

Nov. 20, 1962

R. H. CLAY

3,064,772

INSULATED BUILDING PANEL

Filed March 9, 1960

3 Sheets-Sheet 1

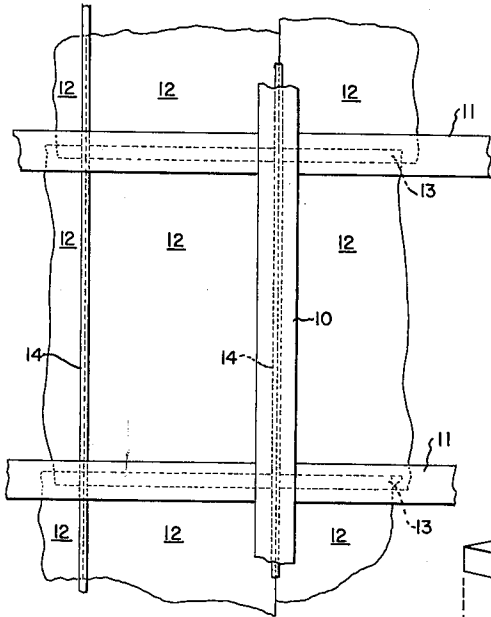


Fig. 1

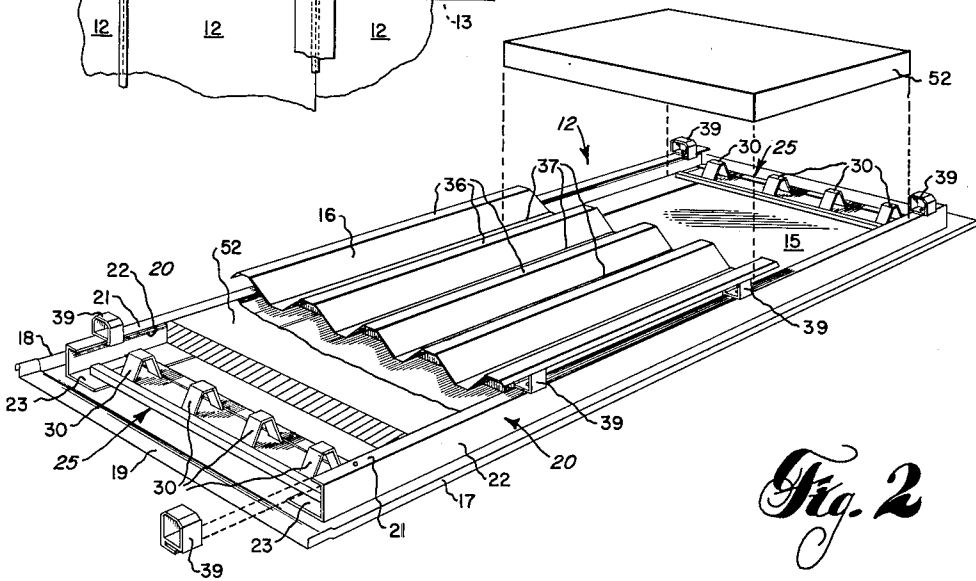


Fig. 2

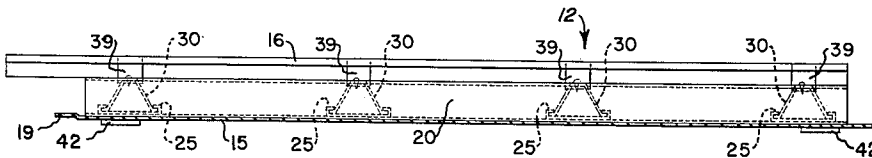


Fig. 3

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3 Sheets-Sheet 2

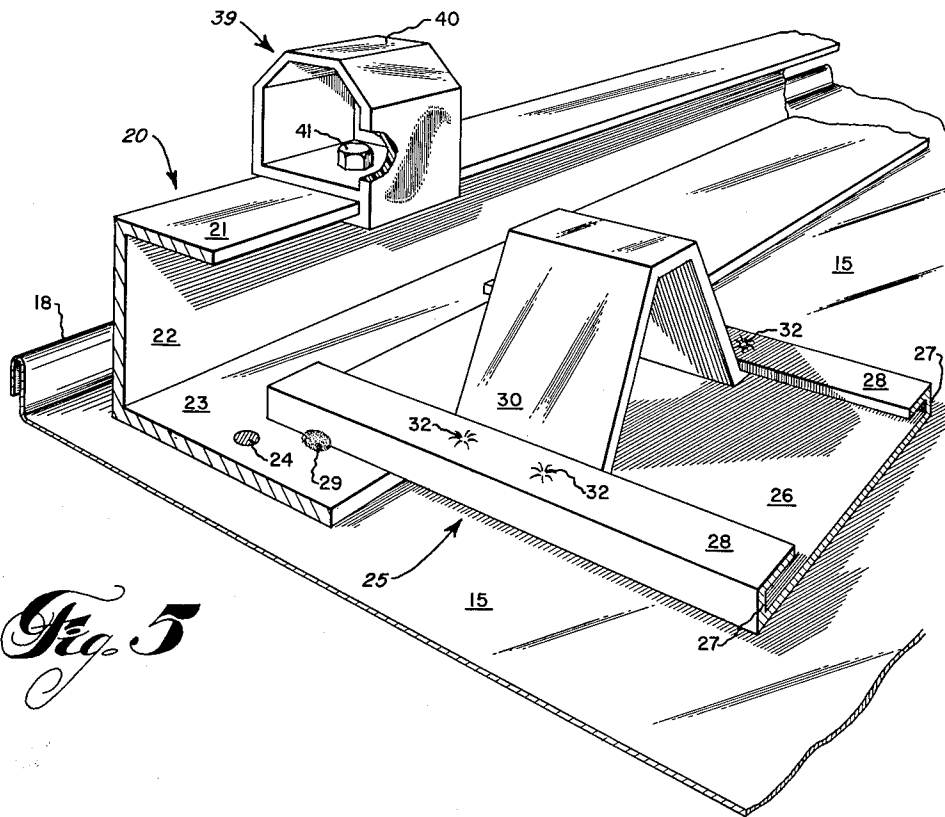


Fig. 5

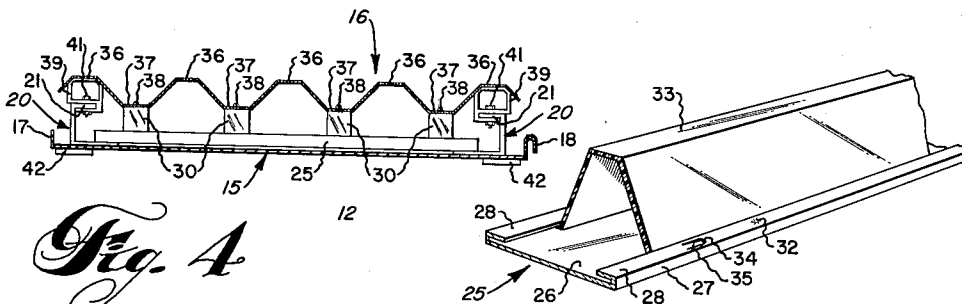


Fig. 4

Fig. 6

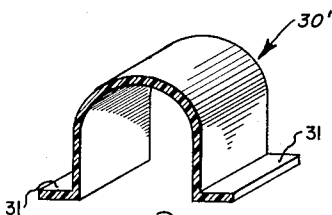


Fig. 8

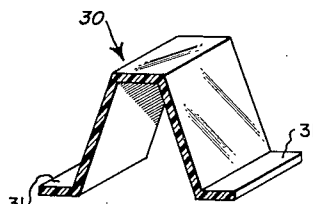


Fig. 7

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3 Sheets-Sheet 3

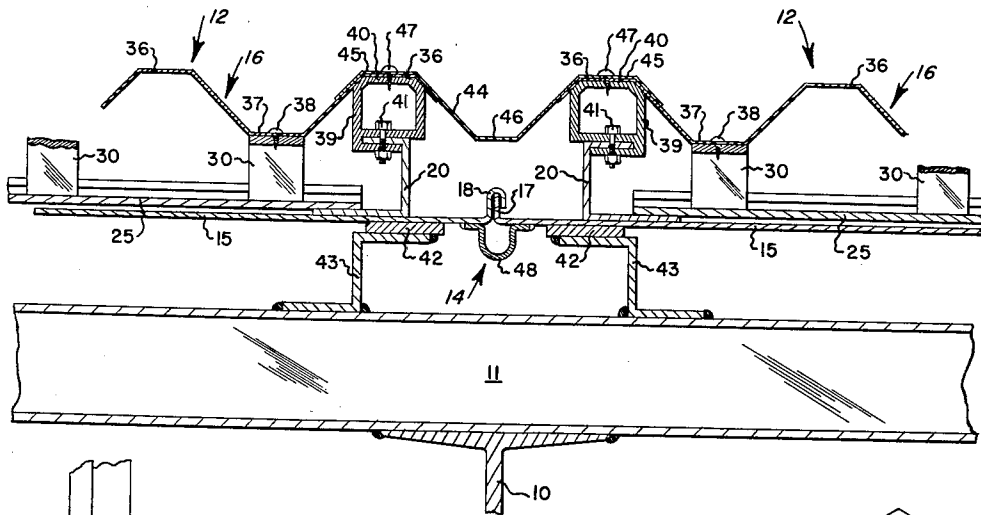


Fig. 9

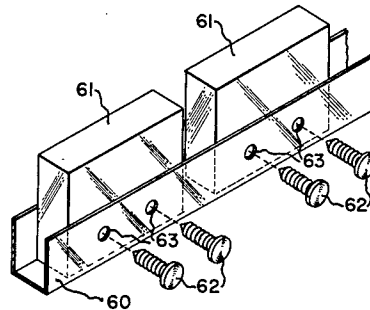


Fig. 11

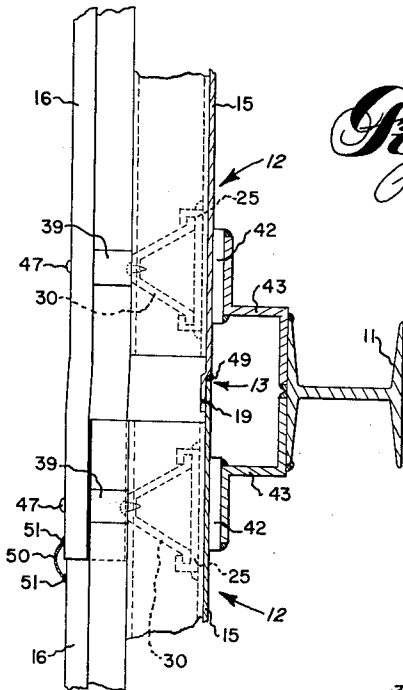


Fig. 10

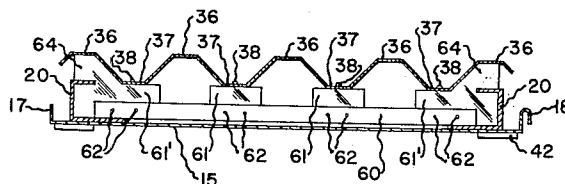


Fig. 12

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3,064,772

INSULATED BUILDING PANEL

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7 Claims. (Cl. 189-34)

The present invention relates to a thermally insulated, fire retardant building panel for use as the outer surface of a building. More particularly, the present invention relates to a thermally insulated, fire-resistant building panel which may be employed in buildings which are to be shielded against transmission of radio frequency radiation.

Insulated building panels have been constructed in the past to provide an outer surface for a building. See, for example, U.S. Patent 2,696,281, A. W. Hedgren et al. Such insulated panels have employed wooden frame spacing elements to separate inner and outer metal sheets of the building panel thereby avoiding any metal-to-metal contact through which thermal energy might be transferred.

In co-pending application S.N. 817,262 filed June 1, 1959, and assigned to the assignee of the present invention there is described an improved insulated building panel employing nonmetallic frames in which the inner metal sheet is spaced from the outer metal sheet to avoid transmission of radio frequency radiation through the panel.

A completely fireproof building panel employing non-metallic, noncombustible spacer elements has been described in co-pending application S.N. 827,750 filed July 17, 1959, now Patent No. 3,029,561, and assigned to the assignee of the present invention.

According to the present invention, a building panel is provided which possesses improved thermal insulation features including fire-resistant nonmetallic spacer elements which may be noncombustible or fire-resistant. The present panels prevent transmission of radio frequency radiation through the walls of buildings in which they are utilized. Buildings constructed from the present panels may be rendered vapor-tight.

It is an object of this invention to provide a building panel having an inner and an outer metal sheet which is thermally insulated and fire-resistant.

A further object of this invention is to provide a building panel having an inner and an outer metal sheet which will withstand exposure to a temperature of 1000° F. against the inner metal sheet for at least three minutes without deterioration to meet the requirements of a familiar fire test.

A still further object is to provide a building structure which is thermally insulated and fire-resistant and which is constructed from insulated, fire-resistant building panels.

Another object of this invention is to provide a thermally insulated, fire-resistant building panel which may be employed in constructing a building in which shielding against transmission of radio frequency radiation is required.

An additional object of this invention is to provide a building panel which is thermally insulated and fire-resistant and which may be employed in the construction of a vapor-tight building.

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According to the present invention I have provided a building panel having a generally rectangular inner metal sheet and a corresponding outer metal sheet which are spaced apart by means of fire-resistant materials. A pair of parallel longitudinal metal channels is secured to the inner metal sheet adjacent to its sides. A plurality of transverse metal channels extends between the longitudinal channels. The transverse channels are secured at their ends to the longitudinal channels and are spaced apart from the inner metal sheet. Secured within the transverse channels are space elements of fire-resistant, nonmetallic materials. The outer metal sheet is fastened to the spacer elements by means of fasteners extending through the outer metal sheet into the spacer elements.

In a preferred embodiment of this invention one or more additional spacer elements is provided outwardly of the longitudinal channels as an additional fastening base to provide rigidity for the outer metal sheet.

The spacer elements may comprise U-shaped flanged straps of fiber-reinforced plastic which are secured to the transverse channels. Alternatively the plastic spacer elements may comprise a U-shaped flanged channel which is secured within and extends over substantially the entire length of the transverse channels. Where plastic materials are selected as the fire-resistant spacer elements they are preferably thermosetting resins filled with noncombustible reinforcing fibers such as glass wool or fabric. Flame-resistant polyester resins are especially useful.

For noncombustible construction, the spacer elements may comprise fiber-reinforced cement, for example, Portland cement filled with long fiber asbestos, glass fibers, mineral wool and the like.

The resulting panels may be assembled in side-by-side relation and top-to-bottom relation to form the external shell of a building. The assembled building shell may be readily sealed by welding along the side-by-side seams and the top-to-bottom seams. Thus a contiguous metal inner sheath, free from metal discontinuities is provided to serve as a vapor barrier, if desired, and, more particularly, to serve as a shield against transmission of radio frequency radiation through the building walls. To achieve adequate radio frequency radiation shielding, it is essential that the outer metal sheets of the panels (and elements conductively associated therewith) be separated from the inner metal sheets (and elements conductively associated therewith) by a distance of at least one inch.

Maintenance of a minimum separation distance avoids arcing of radio frequency radiation from the inner metal sheet to the outer metal sheet. Confinement of radio frequency radiation emanating from the interior of a building which houses apparatus for generating such radiation is desirable because of the well-known physiological hazards accompanying the phenomena.

The invention will be more fully understood by reference to the following detailed description and accompanying drawings in which:

FIGURE 1 is a fragmentary illustration of an outer wall of a building, as viewed from inside the building, illustrating the manner in which the building panels of the present invention are utilized;

FIGURE 2 is a perspective illustration of a preferred embodiment of the present building panel with the outer metal sheet partly broken away;

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FIGURE 3 is an end elevation view of a building panel as shown in FIGURE 2;

FIGURE 4 is a side elevation view of a complete building panel as shown in FIGURE 2;

FIGURE 5 is a fragmentary perspective illustration detailing the corner assembly of the present building panel;

FIGURE 6 is a fragmentary perspective illustration of an alternative embodiment of the spacer elements;

FIGURES 7 and 8 are perspective illustrations of preferred embodiments of the spacer elements;

FIGURE 9 is a cross-section illustration showing the assembly of the present building panels in a building structure in side-by-side relation;

FIGURE 10 is a cross-section illustration showing the assembly of the present building panels in a building structure in top-to-bottom relation.

FIGURE 11 is a fragmentary perspective illustration of an alternative embodiment of transverse channel and spacer elements; and

FIGURE 12 is a side elevation view of a complete building panel employing the alternative embodiment of FIGURE 11.

Referring to FIGURE 1 there is illustrated a fragment of an outer wall of a building structure as viewed from inside the building. Vertical columns 10 and horizontal girts 11 form the skeleton of the building. A plurality of building panels 12 are fixed to the skeleton of the building in side-by-side relation and top-to-bottom relation. Horizontal seams 13 are formed where the building panels 12 are joined in top-to-bottom relation. Vertical seams 14 are formed where the building panels 12 are joined in side-by-side relation. Each individual panel 12 is secured to at least one girt 11 or column 10 whereby the building panels 12 serve as an outer sheath of a building. The panels 12 are not dead load bearing elements of the structure.

The individual panels 12, illustrated in FIGURES 2, 3, 4 and 5 include a flat inner metal sheet 15 and a corrugated metal outer sheet 16. A male lip 17 and female lip 18 are formed on opposite sides of the inner metal sheet 15 to facilitate assembly of adjacent panels in side-by-side relation. An offset tongue 19 is provided along one end of the inner metal sheet 15 to facilitate assembly of adjacent panels in top-to-bottom relation.

Preferably the inner metal sheet is formed from steel, aluminum or other suitable metals of a thickness ranging from about 20 gauge to about 12 gauge.

Preferably the outer metal sheet 16 has a corrugated configuration and comprises protected metal sheets. Plastic coated or bituminous coated protected metal sheets are well suited to the purpose. Porcelain enamel coatings also may be employed for the outer sheets 16.

Secured to the inner metal sheet 15 are two longitudinal channels 20 having an outer flange 21, a central web 22 and a base flange 23. The opening of each longitudinal channel 20 faces inwardly of the panel 12. It will be observed that the base flange 23 is wider than the outer flange 21. The base flange 23 is secured to the inner metal sheet preferably by means of welding, for example, spot welds 24, to avoid penetration of the inner metal sheet 15. Suitably the longitudinal channels 20 may be formed from steel strips having a thickness of about 18 to 12 gauge. The longitudinal channels 20 are spaced inwardly from the side edges of the inner metal sheet 15 and serve principally to provide rigidity in the assembled panel.

Extending between the base flanges 23 are transverse channels 25 which are preferably re-entrant in the embodiment of FIGURE 2 (seen more clearly in FIGURES 5 and 6). The transverse re-entrant channels 25 include a base flange 26, two vertical webs 27 and two re-entrant flanges 28. The transverse channels 25 are secured to the base flanges 23 of the longitudinal channels 20 preferably by means of tack welds 29. It will be observed from

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FIGURE 5 that the transverse channels 25 are spaced apart from the inner metal sheet 15 by the thickness of the base flange 23 to which the ends of the transverse channels 25 are secured. The function of the air space provided between the inner metal sheet 15 and the transverse channel 25 will be described hereinafter.

Plastic reinforced spacer elements 30 are formed from fire retardant plastic materials filled with noncombustible reinforcing fibers, such as glass fibers. Typical spacer elements 30 are shown in FIGURES 7 and 8 wherein the spacer element has a generally U-shaped configuration with radially extending flanges 31. The radially extending flanges 31 fit between the base flange 26 and each re-entrant flange 28 of the transverse channel 25. When the spacer element 30 is positioned at its desired location, it may be secured against sliding within the transverse channel 25 by punching one or more dimples 32 in the re-entrant flanges 28.

It will be observed in the preferred embodiment of FIGURE 2 that a plurality of spacer elements 30 are provided in each of the transverse channels 25 at positions which correspond to the configuration of the outer metal sheet 16.

In an alternative embodiment of this invention as illustrated in FIGURE 6, a single spacer element 33 may be provided in the form of a channel which extends substantially over the entire length of the transverse channel 25. An alternative means for securing the spacer elements within the transverse channels 25 also is illustrated in FIGURE 6. There a U-shaped slit 34 defines a U-shaped tongue 35 in the re-entrant flange 28. The U-shaped tongue 35 may be pounded into the radially extending flange of the spacer element 33.

The outer metal sheet 16 preferably has a corrugated configuration including crests 36 and valleys 37. The outer metal sheet 16 is positioned as shown in FIGURE 2 whereby an individual spacer element 30 is positioned beneath each of the valleys 37. A hole is drilled through each valley 37 of the outer sheet 16 and through the outer surface of the spacer elements 30 to receive a non-metallic blind fastener 38. Fasteners of the type described in co-pending application S.N. 837,256, filed August 31, 1959 by Arthur P. Jentoft and assigned to the assignee of the present invention are especially suited for this purpose. It will be observed from inspection of FIGURE 4 that the outer metal sheet 16 is spaced from the inner metal sheet 15 and is held in position by means of the blind fasteners 38 which are secured to the spacer elements 30.

In order to provide structural rigidity for the lateral edges of the outer metal sheet 16, additional nonmetallic spacer elements 39 are provided in association with the outer flange 21 of the longitudinal channels 20. The outer surface 40 of the spacer element 39 conforms to the inner surface of the outer metal sheet 16 beneath the extreme lateral crests 36. Fastening means are provided whereby the spacer element 39 can be secured to the outer flange 21 of the longitudinal channel 20. A bolt 41 may be provided for this purpose. Alternatively a nonmetallic blind fastener or merely a suitable adhesive may be supplied. The function of the spacer elements 39 is merely to provide rigidity to the extreme lateral crests 36 of the outer metal sheet 16. The outer metal sheets 16 are not fastened to the spacer elements 39 until after the panels have been assembled in a building structure as will be described in detail hereinafter by reference to FIGURE 9.

It will be observed from FIGURE 3 that the outer metal sheet 16 extends lengthwise beyond that end of the inner metal sheet 15 which carries the offset tongue 19. At the other end of the panel 12 the outer metal sheet 16 is set back from the end of the inner metal sheet 15. This configuration permits the ready assembly of two adjacent panels in top-to-bottom relation as will hereinafter appear by reference to FIGURE 10.

Welded to each corner of the inboard surface of the inner metal sheet 15 is a rectangular metal plate 42 which serves as a means by which the panels 12 are secured into a building structure. The rectangular metal plates 42 are preferably welded to the inner metal sheet 15 by a spot weld extending through the base flange 23 of the longitudinal channel 20.

It will be observed by inspection of FIGURE 4 that no metallic element conductively associated with the inner metal sheet 15 is in contact with the metallic elements conductively associated with the outer metal sheet 16. Preferably the minimum distance between "inner" and "outer" metallic elements is at least one-inch where it is desired to employ the panels in a building to be shielded against transmission of radio frequency radiation. The critical metal-to-metal distance in the present panel occurs (FIGURE 4) in the region between the outer flange 21 of the longitudinal channel 20 and the extreme lateral corrugations of the outer metal sheet 16. The spacer elements 39 assure maintenance of the minimum critical distance in this region.

The transverse channels 25 are separated over their length between the longitudinal channels 20 from the inner metal sheet 15. The air space thus provided between the transverse channels 25 and the inner metal sheet 15 serves as a thermal conduction barrier between the named elements. Thus a significantly greater temperature differential can be maintained through the panel when the inner sheet 15 is exposed to elevated temperatures as might occur in the event of fire within a building constructed from such panels. In a standard fire test, the inner surface of a building panel is exposed to temperatures of 1000° F. to determine the effect on the building panel following three minutes exposure to the condition. While the reinforced plastic spacer elements 30 cannot resist such conditions without deterioration, nevertheless, when protected by their position within the channels 25, the test requirements for the building panel can be achieved.

The side-by-side assembly of two adjacent panels 12 is illustrated in FIGURE 9.

A plurality of Z-bars 43 is welded to horizontal girts 11 or columns 10. The rectangular metal plates 42 are welded to the Z-bars 43 with the male flange 17 of one panel 12 engaged with the female flange 13 of the other panel 12. The panels 12 thereby are independently secured to the building structure through the supporting Z-bars. Note that the panels 12 are spaced outwardly from the framework of the building.

Where shielding against transmission of radio frequency radiation is not a factor, the rectangular metal plates 42 and the Z-bars 43 may be omitted and the panels may be bolted directly to the framework of the building. A suitable metal clip may be welded to the inner metal sheet 16 and the longitudinal channel 20 to support bolts for this purpose.

A corrugated cover plate 44 having two crests 45 and one valley 46 is fitted over the adjacent extreme lateral crests 36 of the two building panels 12. The corrugated cover plate 44 is secured to the building structure by drilling a hole through the crests 45, the extreme lateral crests 36 and the outer surface 40 of the spacer element 39 and inserting a nonmetallic blind fastener 47 into the drilled hole.

The cover plate 44 may be made from the same material employed in fabricating the outer metal sheet 16. Alternatively, the cover plate 44 may be made from suitable structurally reinforced plastic sheets such as those formed from glass fiber reinforced polyester resins.

Throughout the fabrication of the panels 12, great care is exercised to avoid perforations in the inner metal sheet 15 where radio frequency radiation shielding is required. It is for this reason that the channels 20 and plates 42 are welded to the inner sheet 15 rather than being secured by bolts. Where bolts are employed to penetrate the

inner sheet 15 for any reason, a bead of weld metal should be applied to the juncture of the bolts and the inner sheet 15 to avoid metal discontinuities.

In order to assure that the inner surface of the assembled building is free from metal discontinuities, a cover strip 48 is secured over the side-by-side vertical seam 14 formed by the interlocking flanges 17 and 18. The cover strip 48 is a U-shaped, flanged metal strip which can be welded along its flanges to the adjacent inner metal sheets 15 as shown in FIGURE 9. Any expansion and contraction occurring in the panels 12 will be absorbed by the U-shaped portion of the cover strip 48 to prevent development of undue stresses in the welded seams along its flanges.

The assembly of two panels 12 in top-to-bottom relation is illustrated in FIGURE 10. A plurality of Z-bars 43 is welded to the horizontal girt 11 or columns 10. The panels 12 are secured to the Z-bars 43 by welding the rectangular plates 42 so that each of the individual panels 12 is independently supported by the building framework. It will be observed that the upper panel 12 has at its lower end the offset tongue 19 and an overlapping length of the outer metal sheet 16. The lower panel 12 has at its upper end an extension of the inner metal sheet 15. The extension of the metal sheet 15 of the lower panel 12 is received in board by the offset tongue 19 of the upper panel 12; the extended portion of the outer metal sheet 16 of the upper panel 12 overlies the outer metal sheet 16 of the lower panel 12. A bead of weld metal 49 may be applied along the horizontal seam 13 formed at the juncture of the two inner metal sheets 15 in order to provide an inner building sheath of metal which is free of discontinuities.

Preferably the outer metal sheets 16 are electrically grounded by means of a metal connection at their exposed outer junction. A portion of the metal in each of the outer metal sheets 16 is exposed and a metal grounding strap 50 is connected across the two exposed portions by means of tack welds 51.

In the assembly of the panels 12, the inner metal sheets 15 are imperforate and free of metal discontinuities. The horizontal seams 13 and vertical seams 14 similarly are free of metal discontinuities so that the inner shell of the building structure presents an uninterrupted metal sheath which is spaced outwardly from the building framework and also spaced inwardly from an external weather resistant building sheath formed by the outer metal sheets 16. Where the building is intended to house radio frequency generating apparatus, the unique imperforate construction prevents transmission of radio frequency radiation through the building walls. The outer sheath is spaced apart from the continuous inner sheet by a distance of at least one inch so that radio frequency radiation cannot gap across the intervening space.

It is not essential that the panels 12 be sealed along their seams 13 and 14 at the time the building is constructed. The ready accessibility of the building panels 12 resulting from their being spaced outwardly from the building framework permits the installation of suitable continuous metal seals at any time thereafter.

It is also apparent that a building having an inner metal sheath free of discontinuities will have vaporproof properties. Hence the present building panels are particularly suited for the construction of buildings where vapor tightness is desirable.

Thermal insulation is achieved in the present building panel by the insertion of rectangular batts 52 of fibrous insulating material between the inner sheet 15 and the outer sheet 16 as shown in FIGURE 2. The batts 52 are cut to fill the space between the longitudinal channels 20 and adjacent transverse channels 25. Suitable insulating materials are glass fiber and mineral wool fiber.

In an alternative embodiment of the present invention, a non-combustible panel can be assembled by utilizing nonmetallic, noncombustible materials as spacer ele-

ments as shown in FIGURES 11 and 12. Suitable non-metallic, noncombustible materials include fiber filled cement such as long-fiber asbestos filled Portland cement.

In FIGURE 12, corresponding numerals refer to elements corresponding to those identified in FIGURE 4. It will be observed that the longitudinal channels 20 are secured to the inner metal sheet 15 as before. A plurality of transverse metal channels 60 are secured to the longitudinal channels 20 and are spaced from the inner metal sheet 15. Spacer elements 61 are secured in the transverse channels 60, for example, by means of non-metallic fasteners 62 which extend into the spacer elements 61 through holes 63 drilled in the sides of the transverse channels 60. The spacer elements are positioned beneath valley 37 of the outer metal sheet 16 which is secured to the spacers by means of nonmetallic fasteners 38.

Preferably the terminal spacer elements 61' include a trapezoidal extension 64 which corresponds in configuration to the lateral crests 36 of the outer sheet 16. The trapezoidal extensions 64 provide a firm foundation for securing a cover plate across the side-by-side seam between adjacent panels.

Thus the present panel can be fabricated entirely from noncombustible materials where such construction is required.

According to the provisions of the patent statutes, I have explained the principle, preferred embodiment and mode of operation of my invention and have illustrated and described what I now consider to represent its best embodiment. However, I desire to have it understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically illustrated and described.

I claim:

1. A thermally insulated, fire retardant building panel comprising a generally flat inner metal sheet and spaced therefrom an outer metal sheet, a pair of longitudinal parallel metal channels each having a web and two leg portions and each being secured to said inner metal sheet adjacent to one of its sides, with one of said leg portions lying against said inner metal sheet and said web portion presenting its outer surface toward the adjacent side of said inner metal sheet, a plurality of transverse metal channels secured by the web portion thereof at each end to a leg portion of one of said longitudinal metal channels and being spaced from said inner metal sheet, fire retardant spacer elements secured by said transverse metal channels and extending outwardly therefrom away from said inner metal sheet, said outer sheet secured to said spacer elements by means of externally applied nonmetallic fasteners extending through aligned holes in said outer sheet and said spacer elements whereby all metallic portions conductively associated with said inner metal sheet are spaced from all metallic portions conductively associated with said outer sheet.

2. A thermally insulated, fire retardant building panel comprising a generally flat inner metal sheet and spaced therefrom an outer metal sheet, a pair of longitudinal parallel metal channels each having a web and two leg portions and each being secured to said inner metal sheet adjacent to one of its sides, with one of said leg portions lying against said inner metal sheet and said web portion presenting its outer surface toward the adjacent side of said inner metal sheet, a plurality of transverse metal re-entrant channels secured by the web portion thereof at each end to a leg portion of one of said longitudinal metal channels and being spaced from said inner metal sheet, generally U-shaped spacer elements each having external flanges secured within said transverse metal re-entrant channels, said spacer elements being formed from retardant, filled plastic compositions, said outer sheet being secured to said spacer elements by means of externally applied nonmetallic fasteners extending through aligned holes in said outer sheet and said spacer elements whereby

all metallic portions conductively associated with said inner metal sheet are spaced from all metallic portions conductively associated with said outer sheet.

3. The building panel of claim 2 wherein said spacer elements are comprised of thermoset polyester resin filled with glass fibers.

4. The building panel of claim 2 wherein the said outer sheet has a corrugated configuration including crests and valleys and one of said spacer elements is provided in each of said transverse channels for each of said valleys in said outer sheet.

5. A thermally insulated, fire retardant building panel comprising a generally flat inner metal sheet and spaced therefrom an outer metal sheet, a pair of longitudinal parallel metal channels each having a web and two leg portions and each being secured to said inner metal sheet adjacent to one of its sides, with one of said leg portions lying against said inner metal sheet and said web portion presenting its outer surface toward the adjacent side of said inner metal sheet, a plurality of transverse metal channels secured by the web portion thereof at each end to a leg portion of one of said longitudinal metal channels and being spaced from said inner metal sheet, fire retardant spacer elements comprising blocks of noncombustible, nonmetallic material secured by said transverse metal channels and extending outwardly therefrom away from said inner metal sheet, said outer sheet being secured to said spacer elements by means of externally applied nonmetallic fasteners extending through aligned holes in said outer sheet and said spacer elements whereby all metallic portions conductively associated with said inner metal sheet are spaced from all metallic portions conductively associated with said outer sheet.

6. A thermally insulated, fire retardant building panel comprising a generally flat inner metal sheet and spaced therefrom an outer metal sheet, a pair of longitudinal parallel metal channels each having a web and two leg portions and each being secured to said inner metal sheet adjacent to one of its sides, with one of said leg portions lying against said inner metal sheet and said web portion presenting its outer surface toward the adjacent side of said inner metal sheet, a plurality of transverse metal channels secured by the web portion thereof at each end to a leg portion of one of said longitudinal metal channels and being spaced from said inner metal sheet, fire retardant spacer elements comprising blocks of noncombustible, nonmetallic material secured by said transverse metal channels and extending outwardly therefrom away from said inner metal sheet, the lateral ones of said spacer elements including a contiguous trapezoidal extension which conforms to the configuration of said outer sheet outwardly from the said longitudinal channels, said outer sheet being secured to said spacer elements by means of externally applied nonmetallic fasteners extending through aligned holes in said outer sheet and said spacer elements whereby all metallic portions conductively associated with said inner metal sheet are spaced from all metallic portions conductively associated with said outer sheet.

7. In a building structure, a plurality of structural members disposed in parallel and spaced relation and a plurality of insulated rectangular panel units extended across and secured in spaced relation to said structural members, each panel unit comprising a flat imperforate metal inner sheet, a longitudinally corrugated outer metal sheet, a pair of longitudinal parallel metal channels each having a web and two leg portions and each being secured to said inner metal sheet adjacent to one of its sides, with one of said leg portions lying against said inner metal sheet, a plurality of transverse metal channel sections secured by the web portion thereof at each end to a leg portion of one of said longitudinal channels and being spaced from said inner metal sheet, fire retardant spacer elements secured by said transverse metal channels and extending outwardly therefrom away from said inner metal sheet, said outer sheet being secured to said spacer elements by

means of externally applied nonmetallic fasteners extending through aligned holes in said outer sheet and said spacer elements, said panel units being assembled in abutting relation to admit the welding together of said inner metal sheets of adjacent panel units whereby the said inner metal sheets form a metal sheet free of metal discontinuities around said structural members.

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