July 28, 1959 G. E. KLOOTE ET AL 2,896,271

ENCLOSURES FOR REFRIGERATED AREAS

Filed Jan. 31, 1955 3 Sheets-Sheet 1

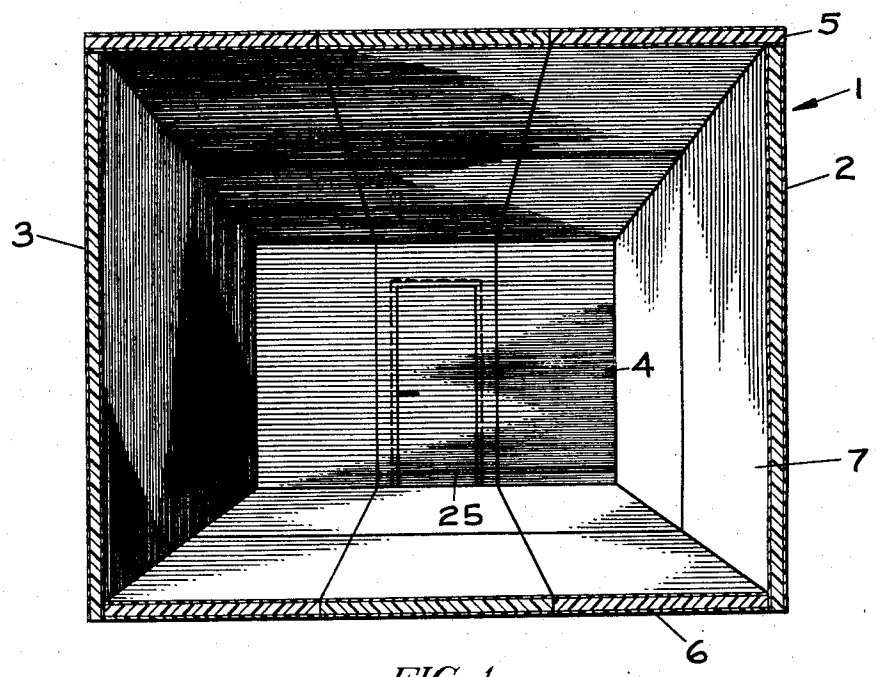

FIG. 1

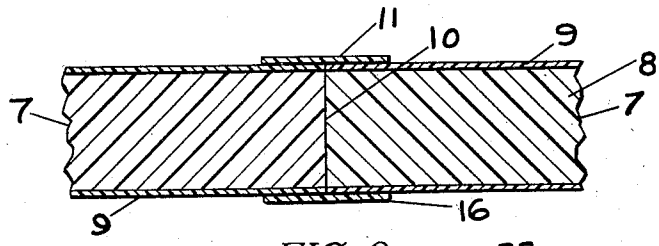

FIG. 2

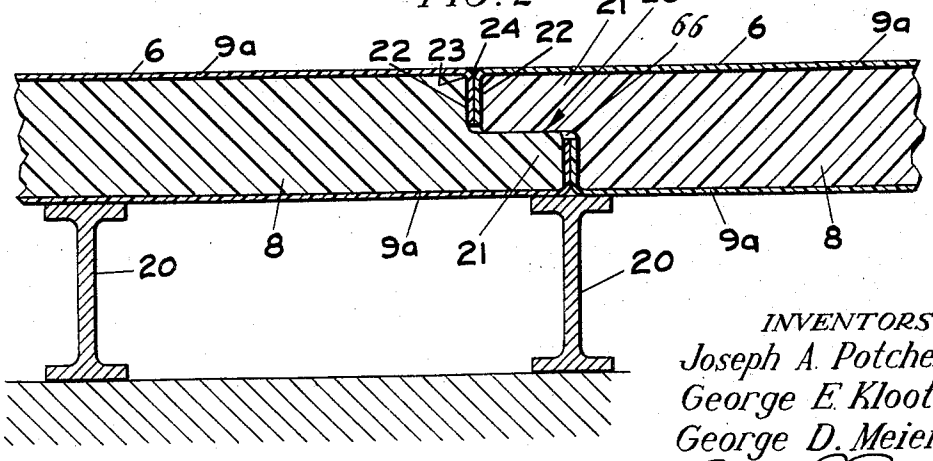

FIG. 3

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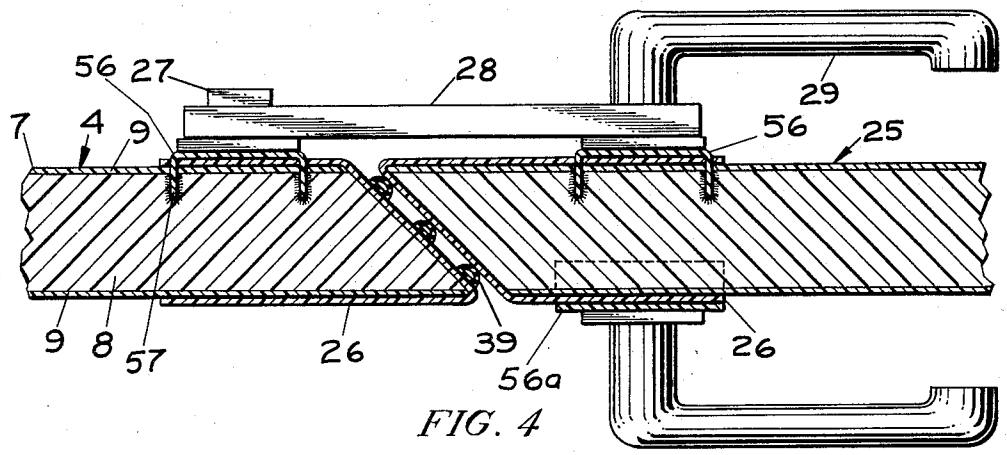

FIG. 4

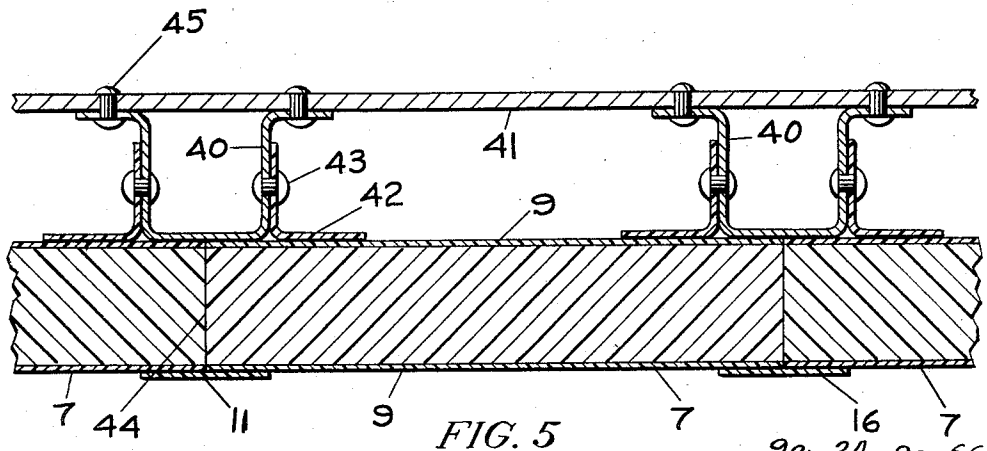

FIG. 5

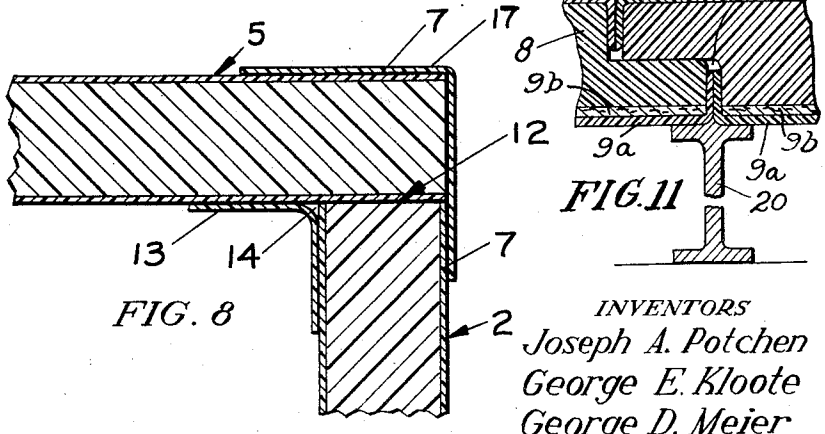

FIG. 8

FIG. 11

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ENCLOSURES FOR REFRIGERATED AREAS

Filed Jan. 31, 1955 3 Sheets-Sheet 3

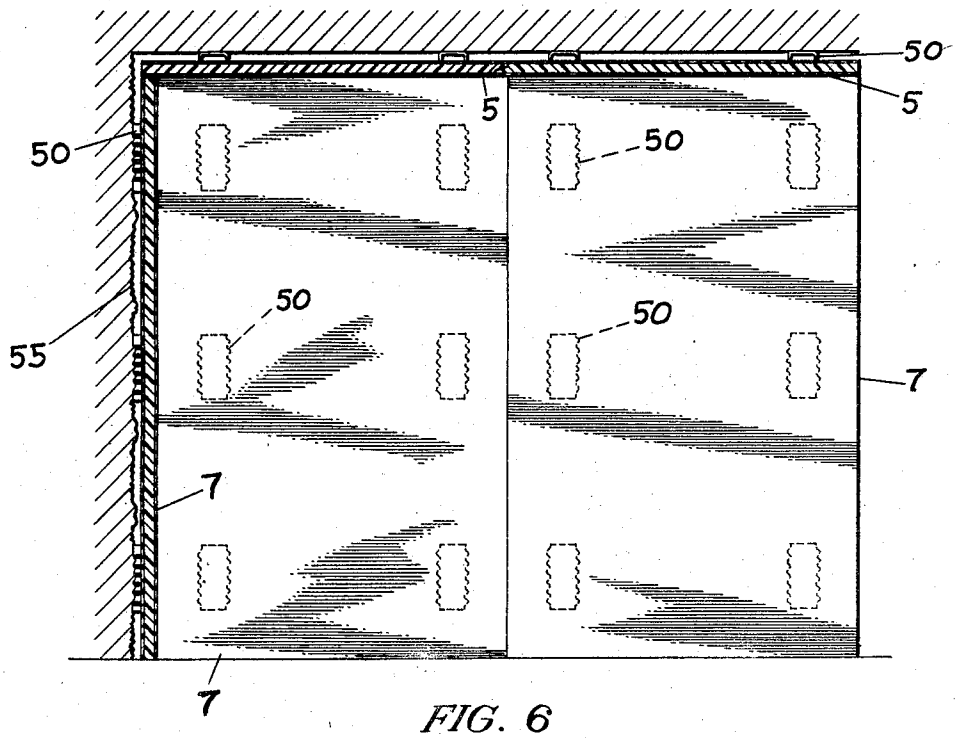

FIG. 6

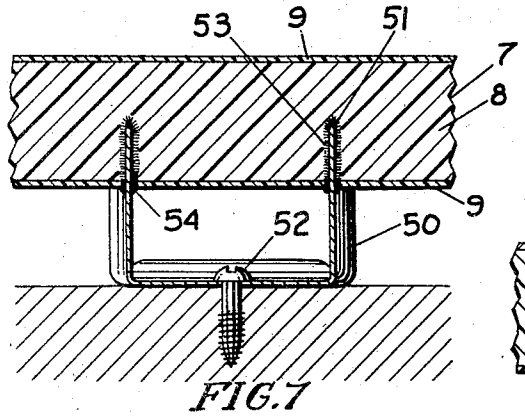

FIG. 7

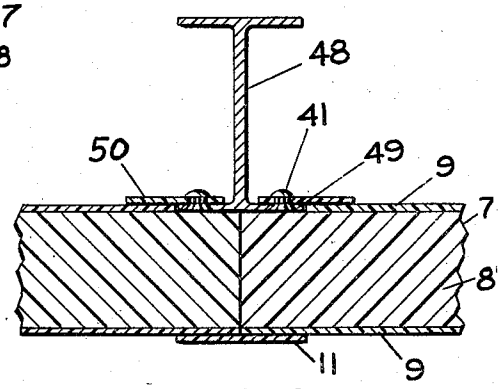

FIG. 9

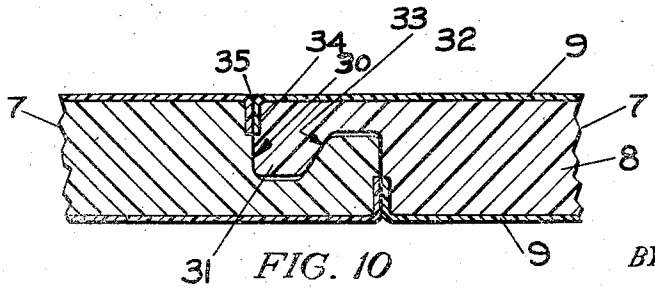

FIG. 10

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United States Patent Office 2,896,271 Patented July 28, 1959

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ENCLOSURES FOR REFRIGERATED AREAS

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Application January 31, 1955, Serial No. 484,948

11 Claims. (Cl. 20—4)

This invention relates to the construction of enclosures particularly adapted but not necessarily limited to refrigerated areas and more particularly to such an enclosure constructed of synthetic resin materials.

The use of synthetic resin materials for the construction of enclosures for refrigerated areas has many structural and functional advantages.

In the construction of walls and other enclosing members for refrigerated areas, moisture constitutes one of the major unsolved problems of the industry. Moisture, even when present in only slight quantities, will migrate toward and collect in a zone of lower temperature. Prior to this invention, all usable thermal insulating materials have been porous to the migration of moisture. Attempts have been made to seal these materials in moisture tight jackets. These attempts have met with only partial success since the slightest failure of the sealing jacket permitted entry of moisture. Within a relatively short time a substantial accumulation of moisture resulted. Once this occurs, the only known solution is replacement of the insulation.

By means of this invention, enclosures for refrigerated areas may now be built with a laminated material having a moisture impervious face and a moisture impervious thermal insulating core material. Thus, even though the facing material is accidentally breached, there will be no opportunity for the moisture to enter and collect. Thus, the material will maintain its thermal efficiency throughout its life rather than rapidly losing it due to the accumulation of moisture. Thus, this invention solves one of the most serious problems in the field of enclosures for refrigerated areas. It also, for the first time, provides a practical and economically feasible, moisture proof thermal insulating material for other types of structures.

This invention has the further advantage of providing a durable material. It is durable since it cannot collect moisture and, therefore, retains its thermal efficiency indefinitely. It is durable because it is resistant to corrosion, rot and fungus attack. It requires no painting or other external finish either to preserve its physical condition or appearance.

It is a material that is less expensive than theretofore known materials serving the same purposes. The core material has a low coefficient of thermal transmission and, therefore, serves as one of the most effective thermal insulators known. The panels are light weight and according ly easily handled. They are adapted to rapid and easy installation, thus materially reducing the initial cost of the structure. The panels are highly resistant to shock loading and will endure rougher treatment than heretofore known materials usable for the same purpose.

The material is easily cleaned since it provides a non-absorbent, smooth, interior surface. This surface may be quickly and easily cleaned by simple washing methods.

Where the refrigerated area is designed for use in connection with foods, this material is particularly desirable because it can be designed to be odorless, tasteless and inert in the presence of foodstuffs. It can also be designed to be proof against attack by any of the acids or other chemicals commonly present in connection with foods irrespective of whether they are fruits, vegetables or meats.

These and other advantages of this invention will be readily understood by those acquainted with the construction of refrigerated enclosures upon reading the following specification and the accompanying drawings.

In the drawings:

Fig. 1 is an oblique somewhat diagrammatic view of an enclosure for a refrigerated area embodying this invention.

Fig. 2 is an enlarged, fragmentary, sectional view of a typical joint between the panels used in this invention.

Fig. 3 is a fragmentary, enlarged, sectional view of the floor structure for a room embodying this invention.

Fig. 4 is an enlarged, fragmentary, sectional view of the joint between the stationary wall and the door of an enclosure embodying this invention.

Fig. 5 is an enlarged, fragmentary, sectional view of this invention applied to a structure for a refrigerated area having a rigid, metallic, exterior shell.

Fig. 6 is a sectional, elevational view of a portion of a structure in which this invention is applied to an existing shell structure where the interior surface of the shell is uneven.

Fig. 7 is an enlarged, fragmentary, sectional view of a clip used to mount the panels in the enclosure shown in Fig. 6.

Fig. 8 is an enlarged, fragmentary, sectional view of a typical wall to ceiling joint in an enclosure embodying this invention.

Fig. 9 is an enlarged, fragmentary, sectional view of still another method of attaching the enclosure panels of this invention to a supporting shell structure.

Fig. 10 is a fragmentary, sectional view of a modified construction for the joint between the panels of this invention.

Fig. 11 is a fragmentary sectional view illustrating a modified floor structure.

Throughout the description of this invention the terms "moisture impervious" and "non-hygroscopic" are used to describe certain properties of the synthetic resins employed. It is to be understood that these terms, as used, means that the materials are characterized by these properties for all practical purposes but not that they are absolutely impervious to moisture or that, under proper circumstances, they may not exhibit slight hygroscopical characteristics.

This invention may be executed in a number of different ways. Several of these ways are described in the following paragraphs. These, however, are not to be considered as mutually exclusive of all the various ways in which this invention can be carried out.

Primarily this invention contemplates the construction of an enclosure for a refrigerated area from laminated panels of synthetic resin material of the type disclosed in our co-pending application entitled Method of Making Laminated Panels, Serial No. 479,498, filed January 3, 1955, now abandoned. This invention contemplates the construction of such enclosures from these panels either as a self supporting, entirely self sufficient structure or the use of these panels as a lining material for existing shell structures with the shells serving as a protective structural housing for the panels.

The panels themselves are fabricated basically of a core of substantial thickness of a low density, expanded, cellular, synthetic resin material having a low coefficient of thermal transmission. To this core there is bonded, on one or both faces, a high density facing sheet of synthetic resin which is moisture impervious and non-hygroscopic. These facing sheets are designed to have high

impact strength and for this purpose are normally reinforced with a fibrous material such as filamentary glass. The facing sheets are designed to support a substantial portion of the loading applied to the panel. The core material serves the dual purpose of acting as the web of a beam and as the thermal insulating medium of the panel. It is essential that the core material or at least the major portion of it be non-hygroscopic and impervious to moisture.

Referring to the drawings and specifically to Fig. 1, the numeral **1** indicates an enclosure having side walls **2** and **3**, a front wall **4**, a ceiling **5** and a floor **6**. Each of these components is made up of panels **7**.

Referring to Fig. 2, the panels **7** each consist of a core **8** of a low density, rigid, expanded cellular, resin material. Each cell of the core **8** is an entirely self-contained area, hermetically sealed from each adjacent cell. This is necessary to provide a material having a low coefficient of thermal transmission and one characterized by its imperviousness to the passage of moisture.

Although various materials may be used for this purpose, one of the most desirable materials from the standpoint of thermal efficiency, light weight, low cost and imperviousness to moisture is rigid, expanded polystyrene. It is preferable to select an expanded polystyrene having a density which will give the panel good structural characteristics. It has been found that expanded polystyrene having a specific gravity in the range of .032 to .072 provides a desirable core material for general application in this invention. This material has a K-factor of about 0.24. Throughout this density range the K-factor remains relatively constant. Density ranges both above and below the range given have a somewhat higher K-factor and are, therefore, somewhat less desirable from the standpoint of thermal insulation. In the case of high surface loadings, such as are experienced in floor panels, the denser expanded polystyrene core material is used.

The facing sheets **9** of the panel may be of any one of a number of different materials. A preferred material, from the standpoint of durability and cost, is a high density, polyester resin such as Hetron 92, sold by Hooker Electrochemical Co., into which there is embeded filamentary glass either in random or woven form as a structural reinforcement. The thickness of this sheet may vary depending upon the particular requirements of the structure for which it is to be used. This thickness may vary from 0.015 to 0.060 of an inch but normally it is approximately 0.018 to 0.032 of an inch.

Where the structure is of the type illustrated in Fig. 1, in which there is no outer, protective shell, it is necessary that the core **8** be enclosed on both surfaces by facing sheets **9**. Where, however, the panels are used as a lining material and thus their external faces are protected by the shell structure to which they are attached, as illustrated in Fig. 6, the external facing sheet may in some cases be omitted.

The facing sheets **9** are bonded to the core **8** by a suitable synthetic resin which is non-hygroscopic and impervious to the passage of moisture. It also must be a resin which will not act as a solvent, in its unpolymerized condition, for the material of the core **8**. Where the core material **8** is polystyrene and the facing sheets are a polyester resin, an epoxy resin such as BR–18795, sold by Bakelite Co., has been found a suitable adhesive.

A plurality of panels **7** may be assembled into a unitary structure suitable for use as a wall, ceiling or floor section of an enclosure by butting the ends of the panels together as shown in Figs. 2, 5 and 9, by using a lap joint as shown in Figures 3 and 11 or by employing a tongue and groove lapping joint as shown in Figure 10. As may be seen in Fig. 2, the panels **7** making up the floor, ceiling and walls of the enclosure **1** are butted at their edges and the resulting joint **10** (Fig. 2) sealed by means of a suitable adhesive such as an epoxy resin or an epoxy resin modified by loading with a suitable inorganic material to increase its viscosity at the time of application. The resin in the joint **10** serves the dual purpose of providing a moisture tight seal and of firmly securing the panels together in a rigid, structural unit.

In many cases it may be desirable to cover the joint with a batting strip **11** to assure a complete moisture seal at the joint in the event there are any breaches in the bonding adhesive used at the joint. The batting strip **11** also protects the joint against mechanical injury. The batting strip **11** is normally of the same material as the facing sheets and is bonded to the facing sheets by the same adhesive used to form the joint **10**. Where the backs of the panels are accessible, a second batting strip **16** is frequently applied to the joint at the back surface.

Where the panel **7** of the ceiling **5** and a wall **2** abut, the resulting joint **12** (Fig. 8) is formed in the same manner as the joint **10** with the panels bonded together by means of a suitable adhesive. Again, if desired, the joint may be sealed and protected by means of a batting strip **13**. In this case the batting strip **13** is identical to the batting strip **11** except that it is L-shaped in cross-section. It is secured to the panels **7** by the same type of adhesive used for the batting strip **11**. If greater strength is required in the joint, the pocket **14** formed between the batting strip and the apex of the joint may be filled with this adhesive at the time the batting strip is installed. Again, where the back faces of the panels are accessible, a second batting strip **17**, similar in structure to the batting strip **13**, may be applied.

A typical floor installation is illustrated in Fig. 3 where the floor panels **6** are shown as supported at suitable intervals by structural members such as the I-beams **20**. The spacing between the I-beams will vary from one installation to another depending upon the nature and severity of the expected loading.

For the purpose of providing a smooth floor, the edges of the floor panels are designed to provide a lapped joint. The use of the lapped joints makes it unnecessary to apply a batting strip either to protect the edges of the panels at the joint or to assure a moisture tight seal. In his construction, each of the panels has an outwardly projecting lap tongue **21** having a thickness equal to substantially one-half that of the panel. The edges of the facing sheets **9*a*** of the panels extend beyond the margins of the panels and are folded. The folded edges are bonded to the edge of the panels to provide a protective flange **22**. When the panels are brought together, the protective flanges **22** abut. Since they provide a smooth, radiused band **23** at the surface of the panel, there is no tendency for objects moving over the panel's surface to dig into the joint, get beneath the facing sheets and tear them loose from the core material.

It is characteristic of many foamed synthetic resins and particularly of expanded polystyrene that they exhibit relatively low strength in tension and relatively high strength in shear. It is, therefore, desirable, wherever possible, to cause loads to act in shear rather than tension. The folding over of flanges **22** causes any loadings tending to pull the facing sheets **9*a*** from the core **8** to act in shear along the margins of the panels rather than to act in tension at the surface joint between the core and facing sheet.

The small pocket formed between the radii **23** is preferably filled with the bonding resin used to form the joint. This assures a tight moisture seal and provides a smooth continuity of surface, further eliminating the possibility of damage. The panels are locked together by this same adhesive which is applied to all abutting surfaces **25** of the joint. Where pockets **66** may be formed within the joint, these preferably are filled with adhesive. The resulting joint is both strong and moisture tight.

While this type of joint has been illustrated as particularly desirable for the construction of the floor, it will be recognized that it may be used on the walls and ceil-

ing, eliminating the necessity for the batting strips 11. The resulting surface is smoother and, therefore, more easily cleaned.

Where the floor panels 6 are to be subjected to substantially higher than normal loadings, they may be reinforced by making the core thicker and by using a core material of substantially higher density adjacent the top surface. Such higher density core materials include foamed isocyanate resin or slabs of a high density expanded polystyrene, laminated to slabs of a low density polystyrene. If necessary, a wooden laminate 9*b*, Fig. 11, may be inserted between the facing sheets 9*a* and the thermal insulating, low density core 8 to give the panel great resistance to crushing loads such as that which would be imposed by the wheels of heavily loaded vehicles moving over the surface. This latter construction, although possible and in some cases perhaps necessary, is not considered preferable since wood is hygroscopic and should the surface sheets 9 be accidently breached, these panels will collect moisture. This, however, is not considered too serious in this construction inasmuch as the wood panels are not relied upon for thermal insulation. The moisture, irrespective of the degree of concentration, will not enter the non-hygroscopic, water impervious core material 8 to lower its thermal insulating efficiency.

The door 25 for the enclosure is made from the same laminated, synthetic resin panels. Since these panels may be readily sawed and drilled, the enclosure may be erected and the opening for the door cut out afterward. Where such a cut-out is made, the exposed edge surfaces of the core material 8 are enclosed and protected by covering them with a somewhat U-shaped channel section of filamentary reinforced, synthetic resin of the same type as that used for the facing sheets 9 and for the batting strips 11. This channel may be considered as the protective edge jacket 26 (Fig. 4). The jacket 26 is applied by bonding it to the edge of the panel, using the same type of adhesive employed for attachment of the batting strips 11. The application of the jacket 26 restores protection to the edge of the panel against mechanical injury. It will be recognized that all these operations can be executed easily at the site of installation.

The jacket also serves to reinforce the panel for the installation of hardware such as the latch keeper 27. To provide means for attachment of fasteners and to further reinforce this area, a U-shaped clip 56 is mounted to the panel. This clip and its application for this purpose is fully described in our copending application entitled Method and Means for Securing Fasteners to Low Density Core Panels, Serial No. 485,228, filed January 31, 1955.

The clip 56 is of a high density, synthetic resin having a filamentary glass reinforcement. It is similar in material to the jacket 26.

To mount the clip 56, slots are routed in the panel 7 through the jacket 26, facing sheet 9 and partially through the core 8. Either the legs 57 of the clip are coated with adhesive or the slots are partially filled with adhesive and the clip then pressed into the slots. The latch keeper 27 is installed by means of screws threaded into the clip 56, jacket 26 and facing sheet 9. This combination provides sufficient thickness for the screw's threads to obtain a firm anchorage to the panel.

The legs 57 of the clip serve to transmit the loads imposed by the latch keeper 27 to the core as shear loads rather than tension loads. Tension loads have a tendency to separate the facing sheet 9 from the core 8. Since expanded, cellular, synthetic resin materials are characterized by high shear strength, the clip 56 provides a durable and substantial support for the latch keeper which will not be subject to failure under the heavy loads imposed by the operation of the latch.

The slab detached from the wall proper in the formation of the doorway may be used as the door 25. The edge of the door is covered by a protective jacket 26.

To provide a suitable reinforcement for mounting the latch mechanism 28 including the handle 29, U-shaped clips 56 and 56*a* are mounted on the door. The mounting of the clips 56 to the door is identical to that of mounting them to panel 4. To avoid making aligned cuts in the panel from both faces, the clip 56*a*, on the interior face of the door, is turned 90° with respect to the clip 56 on the exterior face. The shank or stem of the handle 29 is seated in a suitable opening through the door. It is desirable to prevent air leakage about the handle by providing suitable resilient gaskets about the shank adjacent each face of the door.

Although in some cases it may be desirable to provide internal reinforcement of the panel in the areas of the hardware, in the normal installation this is not considered necessary.

The gap between the door 25 and the edge of the wall panels 4 may be sealed in any suitable manner such as by the use of the compressible gaskets 39.

The construction of the joints 30 (Fig. 10) provides a self-closing, interlocking union between the panels. In this construction, the panel edges in addition to being lapped are provided along their outer margins with a tongue 31 and a groove 32. The contacting edge 33 of the tongues 31 are inclined to urge the panels together as they are pressed flush to each other. The grooves or channels 32 are designed to be slightly deeper than the tongues 31 whereby the panels may be brought into tight abutting relationship before contact between the ends of the tongues and the bottoms of the grooves prevents further alignment of the panels. The joint 30 is secured and sealed by the application of an adhesive such as the adhesive used to attach the batting strip 11 on all contacting surfaces of the edges of the panels. This simultaneously seals the joint against the passage of moisture and firmly secures the panels together as a structural unit.

In the construction of the joint 30, the panel facing sheets 9 preferably extend beyond the edges of the panels and are turned in to form edge flanges 34. The small pocket formed at the surface of the panel by the radiusing of the facing sheets at the panel's edge is preferably filled with a bead 35 of adhesive. This assures a smooth joint and a positive moisture seal. The joint illustrated in Fig. 10, while somewhat more complex than the other panel joints illustrated, does have the advantage of developing a tight fit between the panels and of providing a tortuous path between the panels which may be more readily sealed against moisture.

A number of means may be used for securing the panels to the structure of an external shell where such exists. A few of these are illustrated in Figs. 5, 6, 7 and 9.

The means of attachment illustrated in Fig. 5 is designed for the situation where the shell structure includes channel section studs 40 covered by an external skin 41 of suitable material such as aluminum or stainless steel. In this situation it is assumed that the external facing 41 is applied after the insulating panels 7 have been erected and attached to the studs 40. For the purpose of effecting this type of erection, angle strips 42 of the same material as the batting strips 11 are secured to the studs 40 by suitable means such as rivets 43. The panels 7 are then secured to the angle strips 42 by a suitable adhesive such as that used to attach the batting strips 11. The panels 7 are held in position by temporary props until the adhesive has set. When the adhesive has set, the panels are firmly secured to the studs 40. Preferably, the panels are so sized that their joints will fall at the studs 40. These joints may be of any of the various types described with the actual joint 44 formed and sealed by the same adhesive used to attach the angle strips 42 to the panels. Where the joint is of the simple type illustrated, it is normally covered

and protected by a batting strip 11, also adhesively secured to the facing sheets of the panels.

After the panels 7 have been secured to the studs 40, the surface sheets 41 of the shell are erected and secured to the studs 40 by blind rivets 45. Such an arrangement provides a good structure because the surfacing sheets 41 and the studs 40 provide a firm and positive protective structure for the enclosure while the panels 7 provide complete thermal insulation for the enclosure. The entrapment of moisture in the space between the panels 7 and the surfacing sheets 41 is immaterial in this type of construction so far as the insulating material is concerned since it is impervious to moisture. Where the back surface of the insulating material is protected against mechanical injury such as the protection provided by the surfacing sheets 41, the facing sheet 9 on the back face of the insulating panels 7 may be omitted.

Fig. 9 illustrates another method of joinder of the panels to the structure of a surrounding shell. This method also assumes that the back of the insulating panels will be accessible for erection of the panels 7. In the particular illustrated embodiment of this method, the panels are secured to an I-beam 48. For the purpose of making the attachment, the panels 7 on the back face are provided with a cutout 49 of sufficient depth to seat the flange of the I-beam 48 flush with the back surface of the panels. Anchor strips 50, similar to the batting strips 11, are secured to the I-beam on each side of the web by means of rivets 41. A substantial portion of each of the anchor strips 50 extends beyond the I-beam and is secured to the surface of the panel by a suitable adhesive. As soon as this adhesive has set, the panels will be firmly held to the I-beam 48. After this has been accomplished, the I-beams are enclosed by attachment of exterior facing sheets.

The fact that the facing sheet 9 of the back face of the panels 7 is breached for the purpose of making this attachment is not important when the core material used in the panels 7 is non-hygroscopic and impervious to moisture. The breaching of the moisture impervious facing sheets will not permit moisture to enter the core 8 to impair or destroy the thermal efficiency of the panel.

Figs. 6 and 7 illustrate another method of attaching the panels to a surrounding shell enclosure. This particular means of construction is particularly adapted for use where the back of the panel is inaccessible, requiring blind attachment. This form of attachment is particularly suited to situations in which the shell is masonry and to those situations in which the interior surface of the shell is irregular so that the panels as a whole have to be spaced outwardly from the shell surface sufficiently to permit them to clear all irregularities of the shell's interior surface.

While this form of attachment is particularly suitable for masonry walls, it will be recognized that it may be used with wooden and other types of non-masonry structures. While particularly suited to situations involving inaccessibility of the panel backs, it is equally useful under practically all other circumstances where the panels are to be attached to a supporting structure. It is contemplated that this form of attachment will be extensively used under all of these various circumstances.

This particular form of attachment is preferred over those illustrated in Figs. 5 and 9 because it takes advantage of the fact that low density core materials such as expanded polystyrene have high shear strength. The legs of the clips transmit loads to the panel as shear loads rather than as tension loads tending to separate the facing sheet from the core.

For the purpose of making this type of installation, the clip 50 is utilized. Although the clip 50 may be of many different types of construction, one particularly useful embodiment consists of an elongated U-shaped corrugated clip. The free ends of the sides of the clip are sharpened at 51 to provide a cutting and penetrating edge. This particular clip is illustrated and claimed in our co-pending application entitled Clip for Mounting Panels, Serial No. 484,954, filed January 31, 1955.

The enclosure to be lined with the panels 7 is prepared by first attaching the clips securely to the shell of the enclosure. Where the shell is of wood or other readily penetrable material as suggested in Fig. 7, the clip is secured by means of screws 52. Where, however, the enclosing shell is of masonry, suitable attachment means such as a screw and masonry anchor combination or a percussion set stud is used. Whatever means are employed for attachment of the clip to the shell, it is essential that this attachment be firm and stable so that the clips will be rigidly held to the shell. The quantity and spacing of the clips 50 will be determined by that necessary to provide adequate support for the panels 7. This will vary from one installation to another.

After the clips 50 have been installed, their sides are coated with an adhesive bondable upon curing to both the facing sheets and the core. For this purpose an epoxy resin is desirable where the facing sheets are a polyester resin and the core material is expanded polystyrene. This is the same type of adhesive utilized for mounting the batting strips 11. With the clips 50 freshly coated with the adhesive, the panel is placed in position and then its inner face pushed or struck with sufficient force to cause the sharpened edges 51 of the clip to penetrate partially through the panel. Of course, if the panel has a facing sheet 9 on the back surface, the force required to do this is substantially greater. Some of the adhesive on the sides of the clip is carried into the panel, forming a bond, indicated by the numeral 53, between the clip and the panel core. Some of the adhesive piles up at the point of entry of the surfacing sheet 9, forming a strong bead or fillet 54 further securing the clip to the panel.

The depth to which the clip 50 is caused to penetrate the panel 7 depends upon the circumstances of the installation. Normally the clips 50 are provided with sides or legs having a length appreciably in excess of the depth of penetration necessary to adequately hold the panel. By this arrangement, the panels may be pushed onto the clip only so far as necessary to provide a firm anchorage. Thus, if the surface of the shell structure is irregular, as is indicated by the irregular surface 55 of the side wall in Fig. 6, the panels may be caused to stand out from the general surface of the wall sufficiently to clear all obstructions created by the irregularities.

The several panels 7 forming a single wall or ceiling may be erected by partially inserting them on the clips 50. When all the panels have been so placed, they may be aligned to provide a flush surface by forcing the inwardly projecting panels flush with the other panels. This must be done with sufficient rapidity that it will be accomplished before the adhesive on the clips starts to set.

Normally, the panels when erected as a wall by this method will hold their position without external support until the adhesive on the clips is set. Where, however, the clips 50 are used to mount ceiling panels 7 to form ceiling 5, such as illustrated in Fig. 6, the ceiling panels must be supported until the adhesive is set. Since the panels are comparatively light weight, this presents no serious problem. Panels of this type in four by eight foot sizes are normally light enough for a single man to easily lift and place on the ceiling.

This invention is equally applicable to both stationary and mobile enclosures. It is useful in the construction of refrigerated rooms, portable containers, box cars and trucks. Because of its good structural qualities, it will withstand the loadings characteristic of these applications including vibration and jar incident to use in mobile enclosures.

In addition to enclosures for refrigerated areas, it may

be used for standard building construction, replacing the entire roof and wall structures. It provides in a single construction component a structural support, a weather resistant and weather tight exterior, a durable, injury resistant surface on both the interior and exterior and an insulating factor superior to that of conventionally used materials. In such construction it may be used as the sole building material or it may be applied as the enclosure paneling for a skeleton frame.

An enclosure for a refrigerated area constructed according to this invention has the advantage of a durable wall of high thermal insulating efficiency. This thermal insulating efficiency will be retained throughout the life of the enclosure. It has no tendency to lose its thermal efficiency due to the accumulation of moisture such as characterizes thermal insulating materials heretofore employed. It is also highly resistant to mechanical injury. If injured, it may be quickly and inexpensively repaired by use of a patch of the same type of material as that used for the batting strips. Small breaches may be filled with the adhesive. Both the repair strip and the adhesive form moisture tight seals to prevent the formation of pockets into which dirt or other materials characteristic of refrigerated areas may accumulate. Since the panels retain their thermal efficiency throughout their life, the frequent replacement commonly required of previously known insulating materials is eliminated. This in itself effects a substantial saving in cost and in downtime of the refrigerated enclosure necessitated by repairs.

While a preferred embodiment and several modifications of this invention have been described, it will be recognized that various other modifications may be employed without departing from the principle of this invention. Such modifications are to be considered as included in the hereinafter appended claims, unless these claims by their language expressly state otherwise.

We claim:

1. An enclosure for a refrigerated area comprising a plurality of laminated panels having on at least the surfaces exposed to the interior of said enclosure a moisture impervious facing of synthetic high density resin, a core having a low coefficient of thermal conductivity, said core being a rigid expanded cellular synthetic resin, the cells of said core resin being independent and hermetically sealed from each other, and a moisture impervious adhesive bonding said facing to said core, the abutting surfaces of said panels being adhered with a moisture impervious adhesive to thereby form a strong moisture impervious joint which presents a continuous smooth interior surface in said enclosure.

2. An enclosure for a refrigerated area comprising a plurality of laminated panels having on at least the surfaces exposed to the interior of said enclosure a moisture impervious facing of synthetic high density resin, a filamentary reinforcement embedded in said resin, a core having a low coefficient of thermal conductivity, said core being a rigid expanded cellular synthetic resin, the cells of said core resin being independent and hermetically sealed from each other, and a moisture impervious adhesive bonding said facing to said core, said panels being joined so as to form an enclosure presenting a continuous smooth interior surface, each of the joints thereof being sealed with an adhesive that is moisture impervious.

3. An enclosure for a refrigerated area comprising laminated panels having on their surfaces exposed to the interior of said enclosure a moisture impervious facing of synthetic high density non-hygroscopic, moisture impervious resin, a core having a low coefficient of thermal conductivity, said core being a non-hygroscopic, moisture impervious, rigid expanded cellular synthetic resin, the cells of said core resin being independent and hermetically sealed from each other; and a moisture impervious adhesive bonding said facing to said core, the facing on each of said panels having a down-turned flange portion extending over and adhesively secured to at least a portion of an end surface of said core and a plurality of said panels being abutted so as to place the said flanges thereof in contact, said panels being adhesively joined together to form said enclosure so that said facing presents a substantially smooth surface at said joints.

4. In an enclosure for a refrigerated area, the combination comprising a plurality of panels and adhesive means joining said panels together as said enclosure, said adhesive means sealing the joints between said panels against the migration of moisture therethrough, the surface exposed to the interior of said enclosure of each of said panels being covered by a moisture impervious facing of a synthetic high density resin having embedded therein a filamentary glass reinforcement and presenting a smooth continuous interior surface, a core having a low coefficient of thermal conductivity, said core being of rigid expanded cellular synthetic resin, the cells of said core resin being independent and hermetically sealed from each other; a moisture impervious adhesive bonding said facing to said core, and a laminate resistant to crushing under load adjacent the upper surface of those of said panels forming the floor of said enclosure.

5. In an enclosure for a refrigerated area, the combination of claim 1 wherein the surface of each of said panels exposed to the interior of said enclosure is covered by a moisture impervious facing of a high density polyester resin having embedded therein a filamentary glass reinforcement, and said core comprises a slab of rigid expanded polystyrene.

6. In an enclosure for a refrigerated area, the combination comprising a plurality of panels and means joining said panels together as said enclosure, adhesive means sealing the joints between said panels against the migration of moisture therethrough, the surface exposed to the interior of said enclosure of each of said panels being covered by a moisture impervious facing of a high density polyester resin having embedded therein a filamentary glass reinforcement, and a core comprising a slab of rigid expanded polystyrene, a moisture impervious adhesive bonding said facing to said core, the core slabs of those of said panels forming the floor of said enclosure being of a rigid expanded polystyrene of a higher density than the core slabs of the others of said panels.

7. A lining for an enclosure for a refrigerated area having a rigid shell, said lining comprising a plurality of panels joined together so as to form an enclosure sealed at the joints between said panels by an adhesive capable of preventing the migration of moisture therethrough, the surface exposed to the interior of said enclosure of each of said panels being free of protuberances and covered by a moisture impervious facing of a synthetic high density resin, a core having a low coefficient of thermal conductivity, said core being of rigid expanded cellular synthetic resin, the cells of said core resin being independent and hermetically sealed from each other, a moisture impervious adhesive bonding said facing to said core, and anchor elements secured to said shell and to said panels for holding said panels to said shell.

8. A lining for an enclosure having a rigid shell, said lining comprising a plurality of panels and means joining said panels together, means sealing the joints between said panels against the migration of moisture therethrough, the surface exposed to the interior of said enclosures of each of said panels being covered by a moisture impervious facing of a synthetic high density resin, a core having a low coefficient of thermal conductivity, said core being of rigid expanded cellular synthetic resin, the cells of said core resin being independent and hermetically sealed from each other, a moisture impervious adhesive bonding said facing to said core, and anchor elements rigidly secured to said shell and ad-

hesively bonded to the surface of said panels for holding said panels to said shell.

9. A lining for an enclosure for a refrigerated area having a rigid shell, said lining comprising a plurality of panels joined together so as to form an enclosure sealed at the joints between said panels by an adhesive capable of preventing the migration of moisture therethrough, the surface exposed to the interior of said enclosure of each of said panels being covered by a moisture impervious facing of a synthetic high density resin, a core having a low coefficient of thermal conductivity, said core being of rigid expanded cellular synthetic resin, the cells of said core resin being independent and hermetically sealed from each other, a moisture impervious adhesive bonding said facing to said core, anchor elements rigidly secured to said shell, a portion of each of said anchor elements penetrating said panels, and an adhesive bonding said penetrating portion of the facing and core of said anchor elements to said panels.

10. In an enclosure for a refrigerated area, the combination comprising a plurality of panels and means joining said panels together as said enclosure, each of said panels having a hook shaped tongue projecting from two of its parallel edges, the free end of the tongue on one of said edges extending oppositely to the free end of the tongue on the other of said edges, the face directed toward the panel of the free end of each of said tongues being inclined and converging with said panel toward the base of said hook whereby said panels are adapted to be forced into tight edge to edge relationship as said panels are aligned with each other, means sealing the joints between said panels against the migration of moisture therethrough, the surface exposed to the interior of said enclosure of each of said panels being covered by a moisture impervious facing of a synthetic high density resin having embedded therein a filamentary glass reinforcement, a core having a low coefficient of thermal conductivity, said core being of rigid expanded cellular synthetic resin, the cells of said core resin being independent and hermetically sealed from each other, and a moisture impervious adhesive bonding said facing to said core.

11. A method of forming a refrigerator enclosure which comprises the steps of providing an outer shell, attaching a plurality of spaced panel-securing means to the interior surface of said shell, providing a plurality of panels, each panel having an expanded cellular synthetic core portion and a moisture impervious facing of a synthetic high density resin adhesively secured to one surface of said core, applying a moisture impervious adhesive to the edge surfaces of said core and to the surfaces of said panel-securing means and forcing the said panel against said panel receiving means so that the said receiving means at least partially penetrates the said core, and repeating the step of forcing additional panels against said panel receiving means until the interior surface of said shell is covered.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 2,896,271 July 28, 1959

George E. Kloote et al

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 1, line 56, for "theretofore" read -- heretofore --; column 2, line 45, for "means" read -- mean --; column 10, lines 67 and 68, for "enclosures" read -- enclosure --; column 11, line 18, strike out "the facing and core of" and insert the same before the word "said", first occurrence, in line 18, same column.

Signed and sealed this 19th day of April 1960.

(SEAL)
Attest:

KARL H. AXLINE
Attesting Officer

ROBERT C. WATSON
Commissioner of Patents