

Sept. 28, 1965

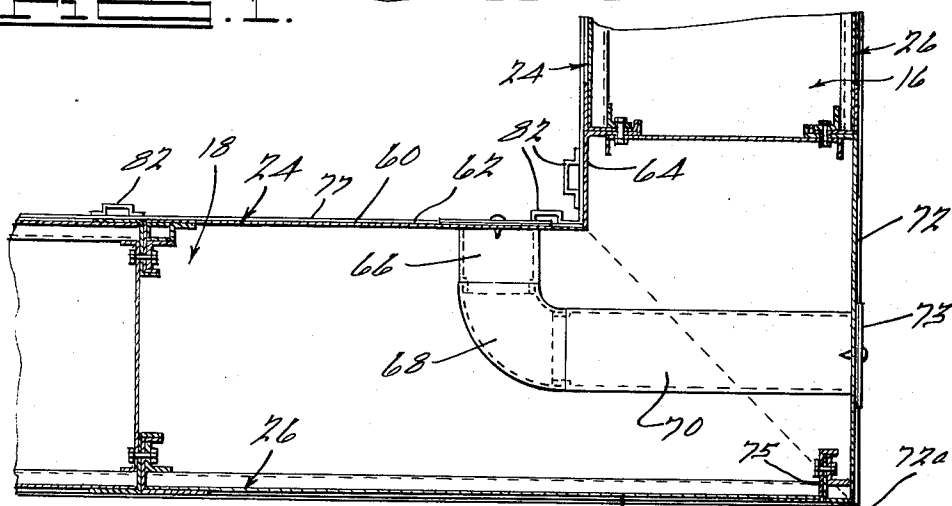
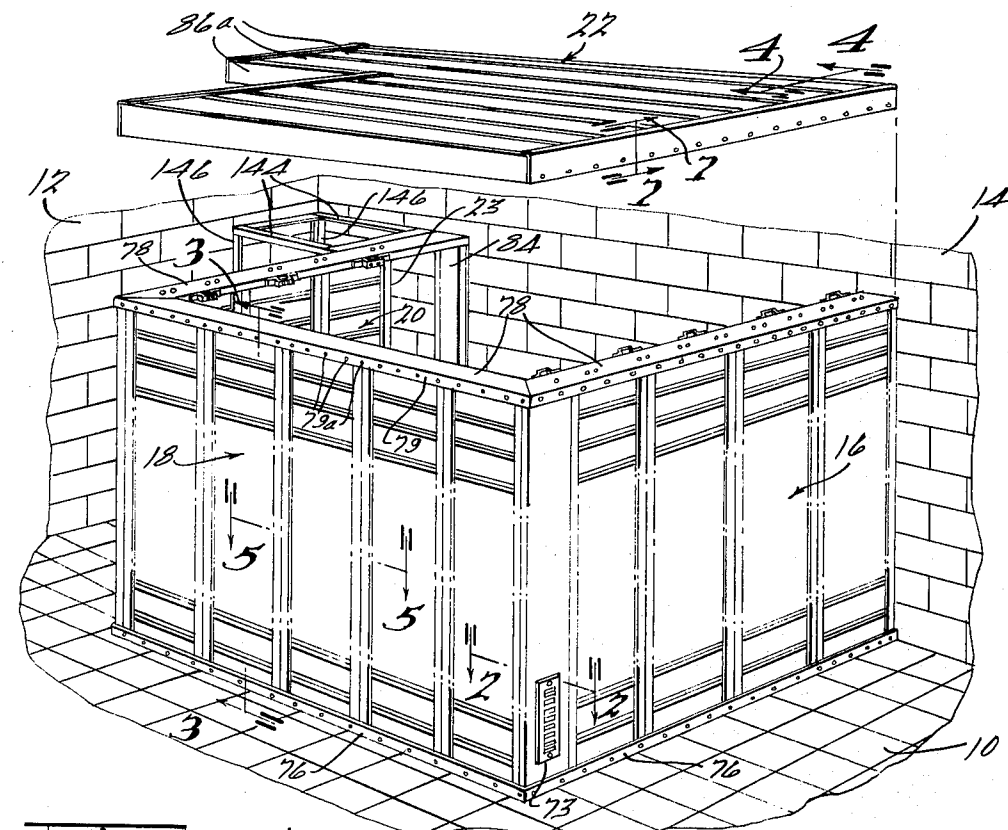
E. J. HAYES ETAL

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RADIATION SHELTER

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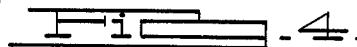
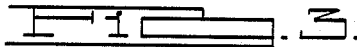
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3 Sheets-Sheet 2



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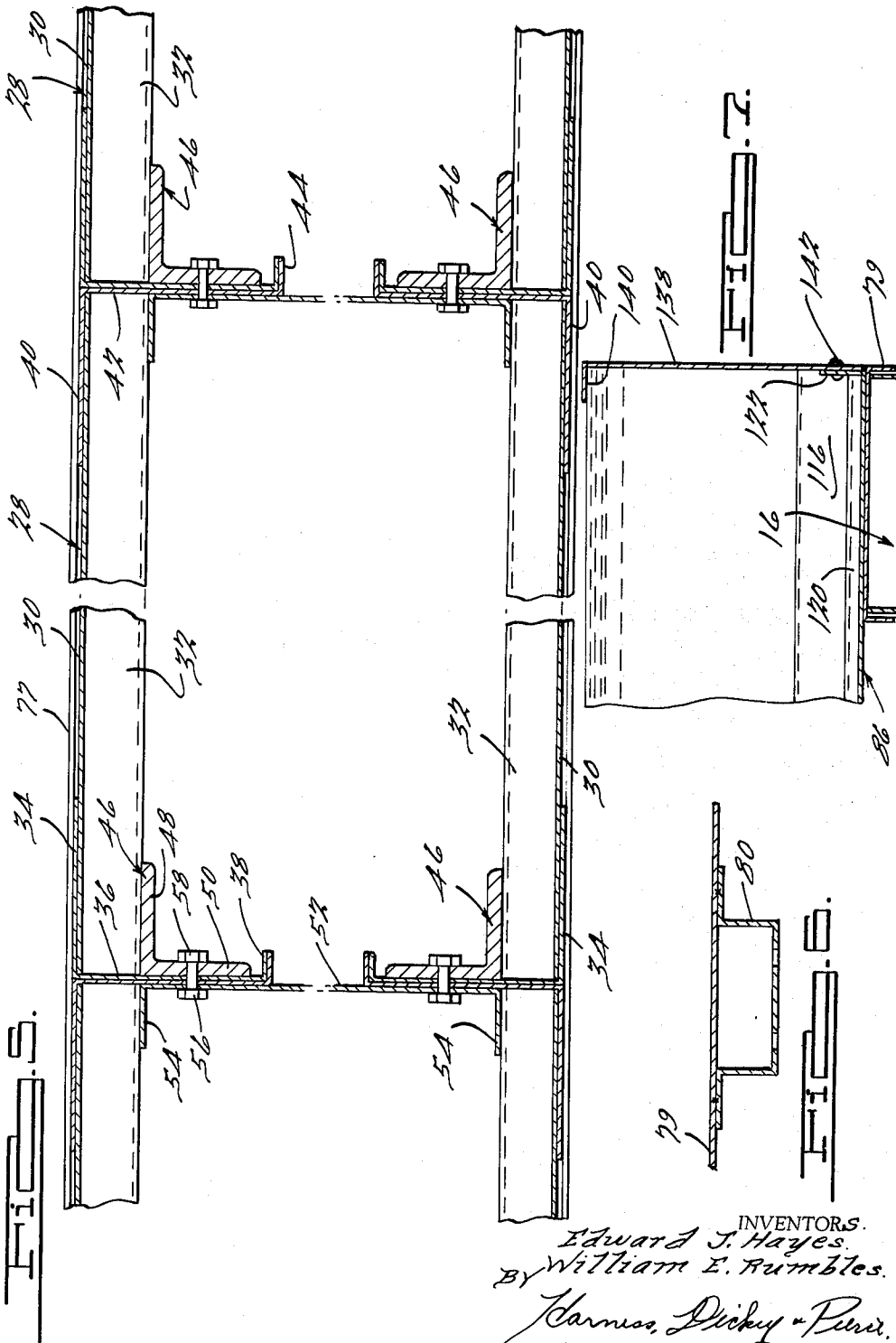
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3 Sheets-Sheet 3



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RADIATION SHELTER

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2 Claims. (Cl. 109-1)

This invention relates to radiation shelters and more particularly to a prefabricated radiation shelter adapted for individual home installation.

It is an object of the present invention to provide a radiation shelter which is effective to shield its occupants from the harmful effects of a relatively high degree of radiation present in the surrounding atmosphere.

It is another object of the present invention to provide a radiation shelter which may be fabricated on a high production basis, sold in a disassembled and relatively compact package and thereafter conveniently assembled by a person of limited mechanical ability or construction experience.

It is a further object of the present invention to provide a radiation shelter which permits the use of sand, gravel, water or other inexpensive, readily available materials as the radiation absorbing or insulating component of the shelter.

It is a still further object of the present invention to provide a radiation shelter which possesses sufficient structural strength to protect the occupants of the shelter from falling debris and damage from physical impact of at least a limited degree.

It is still another object of the present invention to provide a radiation shelter which utilizes standard panels and wall sections whereby radiation shelters of varying sizes and shapes may be constructed from the same basic components.

It is still another object of the present invention to provide a radiation shelter of maximum structural strength for the quantity of materials utilized.

These and other objects of the present invention will become apparent from the following detailed description taken in conjunction with the accompanying drawings wherein:

FIGURE 1 is an exploded perspective view of a radiation shelter constructed in accordance with the principles of the present invention;

FIG. 2 is an enlarged sectional view of the structure illustrated in FIGURE 1, taken along the line 2-2 thereof;

FIG. 3 is an enlarged broken sectional view of the structure illustrated in FIGURE 1, taken along the line 3-3 thereof;

FIG. 4 is an enlarged sectional view of the structure illustrated in FIGURE 1, taken along the line 4-4 thereof;

FIG. 5 is an enlarged broken sectional view of the structure illustrated in FIGURE 1, taken along the line 5-5 thereof;

FIG. 6 is an enlarged sectional view of the structure illustrated in FIG. 3, taken along the line 6-6 thereof, and

FIG. 7 is an enlarged sectional view of the structure illustrated in FIGURE 1, taken along the line 7-7 thereof.

Referring now to the drawings, a radiation shelter constructed in accordance with the teachings of the present invention is illustrated in FIGURE 1 as being located in the basement of a home having a basement floor 10 and two adjacent perpendicular vertical exterior walls 12 and 14. Although not shown in the drawings, soil or earth is, of course, located on the outer sides of the

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walls 12 and 14. The prefabricated portion of the shelter is open on one side, which side is set against the wall 14 and utilizes the wall 14 as the fourth wall of the shelter. The shelter includes additional enclosing side walls 16, 18 and 20. A roof structure 22 is supported on the side walls 16, 18 and 20 and encloses the shelter on the top, while the basement floor 10 encloses the shelter at the bottom. The side wall 20 will be seen as being parallel to the basement wall 12 and spaced several feet therefrom forming a passageway to provide access to a doorway opening 23 in the wall 20 adjacent the basement wall 14, through which access and egress to and from the shelter may be had.

While the so-called "fallout" of an atomic explosion consists of particles which may be carried with the wind or other fluid medium, the radiation or rays emanating from radioactive particles will only travel in a straight line. The design of the radiation shelter of the present invention is accordingly intended to place a large mass of radiation absorbing material in a direct line between the occupants of the shelter and any surrounding environment in which radioactive particles or fallout may be expected to be found. This mass of material is sufficient to absorb radiation of a relatively high level which might result from the detonation of a nuclear device. It is, therefore, possible to leave the doorway opening 23 unclosed without danger of radiation traveling in a U-shaped path to enter through the doorway 23 and reach the occupants of the shelter.

As indicated in FIG. 2, each of the walls 16, 18 and 20 is constructed of spaced inner and outer wall portions 24 and 26, respectively, of rigid sheet metal, which are adapted to hold and confine a loose or fluid radiation absorbing material placed in the cavity therebetween. Both of the wall portions 24 and 26 are constructed with the use of standard wall panels 28 which are successively joined together at their adjacent complementary configured edges. While slightly differently shaped panels are utilized at the ends and corners of the walls 16, 18 and 20, the greater portion of the length of each of said walls is made from the standard panels 28 and the walls may be built to any desired length by simply adding on additional standard panels. The construction of the standard panels is indicated in somewhat greater detail in FIGS. 3 and 5, where it will be seen that each of said panels includes a rectangular sheet metal member 30 having a plurality of vertically spaced, horizontally extending ribs 32 of V-shaped cross section. A vertically extending sheet metal strip 34 is welded to the sheet 30 along one side margin thereof and is provided with an inwardly extending flange portion 36 disposed perpendicularly to the plane of the panel. The flange 36 has a perpendicularly extending shoulder portion 38 at its free edge which is bent parallel to the plane of the panel and extends toward the opposite side of the panel. Another vertically extending strip 40 is welded to the sheet 30 along the side thereof opposite from the strip 34 and is provided with an inwardly extending flange 42 arranged perpendicularly to the plane of the panel. A shoulder portion 44 is formed on the free edge of the flange 42 and extends parallel to the plane of the panel and in the same direction as the shoulder portion 38 of the strip 34. A column or vertical supporting member in the form of an angle iron 46 having two perpendicular flange portions 48 and 50 is integrally formed on the panel by having the flange portion 50 thereof welded to the inside of the flange 36, with the flange portion 48 disposed in engagement with the ribs 32.

Since the adjacent side portions of two adjoining panels are of a complementary configuration, it will be seen that when one panel 28 is placed adjacent another panel 28, the flange 42 of one panel will receive the flange 36

of the next adjacent panel with the shoulder portions **38** and **44** lying flatly against one another. Thus, any number of panels **28** may be connected successively together, so as to have their flanges **36** and **42** interfit. The panels **28** of the inner and outer walls **24** and **26** are disposed in opposite relation so that the interfitting panel flanges of one wall **24** or **26** will align with the abutting panel flanges of the other of said walls. By this means, web members **52** may be positioned flatly against the flanges **42** on the sides thereof opposite from the sides in engagement with the flanges **36**. When so positioned, flanges **54** formed on opposite sides of the web members **52** will engage the ribs **32**. The web members **52**, the flanges **36** and **42** and the angle irons **46** all have aligned apertures in vertically spaced locations thereon that permit the application of bolts **56** and nuts **58** to hold the same in assembled relationship. Thus, the webbing **52** holds the inner and outer walls **24** and **26**, respectively, in properly spaced relationship and divides the walls **16**, **18** and **20** into successive units or compartments defined by a pair of opposite panels **30** and a pair of successive web members **52**. Each of said compartments is adapted to be filled with a radiation absorbing material which may consist of sand, gravel, water or other granular solids, fluids, or aggregate. If it is desired to utilize a fluid, said fluid is preferably enclosed within a flexible bag, as, for example, a plastic bag, which prevents leakage of the liquid out of the wall structure.

As previously mentioned, the standard panels **28** are not utilized at the ends and corners of the walls **16**, **18** and **20**. As indicated in FIG. 2, the panel structure at one corner includes a panel member **60** having a main panel portion **62** forming a part of the inner wall portion **24** of the wall **18** and provided with a perpendicularly bent portion **64** forming a part of the inner wall portion **24** of the wall **16**. The panel portion **62** is provided with an opening fitted with a bent conduit **66** connected successively to an elbow conduit **68** and a conduit **70**. The conduit **70** registers with an opening formed in a panel member **72** forming a portion of the outside wall **26** of the wall structure **16**. The opening in the member **72** may be conveniently covered with a louvered grill or the like, as indicated at **73**. The panel member **72** has a perpendicularly bent portion **72a** which forms a part of the outside wall portion **26** of the wall **18** and is connected to a panel member **74** by flange structure **75** of a similar construction to the flange structure previously described in connection with the standard panels **28**. The conduits **66**, **68** and **70** cooperate to provide an air vent duct through which ventilating air may be brought into the interior of the shelter. When sand or other insulating material is introduced between the panels **60** and the panels **72** and **74**, it will surround the conduits **66**, **68** and **70** and the angular shape of the duct formed by the conduits **66**, **68** and **70** eliminates the possibility of radiation entering the shelter in this location.

All of the side walls of the shelter, including each of the side walls **16**, **18** and **20**, rest upon a base or floor channel member **76** which is of U-shaped cross section. The channel member is provided with a flat base having upstanding flange portions **77** on opposite sides thereof which are fastened to the inner and outer wall portions **24** and **26** by fasteners **77a**, thereby enclosing the side walls at the bottoms thereof. The tops of the side walls are enclosed by an upper capping channel **78** of U-shaped cross section and having depending flange portions **79** connected to the inner and outer wall portions **24** and **26** by fasteners **79a**. As may be noted in FIGURE 1, that portion of the upper capping channel **78** which is disposed over the doorway opening **23** is supported by an upright support **84**.

For the purpose of facilitating the erection of shelving or other supporting members within the interior of the shelter, the upper capping channel **78** and the floor chan-

nel **76** are provided with U-shaped brackets **80** and **82**, respectively, on the inner flanges **77** and **79** thereof. By this means, a wooden post or support may be positioned against the inner wall portion **24** so as to be held at its upper ends by the brackets **80** and **82**, such a post being indicated in broken lines at **83** in FIG. 3. Shelving, bunk beds or other structure within the shelter may then be fastened to such posts, in accordance with the desires of individual shelter owners.

The roof structure **22** rests directly on the upper capping channel **78** and includes a plurality of interlocked standard roof troughs **86**. Each trough **86** has a bottom wall **88** provided with a vertical wall **90** on one side thereof with an inturned horizontal flange **92** being formed at the upper end of the vertical panel **90**. A shoulder portion **94** depends from the free end of the flange **92**. A reinforcing member in the form of an angle iron **96** is welded to the upright wall **90** at its upper corner so as to engage the flange portion **92**. An upright wall **98** is formed on the opposite side of the bottom wall **88** and is provided with an outwardly extending horizontal flange **100** adapted to overlie and engage the flange portion **92** of the next adjacent trough **86**. The flange **100** also has a depending shoulder portion **102** similarly engaging the shoulder portion **94** of the next adjacent trough member **86**. Thus, the wall **90** of one trough **86** is held between the wall **98** and the shoulder portion **102** of the next trough **86**.

A plurality of beam members **104** of T-shaped cross section are suspended between the side walls **16** and **20** and extend parallel to the side wall **18** at evenly spaced locations between the side wall **18** and the basement wall **14**. The beams **104** include an upstanding rib portion **106** and laterally extending shoulder portions **108**. The bottom wall **88** of the trough members **86** is provided with a raised portion **110** on one side thereof which will rest directly on the adjacent of the shoulder portions **108**, while the bottom wall **88** rests directly on the capping channel **78**. A short vertical wall **112** connects the raised portion **110** to the bottom wall **88**. The trough members **86** are similarly bent to provide a raised shoulder portion **114** resting on a rib **106** of the beam **104** on the other side thereof. The shoulder portion **114** is connected to the bottom wall **88** by a vertical wall **116** extending along the rib **106**, a shoulder portion **118** resting on a beam shoulder **108** and a vertical wall **120** extending down the side of the shoulder portion **108**. It will thus be seen that each beam serves to support two interlocked troughs **86**. In view of the support afforded by the iron supporting beams **104** and reinforcing members **96**, the troughs **86** may be made from relatively thin sheet metal, yet they will be held against excessive deflection or bending under the weight of a load of sand or other radiation absorbing material placed within the troughs.

The troughs at the ends of the roof structure are of a slightly modified construction, as indicated at **124**. The trough **124** has a straight outer side wall **126**, which provides a smooth appearance substantially coplanar with the outer side wall **26** of the roof structure **22**. A trough **128** is positioned at the end of the roof structure **22** adjacent the basement wall **14** and is provided with an upstanding wall **130** engaging the basement wall **14** and having an inturned flange portion **132** which is reinforced by an angle iron **134**. The corner structure of the trough **128** at the lower portion of the upstanding side wall **130** is conformed to and rests upon an angle iron **136** which is supported between the wall structures **16** and **20** parallel to the T-beams **104**. As indicated in FIG. 1, the trough **128** and the adjacent of the troughs **86** extend beyond the side wall structure **20** and are supported by horizontal brace members **144** connected to the wall structure **20** and are additionally supported by upright support members **146** to provide insulating material over the space immediately in front of the doorway opening

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23. This further prevents possible entrance of radiation into the shelter through the doorway opening 23.

Varying insulating materials may be positioned both within the side wall structure and within the troughs of the roof structure 22. As indicated in FIG. 3, the side walls may be filled with sand 148. As also indicated in FIG. 3, one of the troughs 86 may be interiorly sprayed with a plastic or other water-impervious lining 150 and the trough thereafter filled with water 152. As indicated in FIG. 4, one of the troughs may be filled with a flexible bag 154, which is filled with water 156.

As shown in FIG. 7, the ends of the troughs 86, 124 and 128 are closed by end closure panels 138 having an upper flange 140 which may be fastened to the tops of the troughs. In addition, the panels 138 are fastened at the bottoms thereof to flanges 122 extending upwardly from the bottoms of the troughs.

From the foregoing, it will be appreciated that the entire shelter, except for the radiation absorbing material utilized, may be fabricated in a factory under high production methods. The various troughs, wall panels and other components may then be sold in a disassembled package. A home owner purchasing such a package may readily assemble the shelter in his basement with a minimum number of tools, as, for example, simple extension wrenches. It may also be necessary for the home owner to level off the floor with cement, if the floor is excessively warped or uneven or to secure the floor channel 76 and the side walls 16 and 20 to the floor 10 and the basement walls 12 and 14, respectively, by means of anchor bolts. After assembly of the side walls, the space between the inner and outer walls 24 and 26 is filled with sand or other insulating material, and thereafter the roof structure 22 is installed in place. Finally, the radiation absorbing material is placed into the troughs of the roof structure. For convenience in inserting sand in the troughs of the roof structure, corrugated cardboard boxes may be obtained of a width and height corresponding to the dimensions of the trough. These boxes may then be filled with sand and slid down the lengths of the troughs until each trough is filled with sand. When using water as an insulating material, it is possible to provide outlet spouts such as indicated at 158 in FIG. 4 for the purpose of providing drinking water for the occupants of the shelter.

It will be seen that the individual panels of the side walls of the present shelter are horizontally ribbed to provide strengthening against outward bowing under the weight of the material placed in the side walls. The sheets 30 may be fed through high production machinery to accomplish the bending and rib forming operation and the strip members 34 and 40 subsequently welded to the sheets 30. The flanges which are formed on said rib members provide a convenient means of fastening the panels together and the shoulder portions on said flanges, which overlap, help prevent the escape of material out of the wall structure. The web members 52, which interconnect the inner and outer walls 24 and 26, divide each of the walls 16, 18 and 20 into separate compartments, so that any leakage developing in one unit will not affect the other compartments. Furthermore, the web members increase the overall rigidity and strength of the wall structure, as well as facilitating the erection or disassembly of the shelter on a unit by unit basis.

While it will be apparent that the preferred embodiment herein illustrated is well calculated to fulfill the objects above stated, it will be appreciated that the invention is susceptible to modification, variation and change without departing from the proper scope or fair meaning of the subjoined claims.

What is claimed is:

1. A radiation shelter having side walls and a roof supported at least in part on said side walls, said side

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walls including spaced inner and outer wall portions and containing a radiation absorbing material therewithin, each of said wall portions comprising a plurality of panels joined together at the adjacent side edges thereof, the panels of said inner and outer wall portions being arranged directly opposite one another, the side edges of said panels being formed with flange sections which lie along planes transverse to the plane of said side walls, the innermost edge of each of said flange sections being formed with a shoulder portion which extends parallel to the plane of said wall portions, the flange sections and shoulder portions along one side of each pair of opposed panels being adapted to engage the flange sections and shoulder portions along the side edge of the adjacent pair of opposed panels whereby the flange sections of each of said pair of opposed panels are contiguously oriented, said side walls further including a plurality of vertically extending angle irons having perpendicular leg portions, said angle irons being arranged adjacent said flange sections of said panels whereby one leg portion of each of said angle irons extends parallel to the plane of said side walls and whereby the other leg portion of each of said angle irons extends parallel to said flange sections, a plurality of web members extending transversely to the plane of said side walls and arranged one adjacent at least one side edge of each pair of opposed panels, fastening means securing said angle irons and said web members to said flange sections and for securing the adjacent flange sections of the adjacent pairs of opposed panels together, and channel members of generally U-shaped cross section aligned with and closing top and bottom of said side walls.

2. A radiation shelter as set forth in claim 1 wherein said radiation absorbing material contained within said side walls comprises sand.

References Cited by the Examiner

UNITED STATES PATENTS

375,998	1/88	Hodges	189—34
504,544	9/93	Van Der Heyden	50—100
1,013,591	1/12	Edwards	189—34
1,178,491	4/16	Clasen	189—34
1,198,764	9/16	Pruden	189—34
1,706,924	3/29	Kane	189—34
1,709,701	4/29	Althoff	244—135
1,742,947	1/30	Brash	189—34
1,778,889	10/30	Disboro	189—34
1,883,141	10/32	Walthers	189—34
2,013,043	9/35	Fox	189—34
2,397,184	3/46	Klose	244—135
2,397,259	3/46	Halicki et al.	189—34
2,790,524	4/57	Herrschaft	189—39
2,897,668	8/59	Graham	50—100

FOREIGN PATENTS

445,683 4/36 Great Britain.

OTHER REFERENCES

Publication I: "The Family Fallout Shelter," publication of Office of Civil and Defense Mobilization, #MP-15, 6/59, 32 pp. (only p. 22 relied upon).

Publication II: "Clay and Masonry Family Fallout Shelters," publication of Office of Civil Defense Mobilization, #MP-18, 2/60, 16 pp. (only p. 10 relied upon).

Publication III: "Progressive Architecture," magazine, 1/59, p. 83.

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