Dec. 9, 1969 B. E. CURRAN 3,482,367

FIELD ERECTED INSULATED WALL STRUCTURE

Filed April 12, 1968 2 Sheets-Sheet 1

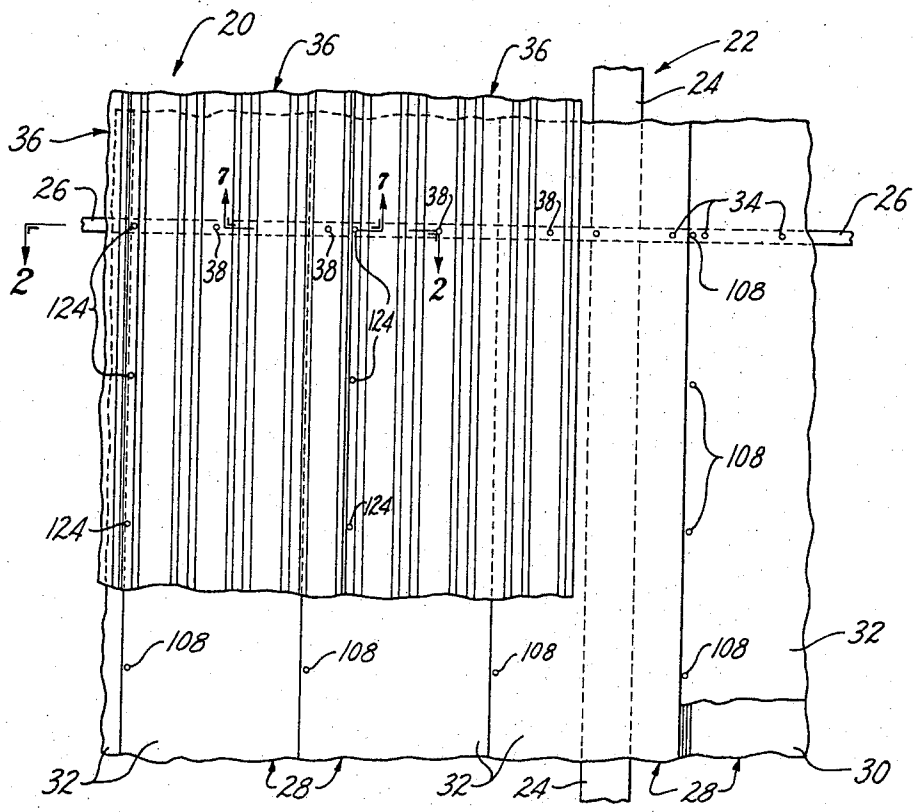

Fig. 1

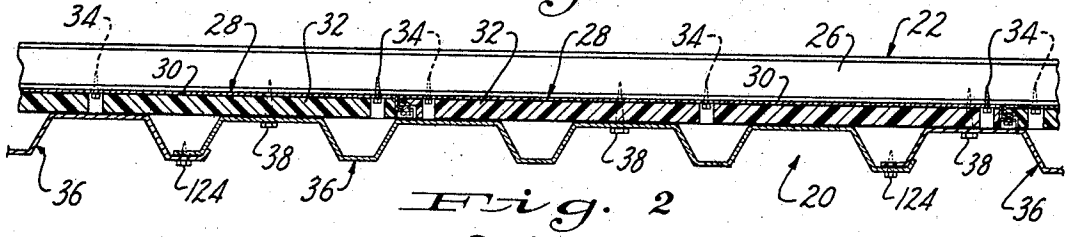

Fig. 2

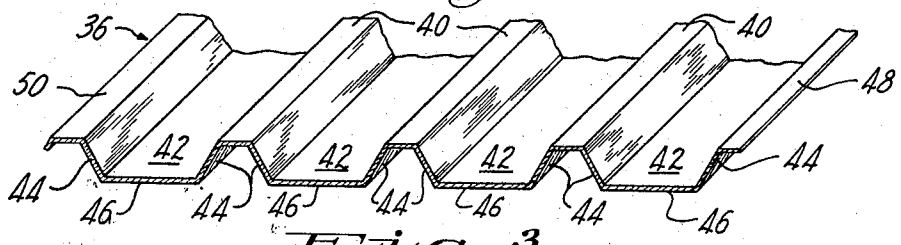

Fig. 3

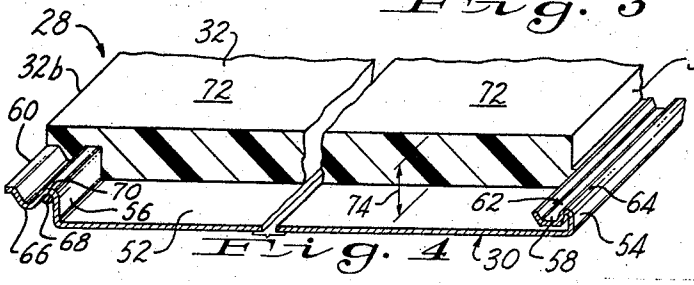

Fig. 4

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FIELD ERECTED INSULATED WALL STRUCTURE

Filed April 12, 1968 2 Sheets-Sheet 2

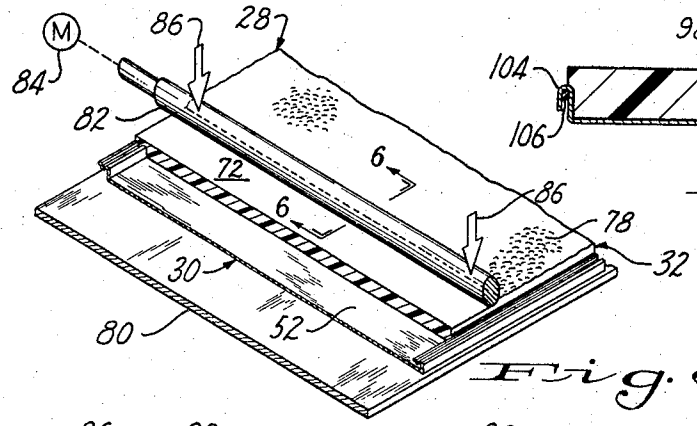

Fig. 5

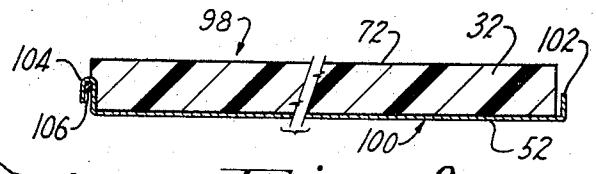

Fig. 9

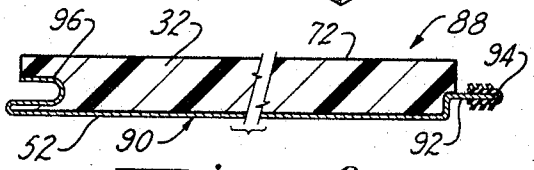

Fig. 8

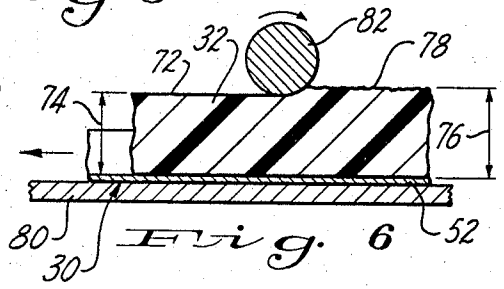

Fig. 6

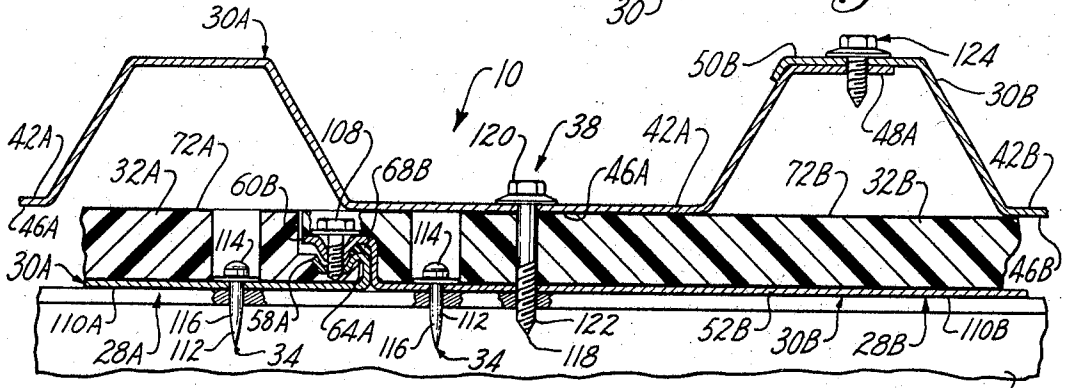

Fig. 7

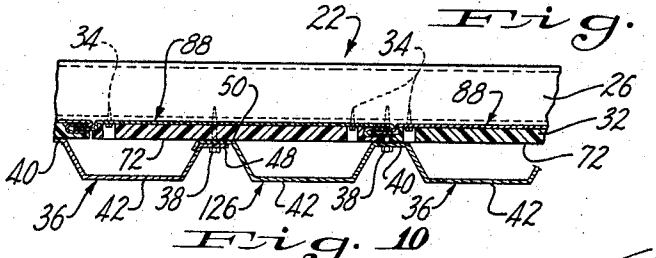

Fig. 10

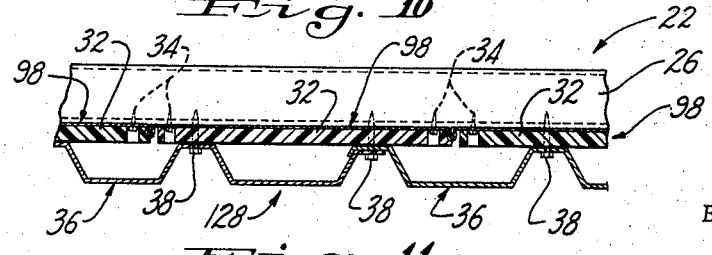

Fig. 11

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United States Patent Office 3,482,367
Patented Dec. 9, 1969

3,482,367

FIELD ERECTED INSULATED WALL STRUCTURE

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Filed Apr. 12, 1968, Ser. No. 720,905
Int. Cl. E04b 1/74, 2/62; E04c 2/08
U.S. Cl. 52—309 6 Claims

ABSTRACT OF THE DISCLOSURE

A field erected, insulated wall structure secured to a building structural framework. The insulated wall structure consists of a plurality of metal liner sheets each provided with a foamed plastic core. The metal liner sheets are secured to the building structural framework by first fastening means penetrating the foamed plastic cores and the metal liner sheets. A plurality of corrugated facing sheets are erected in side-by-side relation and abut the foamed plastic cores. The corrugated facing sheets are secured to the structural framework by second fastening means penetrating the corrugated facing sheets, the foamed plastic cores and the metal liner sheets. The foamed plastic cores provide firm supporting surfaces for the corrugated facing sheets, maintain the corrugated facing sheets separated from the metal liner sheets and serve as thermal insulation.

BACKGROUND OF THE INVENTION

Field of the invention

This invention relates to an insulated wall structure which is field erected to a building structural framework, and more particularly to an insulated wall structure of the type consisting of a plurality of metal liner sheets each provided with a foamed plastic core self-adhered to the metal liner sheet, and a plurality of corrugated facing sheets.

Description of the prior art

Heretofore, insulated wall structures have been assembled by (a) erecting a plurality of metal liner sheets in side-by-side relation to form an inner metal sheath, (b) applying batts of insulating material, such as glass wool and the like, to the metal liner sheets, (c) securing subgirt members to the metal liner sheets outboard of the insulating material, and (d) securing outer facing sheets to the subgirt members to form an outer metal sheath. See for example U.S. Patents 2,728,423; 2,744,589; 2,841,253; 2,876,871; 2,910,150; 2,910,151; 2,918,993; 3,054,482; 3,300,934. The major disadvantages of such insulated wall structures include the relatively complicated erection procedures and high labor costs required to assemble the numerous wall components; the through conduction of heat due to extensive areas of metal-to-metal contact between the inner and outer sheets; and the relatively high total cost of the numerous wall components.

Insulated wall structures assembled from modular panel units are also known in the prior art. See for example, U.S. Patents 1,697,189; 2,912,725; 3,070,196; 3,094,198; 3,113,401; 3,310,926. Such modular panel units include a metal liner sheet secured to a metal facing sheet and conventional insulating materials such as glass wool, mineral fibers and the like, filling the space between the sheets. Such modular panel units are intended to serve as building structural members and, as such, are erected in side-by-side interlocked relation to a building structural framework. The major disadvantage of such modular panel units is the severe through conduction of heat encountered at the joints between adjacent modular panel units.

The prior art provides still another type of modular panel unit whose development resulted from the relatively recent availablity of insulating materials, such as foamed polyurethane, foamed polystyrene and the like. Such prior art panel units are best termed modular foamed plastic core panel units and can be erected in side-by-side relation to form an insulated wall structure. See for eample, U.S. Patents 3,062,337; 3,113,401; 3,310,926; 3,290,845. See also, Canada Patent 734,901 and Belgium Patent 696,876. Such prior art modular foamed plastic core panel units comprise a pair of facer sheets having a foamed plastic core disposed therebetween. The foamed plastic core can be produced by introducing an actively foaming liquid mixture between the facer sheets and thereafter allowing the mixture to expand into contact with and to adhere to the opposed faces of the facer sheets. The facer sheets must be restrained to resist the relatively high pressures produced by the expanding actively foaming liquid mixture. Apparatus employed to restrain the facer sheets includes cumbersome and complex mold equipment, armored conveyors and the like.

The major disadvantages of these prior art modular foamed plastic core panel units include the high cost of the materials constituting the foamed plastic core; the high cost of the relatively complex equipment employed to produce the panel unit; the relatively high cost associated with the operation of the complex equipment; and the relatively slow production rate at which the panels are produced.

Such prior art modular foamed plastic core panel units are intended to serve as building structural members wherein the foamed plastic core fills the entire space between the facer sheets and acts as a shear connecting core. The facer sheets serve as the compression and tension flanges of the panel in beam action. The foamed plastic core acts compositely with the facer sheets and transfers shear stresses from one sheet to the other. Hence, other essential considerations in the production of such prior art modular foamed plastic core panel units include the strength of the bonds between the foamed plastic core and the facer sheets; the humid-aging characteristics of the foamed plastic core; and those physical properties of the foamed plastic core, such as tensile strength, yield strength, compressive strength, shear strength and modulus of elasticity. Thus, it will be appreciated that the production of such prior art modular foamed plastic core panel units requires extensive quality control procedures which add considerably to the overall cost of producing the panel units.

SUMMARY OF THE INVENTION

The principal object of this invention is to provide an insulated wall structure which is assembled by sequentially erecting (a) a plurality of metal liner sheets, each liner sheet being provided with a foamed plastic core material, and (b) corrugated facing sheets, each facing sheet abutting the foamed plastic core material.

Another object of this invention is to provide an insulated wall structure wherein the principal virtues of the use of a foamed plastic core material as thermal insulation are retained but which avoids the major disadvantages heretofore encountered by the prior art in the use of such foamed plastic core materials.

Another object of this invention is to provide an insulated metal wall structure which does not require the use of intermediate subgirt members interposed between the metal liner sheets and the metal facing sheets.

Still another object of this invention is to provide an insulated wall structure incorporating a foamed plastic core material serving as an insulating member and as a spacer member for maintaining the liner sheets separated from the facing sheets.

The present invention provides an insulated wall structure of the type assembled from a plurality of metal liner sheets each provided with a foamed plastic core; a plurality of corrugated facing sheets abutting the foamed plastic cores; first fastening means securing the metal liner sheets to a building structural framework; and second fastening means securing the corrugated facing sheets to the building structural framework.

Initially, the metal liner sheets are erected in side-by-side interlocked relation and are secured to the building structural framework. The metal liner sheets provide an inner sheath which completely encloses the building structural framework. Thereafter, the facing sheets are erected in side-by-side overlapped relation, in direct engagement with the foamed plastic cores and are secured to the building structural framework. In the present insulated wall structure, the corrugated facing sheets are maintained separated from the metal liner sheets by means of the foamed plastic cores. No intermediate subgirt members are used or are necessary in the assembly of the present insulated wall structure.

The foamed plastic cores are self-adhered to the metal liner sheets and serve as insulating members and as spacer members. The self-adherent bond between the metal liner sheet and the foamed plastic core reliably but provisionally joins the metal liner sheet to the foamed plastic core to form an inner panel unit capable of withstanding handling during manufacturing, packaging, shipping and erection. This self-adherent bond is disregarded when the structural strength of the wall structure is determined, notwithstanding the fact that it may have substantial strength. Once the present insulated wall structure is erected, the structural strength required of the insulated wall structure is developed by the corrugated facing sheets. Nevertheless, the principal virtues of the use of a foamed plastic core material as thermal insulation are retained in the present insulated wall structure.

In producing the inner panel units of the present invention, the normally textured exposed foamed plastic core surface is modified, for example by calendering, to produce an essentially smooth surface and to reduce the thickness of the foamed plastic core to a desired value. Consequently, when a plurality of the present inner panel units are erected to a building structural framework, the essentially smooth foamed plastic core surfaces will be substantially coplanar and provide firm supporting surfaces for engagement by the subsequently erected corrugated facing sheets.

The benefits gained by producing the present inner panel units in the manner taught by this invention include: the elimination of complex fabrication facilities; the elimination of great volumes of relatively expensive foamed plastic core filling; and avoidance of panel bulging which occurs in prior art modular foamed plastic core panel units.

The benefits gained by assembling an insulated wall structure in the manner taught by this invention include substantial cost savings in materials, packaging, shipment and erection. For example, the present inner panel units (metal liner sheet with foamed plastic core) may be conveniently and efficiently stacked, packaged and shipped to the building site. Also, the corrugated facing sheets may be conveniently and efficiently nested, packaged and shipped to the building site. Erection of the present insulated wall structure components is facilitated by the absence of intermediate subgirt members.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a fragmentary front view illustrating the present insulated wall structure secured to a building structural framework;

FIGURE 2 is a cross-sectional view, on an enlarged scale, taken along the line 2—2 of FIGURE 1;

FIGURE 3 is a fragmentary isometric view of a typical corrugated facing sheet employed in the present insulated wall structure;

FIGURE 4 is a fragmentary isometric view illustrating one embodiment of an inner panel unit employed in the present insulated wall structure;

FIGURE 5 is a fragmentary isometric view of the inner panel unit of FIGURE 4, illustrating the modification of a normally textured foamed plastic core surface to produce an essentially smooth foamed plastic core surface;

FIGURE 6 is a cross-sectional view taken along the line 6—6 of FIGURE 5;

FIGURE 7 is a cross-sectional view taken along the line 7—7 of FIGURE 1;

FIGURES 8 and 9 are transverse cross-sectional views illustrating alternative embodiments of the present inner panel unit; and

FIGURES 10 and 11 are fragmentary cross-sectional views, similar to FIGURE 2, illustrating alternative embodiments of the present insulated wall structure, which utilize the inner panel units of FIGURES 8 and 9.

DESCRIPTION OF THE PREFERRED EMBODIMENT(S)

Referring to FIGURES 1 and 2, there is illustrated an insulated wall structure **20** secured to a building structural framework **22** which includes vertical columns **24** (only one shown) and vertically spaced, horizontal girts **26** (only one shown). The insulated wall structure **20** consists of a plurality of inner panel units **28** erected in side-by-side interlocked relation and each consisting of a metal liner sheet **30** provided with a foamed plastic core **32**; first fastening means **34** for securing the inner panel units **28** to the building structural framework **22**; a plurality of corrugated facing sheets **36** erected in side-by-side overlapped relation in direct engagement with the foamed plastic cores **32**; and second fastening means **38** for securing the corrugated facing sheets **36** to the building structural framework **22**.

Referring to FIGURE 3, the corrugated facing sheet **36** presents alternating crests **40** and valleys **42** and inclined webs **44** connecting adjacent ones of the crests **40** and the valleys **42**. The valleys **42** present facing sheet surfaces **46** which engage the foamed plastic cores **32** (FIGURE 1) when the corrugated facing sheet **36** is erected. The corrugated facing sheet **36** is provided with an overlapped edge portion **48** and an overlapping edge portion **50** along its opposite longitudinal edges. The overall arrangement is such that a plurality of the corrugated facing sheets **36** may be erected in side-by-side overlapped relation as will hereinafter be more fully described. The corrugated facing sheet **36** has a typical profile. Other facing sheets having profiles different from the profile of the facing sheet **36** also can be used in the present insulated wall structure. Furthermore, the corrugated facing sheet **36** may be reversed such that when erected, the crests **40** are engaged directly with the foamed plastic core **32** while the valleys **42** are spaced therefrom.

Referring to FIGURE 4, the metal liner sheet **30** of the inner panel unit **28** includes a generally flat web **52** and upstanding side walls **54**, **56** provided along the opposite longitudinal edges of the web **52**. The metal liner sheet **30** additionally includes marginal connecting means, such as an inwardly extending flange **58** and an outwardly extending flange **60** formed integrally with the upstanding side walls **54**, **56**, respectively. The inwardly extending flange **58** is provided with a longitudinal well **62** and a sealant-penetrating lip **64**. The outwardly extending flange **60** is provided with a longitudinal rib **66**. A sealant material **68** is disposed in a groove **70** provided between the longitudinal rib **60** and the upstanding side wall **56**. The overall arrangement is such that a plurality of the inner panel units **28** may be erected in side-by-side relation to provide an interlocked sealed connection between adjacent ones of the inner panel units **28**, as will hereinafter be more fully described.

Referring still to FIGURE 4, the foamed plastic core **32** is substantially coextensive in width and length with the metal liner sheet **30** and presents an essentially smooth foamed plastic core surface **72**. The foamed plastic core surface **72** is generally parallel with the web **52** and is spaced therefrom by a selected distance indicated at **74**. The foamed plastic core **32** overlaps the outwardly extending flange **60**. The inwardly extending flange **62**, however, is exposed for the purpose of making the aforesaid interlocked connection with an adjacent one of the inner panel units **28**.

The phrase "foamed plastic" used to describe the core **32**, is intended to include those foamed-in-place thermal insulation materials produced from organic and inorganic constituents.

The foamed plastic core **32** can be produced by applying a metered quantity of an actively foaming mixture onto the web **52** of the metal liner sheet **30**. The actively foaming mixture expands and cures to form the foamed plastic core **32**. Suitable edge dams (not illustrated) can be provided to produce those clean opposite edges **32*a***, **32*b*** of the foamed plastic core **32**, illustrated in FIGURE 4.

Referring to FIGURE 6, the actively foaming mixture is preferably poured onto the web **52** of the metal liner sheet **30**. The preferred pouring technique will produce a foamed plastic core **32** having a generally uniform thickness, indicated at **76** in FIGURE 6, throughout its entire area and a generally smooth but textured foamed plastic core surface **78**. It is desirable to modify the textured foamed plastic core surface **78**, for example by calendering, to produce the aforesaid essentially smooth foamed plastic core surface **72** and to reduce the normal thickness **76** of the foamed plastic core **32** to the desired thickness **74**.

Apparatus for calendering the textured foamed plastic core surface **78** is schematically illustrated in FIGURES 5 and 6 and includes a conveyor **80** which conveys the inner panel unit **28** beneath a calendering roll **82** driven by suitable drive means indicated at **84**. The calendering roll **82** is supported by means (not illustrated) which permits the calendering roll **82** to be vertically adjusted at selected distances from the conveyor **80**. Pressure is applied to the calendering roll **82** by means schematically illustrated by the arrows **86**.

As the inner panel unit **28** passes beneath the calendering roll **82**, the textured foamed plastic core surface **78** is compressed and leveled to produce the essentially smooth foamed plastic core surface **72**. In addition, the normal thickness **76** of the foamed plastic core **32** is reduced such that the resulting essentially smooth foamed plastic core surface **72** is spaced from the web **52** of the metal liner sheet **30** by the selected distance **74**.

As illustrated in FIGURE 7, adjacent inner panel units **28A**, **20B** may be sequentially erected in side-by-side, interlocked relation. The outwardly extending flange **60B** overlaps and is interlocked with the inwardly extending flange **58A**. The sealant-penetrating lip **64A** penetrates the sealant material **68B** to provide an essentially weather tight seal between the adjacent inner panel units **28A**, **28B**. The flanges **58A**, **60B** can be secured together by fasteners, such as self-tapping screw **108**, positioned at spaced locations along the length of the flanges, as shown in FIGURE 1.

The inner panel units **28A**, **28B** are secured to the girt member **26** by the aforesaid first fastening means **34** which penetrate the foamed plastic cores **32A**, **32B** and are disposed inboard of the essentially smooth foamed plastic core surfaces **72A**, **72B** and spaced from the corrugated facing sheets **30A**, **30B**. The first fastening means **34**, for example, may comprise fasteners **112** of the type which are driven by an explosive charge and include a head portion **114** and a shank **116**. When the fasteners **112** are installed, the head portion **114** is contiguous with the metal liner sheets **30A**, **30B** and the shank **116** penetrates the metal liner sheets **30A**, **30B** and the girt **26** of the building structural framework. Other suitable fasteners, such as self-tapping screws may also be used.

After the inner panel units **28A**, **28B** have been erected, the corrugated facing sheets **30A**, **30B** are sequentially erected in side-by-side, overlapped relation. The facing sheet surfaces **46A** presented by the valleys **42A**, are in direct engagement with the essentially smooth foamed plastic core surfaces **72A**, **72B**. The second fastening means **38** are then applied to secure the corrugated facing sheet **30A** to the building structural framework **22**. The second fastening means **38** may comprise self-tapping screws **118** having a decorative head **120** contiguous with the valleys **42A** and a threaded shank **122** extending through the valleys **42A**, the foamed plastic cores **32B**, the web **52B** of the metal liner sheet **30B** and into threaded engagement with the girt **26**.

The adjacent corrugated facing sheets **30A**, **30B** also are disposed in overlapped relation. The overlapped edge portion **48A** underlies the overlapping edge portion **50B** and is in surface engagement therewith. The edge portions **48A**, **50B** are secured together by fasteners **124** which are spaced along the length of the adjacent corrugated facing sheets **36** as illustrated in FIGURE 1.

It will be appreciated by inspection of FIGURES 1, 2 and 7, that intermediate subgirt members, normally found in similar prior art insulated wall structures, are conspicuously absent from the present insulated wall structure **20**. Such intermediate subgirt members are not needed and their omission reduces the materials cost and the erection cost of the present wall structure **20**. Since intermediate subgirt members are essential to the assembly of similar prior art insulated wall structures, their omission from the present insulated wall structure **20** constitutes an improvement over similar prior art insulated wall structures. Furthermore, the use of intermediate subgirt members normally is accompanied by extensive areas of metal-to-metal contact between the metal liner sheets and the metal facer sheets. Such metal-to-metal contact promotes through conduction of heat and results in a greater overall heat transfer coefficient. Consequently, the omission of intermediate subgirt members from the present wall structure **20** lowers its overall heat transfer coefficient.

Alternative embodiments of the present inner panel unit are illustrated in FIGURES 8 and 9. Corresponding numerals will be employed to identify corresponding parts heretofore described.

Referring to FIGURE 8, there is illustrated an inner panel unit **88** consisting of a metal liner sheet **90** and a foamed plastic core **32** having an essentially smooth foamed plastic core surface **72**. The metal liner sheet **90** includes a generally flat web **52** having marginal connecting means, such as a laterally outwardly extending male lip **92** provided with a sealant strip **94** and a laterally inwardly extending female lip **96**.

Referring to FIGURE 9, there is illustrated an inner panel unit **98** consisting of a metal liner sheet **100** and a foamed plastic core **32** having the essentially smooth foamed plastic core surface **72**. The metal liner sheet **100** comprises a generally flat web **52** having marginal connecting means, such as an upstanding male lip **102** and an upstanding female lip **104** provided along its opposite longitudinal edges. A sealant strip **106** is disposed within the female lip **104**.

Alternative arrangements of the present insulated wall structure are illustrated in FIGURES 10 and 11. Corresponding numerals will be employed to identify corresponding parts heretofore described.

Referring to FIGURE 10, there is illustrated an insulated wall structure **126** consisting of a plurality of the inner panel units **88** secured to the structural framework **22** by the first fastening means **34** and a plurality of the corrugated facing sheets **36** abutting the foamed plastic cores **32** and secured to the building structural framework **22** by the second fastening means **38**.

In this arrangement, the corrugated facing sheets **36** are reversed. The crests **40** and the overlapping edge portions **50** are in direct engagement with the essentially smooth foamed plastic core surface **72** while the valleys **42** are spaced from the inner panel units **88**. The normal overlapping arrangement of the edge portion **48**, **50** is also reversed. By reversing the corrugated facing sheets **36**, the fasteners **124** (FIGURE 7) normally employed to secure the edge portions **48**, **50** are eliminated.

Referring now to FIGURE 11, there is illustrated an insulated wall structure **128** consisting of a plurality of the inner panel units **98** erected in side-by-side interlocked relation and secured to the building structural framework **22** by the first fastening means **34**; and a plurality of the corrugated facing sheets **36** erected in side-by-side overlapped relation in abutment with the foamed plastic cores **32** and secured to the building structural framework **22** by the second fastening means **38**. The corrugated facing sheets **36** are reversed in the insulated wall structure **128** and are erected in the manner described above in connection with the insulated wall structure **126** of FIGURE 10.

I claim:

1. An insulated wall structure secured to a building structural framework, said insulated wall structure consisting of

a plurality of inner panel units erected in side-by-side interlocked relation and contiguous with the said building structural framework, each of the said inner panel units consisting of

a metal liner sheet having a generally flat web contiguous with the said building structural framework and marginal connecting means along the opposite longitudinal edges of the said generally flat web, and

a foamed plastic core self-adhered to the said metal liner sheet, said foamed plastic core being substantially coextensive in length and width with the said metal linear sheet and presenting an essentially smooth foamed plastic core surface;

first fastening means disposed inboard of the said essentially smooth foamed plastic core surface for securing the said inner panel units to the said building structural framework;

a plurality of corrugated facing sheets erected in side-by-side overlapped relation in abutment with the essentially smooth foamed plastic core surfaces of the foamed plastic cores; and

second fastening means extending through the said corrugated facing sheets, the foamed plastic cores and the metal liner sheets for securing the said corrugated facing sheets to the said building structural framework.

2. The insulated wall structure of claim **1** wherein the essentially smooth foamed plastic core surfaces are disposed entirely outboard of the metal liner sheets, said corrugated facing sheets abutting said smooth foamed plastic core surfaces and being maintained spaced-apart from the metal liner sheets.

3. The insulated wall structure of claim **2** wherein the said essentially smooth foamed plastic core surfaces of the said inner panel units are substantially coplanar.

4. The insulated wall structure of claim **1** wherein the said first fastening means penetrate the foamed plastic cores and are disposed inboard of and spaced from the said corrugated facing sheets.

5. The insulated wall structure of claim **4** wherein the said first fastening means comprise fasteners each having a head portion contiguous with the said metal liner sheet and a shank penetrating the said metal liner sheet and the said building structural framework.

6. An insulated wall structure secured to a building framework, said insulating wall structure consisting of:

a plurality of metal liner sheets having generally flat webs and marginal connecting means along the opposite longitudinal edges of the said generally flat webs, said plurality of metal liner sheets being erected in side-by-side relation contiguous with the said building structural framework and with each of said marginal connecting means of each metal liner sheet interlocked with a corresponding marginal connecting means of an adjacent metal liner sheet;

foamed plastic cores, one self-adhered to each of the said metal liner sheets, each of the said foamed plastic cores being substantially coextensive in width and length with the metal liner sheet, said foamed plastic cores presenting essentially smooth, substantially coplanar foamed plastic core surfaces disposed outboard of the said metal liner sheets;

first fastening means positioned inboard of the said essentially smooth, substantially coplanar foamed plastic core surfaces for securing the said metal liner sheets to the said building structural framework;

a plurality of corrugated facing sheets each having an overlapping edge portion and an overlapped edge portion along its opposite longitudinal edges and presenting facing sheet surfaces, the said corrugated facing sheets being erected in side-by-side relation with the said facing sheet surfaces abutting the said essentially smooth, substantially coplanar foamed plastic core surfaces, the overlapping edge portion of each of the said corrugated facing sheets being disposed in overlapping surface engagement with the overlapped edge portion of an adjacent one of the said corrugated facing sheet;

second fastening means extending through the said corrugated facing sheets, the said foamed plastic cores and the said metal liner sheets for securing the said corrugated facing sheets to the said building structural framework; and

means for securing together the overlapping edge portion and the overlapped edge portion of adjacent ones of the said corrugated facing sheets.

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JOHN E. MURTAGH, Primary Examiner

U.S. Cl. X.R.

52—478, 618