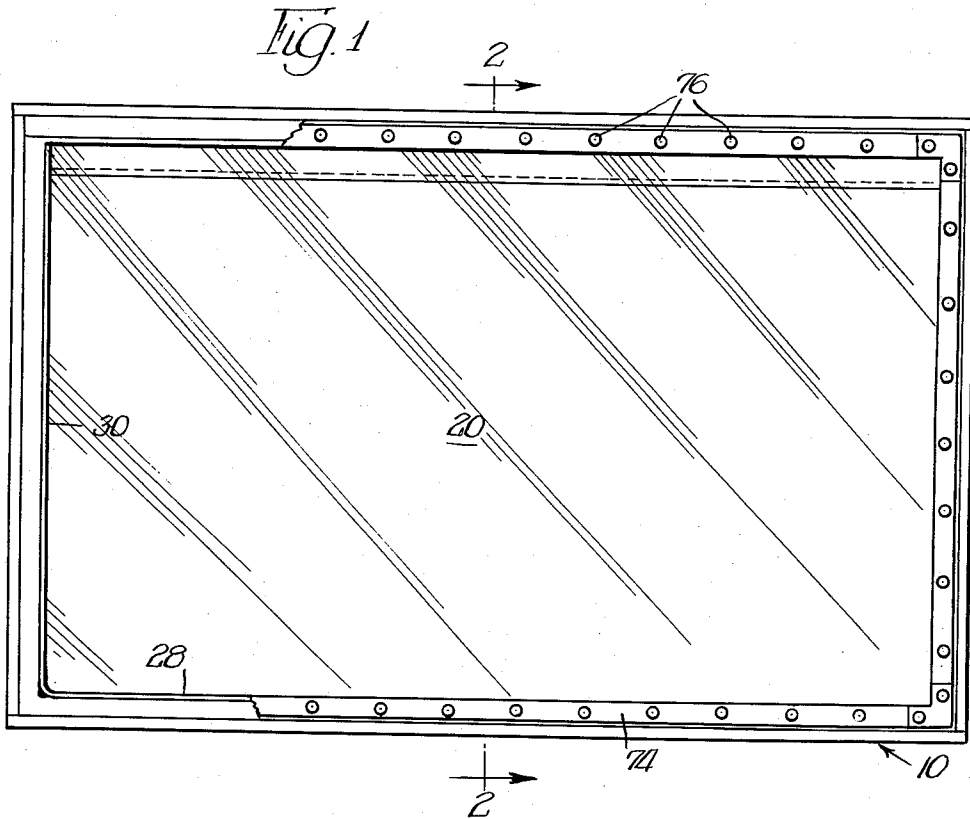
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3,045,120

RADIATION SHIELDING WINDOW

Filed July 25, 1958

3 Sheets-Sheet 1



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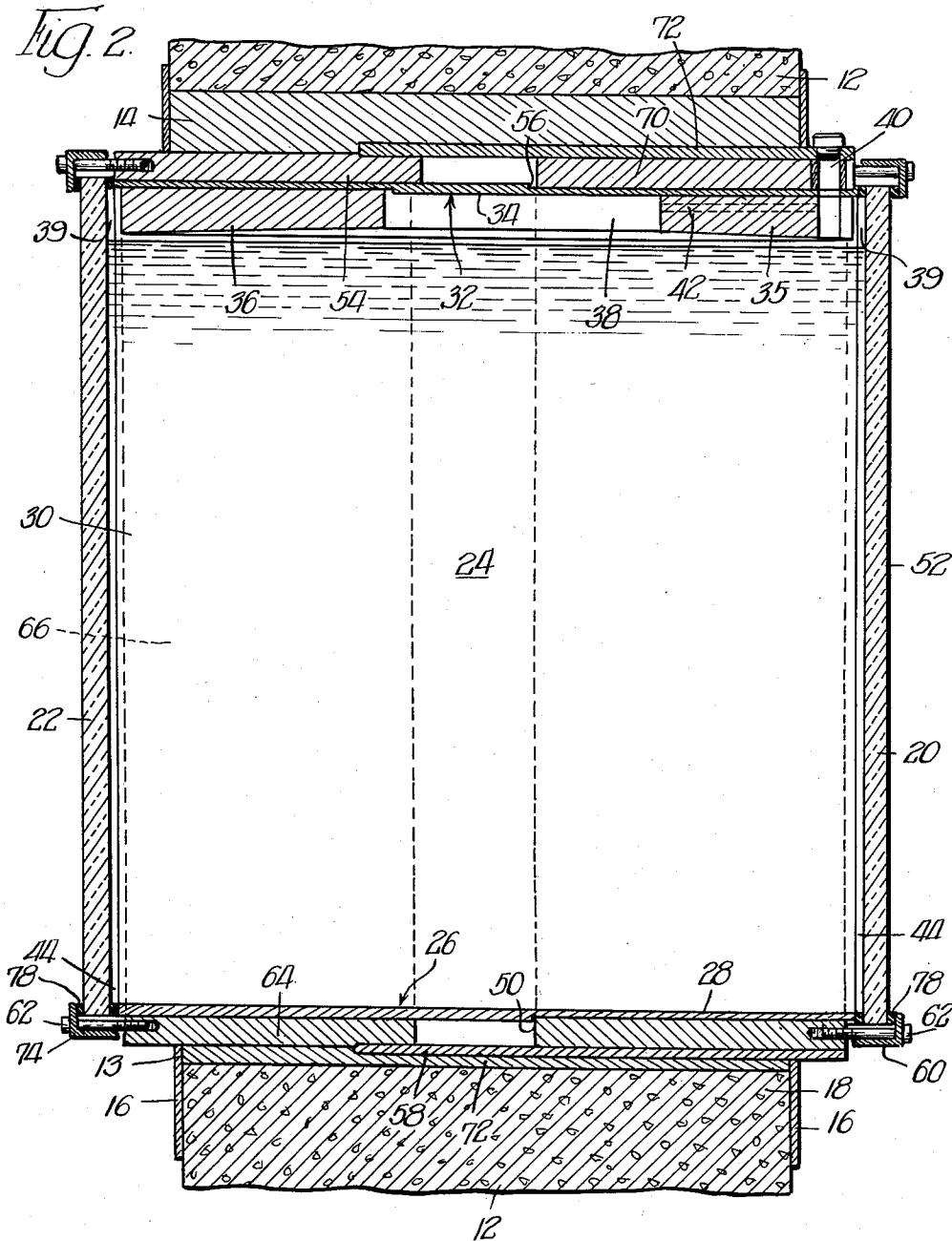
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RADIATION SHIELDING WINDOW

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3 Sheets-Sheet 2



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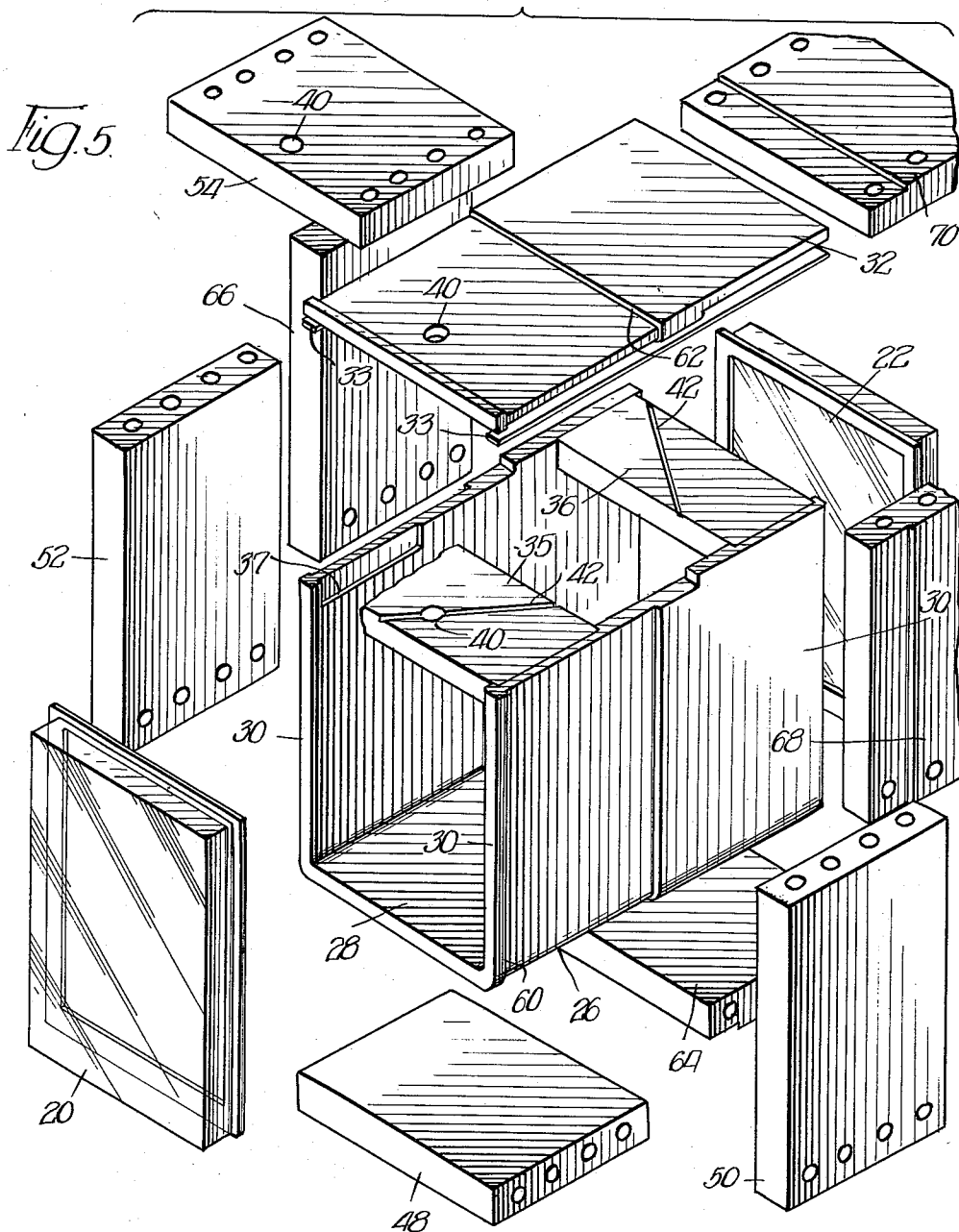
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RADIATION SHIELDING WINDOW

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3 Sheets-Sheet 3



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3,045,120

RADIATION SHIELDING WINDOW

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8 Claims. (Cl. 250-108)

This invention pertains to a radioactive shielding device and in particular to a radiation shielding window adapted to be used for laboratories and in other areas where radioactive substances are to be observed, including cobalt teletherapy machines.

It has been proposed to construct radiation shielding windows which include concentrated solutions of a zinc halide, generally zinc bromide, but may include other halides as the radiation shielding medium. These solutions are placed in a tanklike enclosure which includes spaced sheets of glass. The spaced sheets of glass are generally mounted on heavy steel plates which form the remaining sides of the tanklike enclosure. The steel casing is then mounted in the wall through which the radioactive material is to be observed. While this construction does provide a considerable amount of shielding from the radioactivity, it has been found that it has at least one major disadvantage. That disadvantage is the fact that zinc bromide solutions attack the steel used in the construction of the window, and causes the zinc bromide solution to become discolored and in particular turn a brownish color which affects the transparency of the window. In other words, the visual observation possible through the window is obscured by the attacking of the steel by the zinc bromide.

It has been further proposed to coat the steel surfaces with a resinous substance of some suitable type to protect the steel. This procedure has been somewhat successful since it prevents the attacking of the steel surface by the zinc bromide, particularly during the initial use of the window. However, it has been found that most resinous substances, when subjected to extensive or prolonged radiation, may become brittle and crack. This cracking exposes the steel surfaces to the zinc bromide. Thus, in time the zinc bromide becomes discolored even though a resinous substance is used to coat the steel surfaces, so that the window must be replaced or reworked. The criticality of this disadvantage in radiation shielding windows can be further appreciated by pointing out that these windows cost many thousands of dollars. In view of these reasons a foremost feature and object of this invention is to provide a radiation shielding window using a zinc halide solution of a new and novel construction.

Another object of the invention is to provide a radiation shielding window using a zinc halide solution which is resistant to discoloration and resulting impairment of the transparency of the window.

Another object of the invention is to provide a radiation shielding window which is impervious to all types of radiation.

Another object of the invention is to provide a radiation shielding window which is of a relatively economical construction as compared to heretofore known radiation shielding windows.

Another object of the invention is to provide a radiation shielding window that permits a wide angle visual observation and in which there is a minimum of wasted visual area.

These and other objects will be apparent upon reading of the specification with reference to the following drawings.

In the drawings:

FIGURE 1 is a front view in elevation of a radiation shielding window embodying the invention.

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FIGURE 2 is a sectional view taken along the lines 2-2 in FIGURE 1;

FIGURE 3 is a segmental view in section in somewhat greater detail;

FIGURE 4 is a segmental view in section in somewhat greater detail;

FIGURE 5 is an exploded view of the radiation shielding window embodying the invention, with some of the parts removed.

Referring now to FIGURES 1 and 2, there is shown a radiation shielding window generally denoted by the numeral 10 embodying the invention. The window is adapted to be mounted in the walls 12 of a room in which radioactive substances are to be observed. The wall is of any suitable type that will provide shielding of the personnel outside the room from the radioactivity of the substances within the room. At the top of the window is the caulking material 14 which provides a seal between the walls 12 and the window 10. This caulking material is of some suitable substance such as lead wool that is impervious to the radioactivity of the substances within the room.

It should be pointed out that radiation shielding windows of this type are extremely heavy due to the materials used in their construction. For example, the zinc bromide or zinc chloride solutions are approximately 2.5 times the density of water which along with the metallic members used in the construction of the window compile a relatively heavy unit. It may be desirable to mount a flashing member 16 on the wall 12 around the window 10, although it is not necessary to the practice of this invention.

In FIGURE 2 it can be seen that the window 10 consists of two spaced sheets of glass 20 and 22 with the sheet of glass 20 to be nearest the observer and the sheet 22 to be nearest the radioactive material. The sheet 20 may be constructed of polished plate glass of some conventional type sufficiently thick to confine a zinc bromide solution within the window. The sheet 22, however, must be of a glass that is stable against discoloration with regard to large amounts of radiation. Types of glass that are particularly suited for this use are the non-browning glasses, available commercially under various trade names and catalog numbers. Intermediate the spaced sheets of glass 20 and 22 is a transparent radiation absorbing medium 24 such as a zinc bromide solution. By zinc bromide solution is meant a solution consisting of approximately 80 percent zinc bromide dissolved in water. Although the specification is in terms of zinc bromide, it is to be understood that other zinc halides, such as zinc chloride, can be substituted. These compounds when in a concentrated solution exhibit the property of absorbing large amounts of radiation. Solutions of these materials are substantially colorless and transparent and, therefore, present little or no impairment to the visual observation of the contents of the room.

Between the glass sheets 20 and 22 and in sealing relationship therewith is the copper liner member 26 which forms the sides and bottom of the window. The copper liner 26 is arranged in a U-shaped configuration consisting of the bottom portion 28 and the side portions 30. The copper liner 26 may be constructed of a machined copper plate bent so as to form the sides 30, so that it may be constructed at a relatively low cost.

A copper lid member 32 is adapted to rest on the side members 30 as shown in the drawing. The sealing members 33 are adapted to lie intermediate the lid member 32 and the side members 30 in order to provide sealing engagement therebetween. The copper bars 35 and 36 extend underneath the lid 32 and are supported at their ends by the cutaway portions 37 in the sides 30

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as best shown in FIGURE 5. The space intermediate the bars 36 forms an expansion chamber 38 which permits expansion of the zinc bromide solution without causing any undue stress on the various structural elements of the window. The expansion chamber 38 and the spaces 39 between the bars 35 and 36 and their respective adjacent sheets of glass 20 and 22 communicate with an air vent filler tube 40 by means of the ducts 42. The filler tube 40 as the name implies facilitates the filling of the window 10 with the zinc bromide solution and is preferably positioned outside the wall 12 as shown in FIGURE 2. The bromide solution 24 must be slightly above the lower surfaces of the bars 35 and 36 to provide the desired radiation shielding. In the space not filled with the zinc bromide solution the copper bars 35 and 36 provide the necessary radiation shielding. The copper liner 26 and the lid 32 are in sealing engagement with the sheets of glass 20 and 22, as shown in the drawing. This sealing engagement is the result of the sealing rings 44 clamped between the edges of the liner 26 and the lid 32. The sealing rings are of any suitable material that is resistant to the zinc bromide and will provide a suitable seal. One material that is particularly suitable for this purpose is the synthetic rubber sold under the trademark "Koroseal" by the B. F. Goodrich Co.

In order to facilitate the mounting of the window and at the same time provide additional shielding, the copper liner 26 and the lid 32 are preferably at least partially encased in a plurality of barlike reinforcing elements. These reinforcing elements are preferably constructed of steel, although other types of materials may be used where suitable. Along the bottom and sides of the copper liner 26 and across the lid 32 near the sheet of glass 20 are the bar members 48, 50, 52, and 54. The bar members 48-54 are secured at their ends to adjacent bar members by means of the threaded bolts 56, as can be seen in FIGURES 4 and 5. These bar members are received in the recess portions 60 and 62 of the copper liner 26 and the lid 32 respectively. The dimensions of the bar members are such that when assembled, they tightly embrace and reinforce the copper liner 26 and the lid 32 and in fact serve to hold the lid in its assembled position. A second set of bar members 64, 66, 68, and 70 is adapted to embrace the copper liner 26 and the lid 32 adjacent the sheet of glass 22 in a manner similar to that of the first bar members. The bar members 64-70 are secured at their ends to adjacent bar members by a bolt construction similar to that shown in FIGURE 4.

It will be noticed that the outside surfaces of the liner 26 and the lid 32 are stepped intermediate the glass members 20 and 22 as the result of the recesses 60 and 62. The purpose of this construction is to prevent gamma radiation from following the parting line between the various elements used in the construction of the window such as the before-mentioned steel bars and the copper liner 26. By providing the stepped surface it is possible to block out any gamma radiation that would ordinarily tend to follow a crack or parting line between the various structural elements. It is further pointed out along this line that the lid 32 on its inside surface is stepped, with the bars 35 and 36 being in touching relationship with the different levels of the surface as can be seen in FIGURE 2. This stepped construction makes it possible to eliminate the requirement for welding the steel bars to the copper liner 26 and the lid 32. As a result, this particular construction results in an economy in the manufacture of the window due to the elimination of substantial amounts of welding or brazing.

A still further constructional feature designed to prevent leakage of gamma radiation is the placement of the ducts 42 in the bars 35 and 36. As can be seen in FIGURE 5, the ducts extend diagonally across the bars 35 and 36 so that they do not form a straight path the length of the window, which would permit leakage of gamma radiation,

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In the preferred embodiment, the corresponding steel bars in the two groups 48-54 and 64-70 are bridged by the steel plates 72 as can be seen in FIGURE 2. The steel plates 72 are secured to the steel bars by any suitable means such as welding, brazing or even by mechanical means such as bolts, rivets, or the like. It will be noticed that the rearward end of each of the steel plates 72 is received in a recess in the steel bars 54 and 64 so as to prevent any leakage of radiation therebetween, as was explained previously. A frame member 74 extends around each of the sheets of glass 20 and 22 for holding them in place. The frame members 74 are secured to the associated steel bars by the studs 76 as shown in the drawings. Intermediate the frame members 74 and the associated sheets of glass 20 and 22 is a rubberlike cushion 78 which permits the glass to be forced into place without any danger of chipping or breaking. When the frame member 74 is tightened down by the stud 76, the seal members 44 between the glass and copper members are forced into sealing engagement. This arrangement results in an effective seal formed between the glass and copper so that none of the zinc bromide is permitted to leak.

It will be noticed that the copper liner 26 and the lid 32 are movable with respect to the steel casing. Thus, if the studs 76, associated with sheet 22, were tightened to compress the associated seal 44, the copper member would be shifted to the right so that both seals 44 would be compressed an equal amount. This arrangement results in an equalization of the stresses on the sheets 20 and 22 so as to reduce any tendency to overstress during the assembly operation.

Referring now to FIGURE 4, it can be seen at the corners of the copper liner 26 between the corner formed by the abutting steel bars 48 and 52 that there is a lead caulking 80 which serves to prevent any leakage of radiation through the window. Although a preferred embodiment of the invention has been disclosed, it is to be understood that this is merely by way of example and in no manner is to be construed as a limitation.

It is contemplated that certain modifications may be made within the scope of the claims without departing from the spirit of the invention.

What is claimed is:

1. A radiation shielding window comprising two spaced sheets of glass adapted to be substantially parallel with the walls in which the window is mounted, a copper liner having two side sections and a bottom section arranged in a U-shaped configuration, said copper liner conforming to at least part of the periphery of said spaced sheets and in sealing engagement therewith so as to form an enclosure, and a copper plate supported by said side sections of said U-shaped copper liner forming the top of said enclosure, said enclosure being at least partially filled with a radiation absorbing media.

2. A radiation shielding window comprising two spaced sheets of glass adapted to be substantially parallel with the walls in which the window is mounted, a copper plate having two side sections and a bottom section arranged in a U-shaped configuration, said copper plate conforming to at least part of the periphery of said spaced sheets and in sealing engagement therewith so as to form an enclosure, a second copper plate supported by said side sections of the said U-shaped copper plate forming the top of said enclosure, and an air vent filler tube in said second copper plate, said enclosure being at least partially filled with a radiation absorbing media.

3. A radiation shielding window comprising two spaced sheets of transparent material, said spaced sheets of transparent material adapted to be substantially parallel with the walls in which the window is mounted, and a copper plate transversely bent, said copper plate being intermediate said spaced sheets of transparent material and in sealing engagement therewith to form an enclosure, said enclosure being at least partially filled with a solution of zinc bromide.

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4. A radiation shielding window comprising two spaced sheets of glass adapted to be substantially parallel with the walls in which the window is mounted, a liner having two side sections and a bottom section arranged in a U-shaped configuration, said liner conforming to at least part of the periphery of said spaced sheets and in sealing engagement therewith so as to form an enclosure, a plate supported by said side sections of said U-shaped liner forming the top of said enclosure, an air vent filler tube in said plate, and reinforcement members embracing said liner and said plate, adapted to be in wall engaging position, said reinforcement members in touching relationship with said liner and said plate, said enclosure being at least partially filled with a solution of zinc bromide.

5. A radiation shielding window comprising two spaced sheets of glass adapted to be substantially parallel with the walls in which the window is mounted, a copper liner having two side sections and a bottom section arranged in a U-shaped configuration, said copper liner conforming to at least part of the periphery of said spaced sheets and in sealing engagement therewith so as to form an enclosure, a copper plate supported by said side sections of said U-shaped copper liner forming the top of said enclosure, an air vent filler tube in said copper plate, and reinforcement members embracing said copper liner and said copper plate, adapted to be in wall engaging position, said enclosure being at least partially filled with a solution of zinc bromide.

6. A radiation shielding window comprising two spaced sheets of glass adapted to be substantially parallel with the walls in which the window is mounted, a copper liner having two side sections and a bottom section arranged in a U-shaped configuration, said copper liner conforming to at least part of the periphery of said spaced sheets and in sealing engagement therewith so as to form an enclosure, a copper plate supported by said side sections of said U-shaped copper liner forming the top of said enclosure, an air vent filler tube in said copper plate, and reinforcement members surrounding said copper liner and said copper plate, adapted to be in wall engaging position, said reinforcement members in touching relationship with said copper liner and said copper plate, said enclosure being filled with a solution of zinc bromide.

7. A radiation shielding window comprising two spaced sheets of glass adapted to be substantially parallel with the walls in which the window is mounted, a copper plate having two side sections and a bottom section arranged in a U-shaped configuration, said copper plate conform-

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ing to at least part of the periphery of said spaced sheets and in sealing engagement therewith so as to form an enclosure, a second copper plate supported by said side sections of said U-shaped copper plate forming the top of said enclosure, an air vent filler tube in said second copper plate, the external faces of said copper plate and of said second copper plate being stepped intermediate said spaced sheets of glass, reinforcement members surrounding said copper plate and said second copper plate, adapted to be in wall engaging position, said reinforcement members in touching relationship with said copper plate and said second copper plate, said enclosure being filled with a solution of zinc bromide, and an expansion chamber in said enclosure to accommodate expansion of said zinc bromide solution.

8. A radiation shielding window comprising two spaced sheets of glass adapted to be substantially parallel with the walls in which the window is mounted, a plate having two side sections and a bottom section arranged in a U-shaped configuration, said plate conforming to at least part of the periphery of said spaced sheets and in sealing engagement therewith so as to form an enclosure, a second plate supported by said side sections of said U-shaped plate in sealing engagement with said spaced sheets of glass forming the top of said enclosure, an air vent filler tube in said second plate, the external faces of said plate and of said second plate being stepped intermediate said spaced sheets of glass, reinforcement members surrounding said plate and said second plate, adapted to be in wall engaging position, said reinforcement members in touching relationship with said plate and said second plate, and a plurality of bars in spaced and stepped relationship extending between said sides at their upper ends, said plate being stepped on its normally internal face so as to be in touching relationship with said bars, said enclosure being filled with a zinc bromide solution to a level that at least partially covers said bars.

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