United States Patent [19]

Payne

[11] **3,842,559**

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[54] **GLASS-FIBER-REINFORCED GYPSUM ROOF DECK**

[75] Inventor: **Harold J. W. Payne,** Wirral, England

[73] Assignee: **H. H. Robertson Company,** Pittsburgh, Pa.

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[30] **Foreign Application Priority Data**

Oct. 1, 1971 Great Britain 45719/71

[52] **U.S. Cl.** **52/309,** 52/536, 52/615

[51] **Int. Cl.** **E04c 2/04,** E04c 2/10

[58] **Field of Search** 52/731, 619, 615, 569, 52/579, 596, 599, 602, 609, 536, 409, 508, 309, 479

[56] **References Cited**

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2,370,638	3/1945	Crowe	52/598 X
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FOREIGN PATENTS OR APPLICATIONS

1,204,541	9/1970	Great Britain

Primary Examiner—John E. Murtagh

Attorney, Agent, or Firm—Harry B. Keck; George E. Manias

[57] **ABSTRACT**

A roof deck construction involves trays and decking units fabricated from glass-fiber-reinforced gypsum. The decking units preferably are coated with a foamed plastic covering which is in turn factory-coated with at least one ply of roofing felt.

15 Claims, 7 Drawing Figures

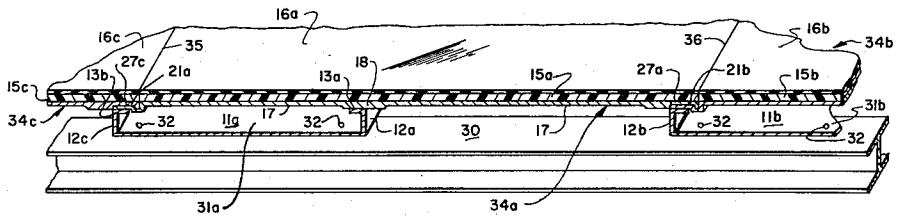
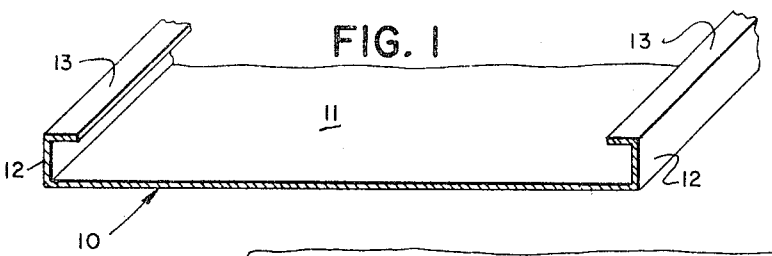


FIG. 1



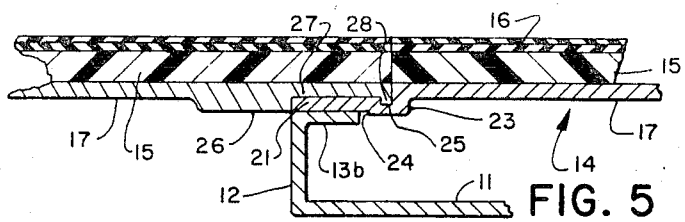


FIG. 5

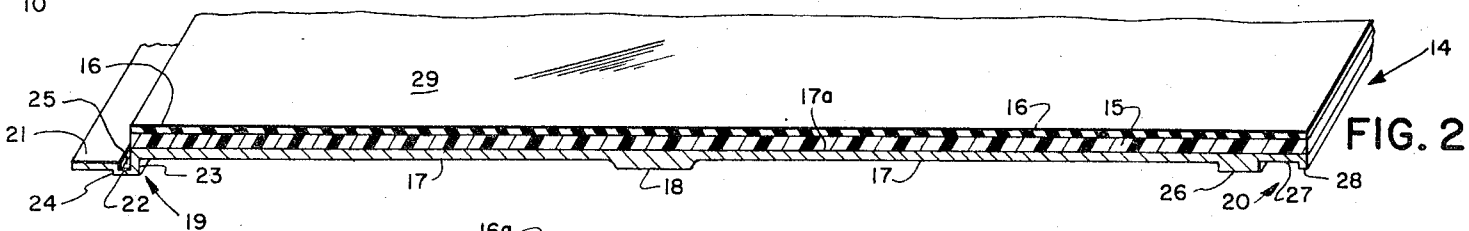


FIG. 2

FIG. 3

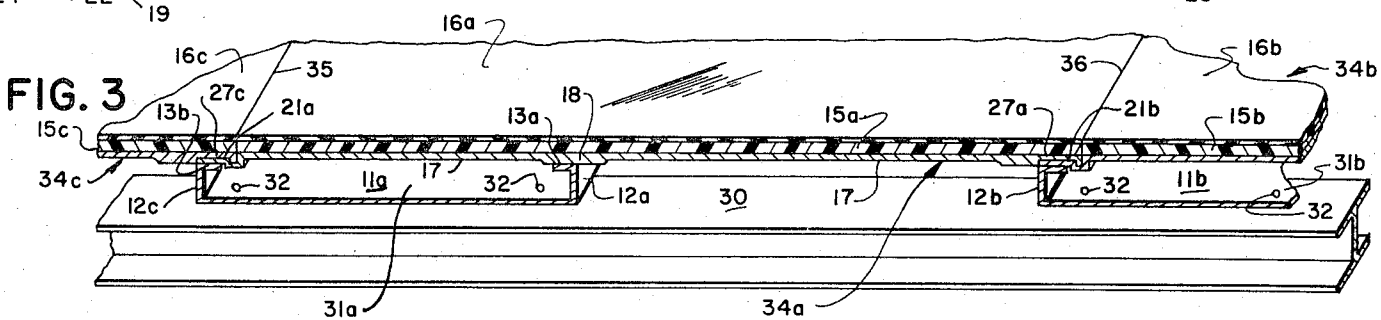
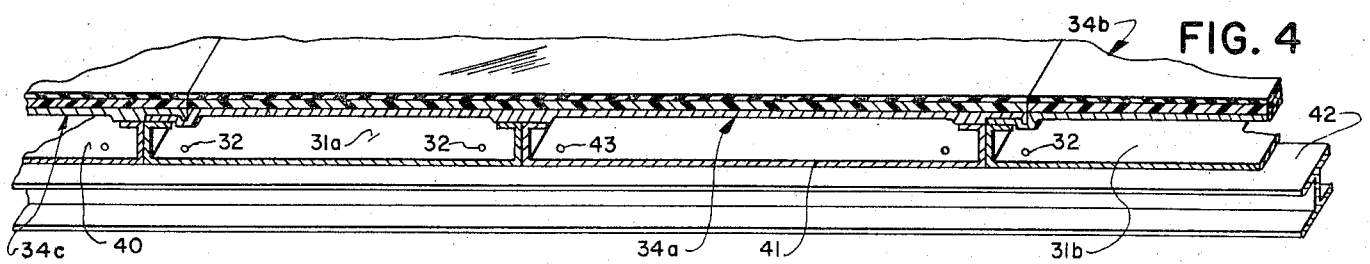


FIG. 4



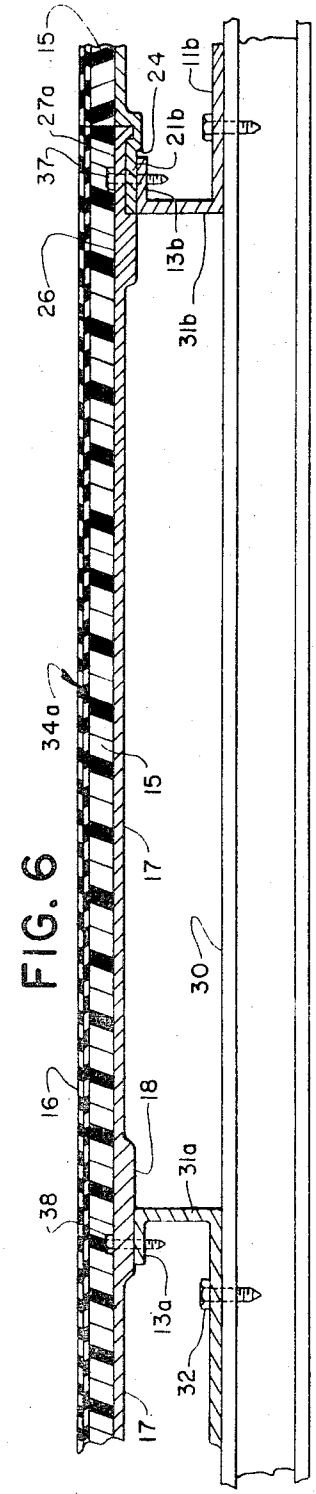

15
24
11b
27a
21b
37
26
13b
31b
34a
15
17
30
16
18
31a
38
13a
32
17

FIG. 6

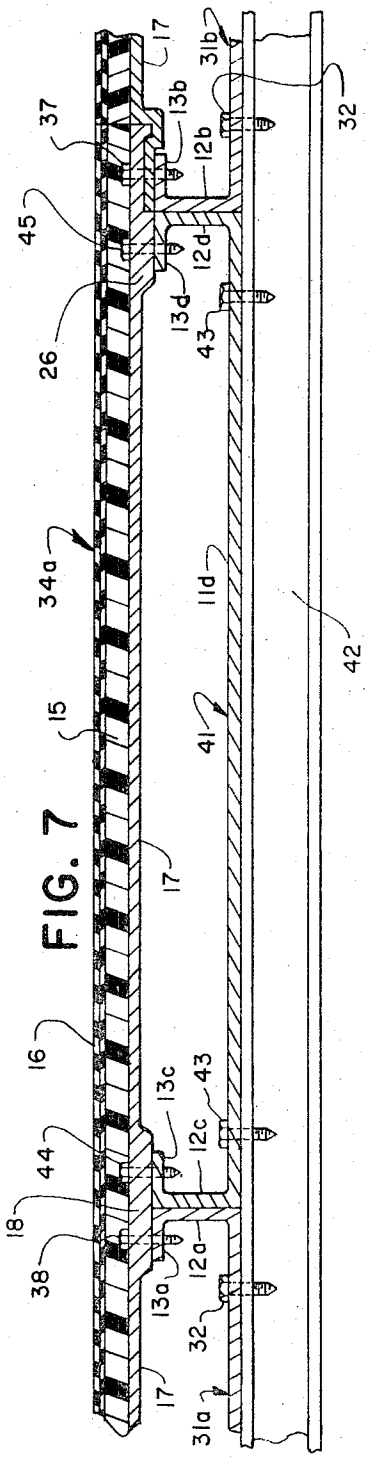

17
31b
13b
32
37
12b
45
12d
13d
43
26
34a
11d
42
15
41
17
16
43
13c
12c
44
18
38
12a
13a
32
17
31a

FIG. 7

GLASS-FIBER-REINFORCED GYPSUM ROOF DECK

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to building components fabricated from glass-fiber-reinforced gypsum and to roof deck constructions utilizing the components.

2. Description of the Prior Art

Glass-fiber-reinforced gypsum is described in British Pat. No. 1,204,541.

SUMMARY OF THE INVENTION

The object of the invention is to provide a fire resistant roof deck having useful span capabilities, having an aesthetically attractive undersurface which can be employed directly as a ceiling for the subjacent building space, and having inherent installation economies to permit the construction of low cost roof decking.

According to one embodiment of the present invention there is provided a roof-deck structure comprising tray units of glass-fiber-reinforced gypsum, and decking units also of glass-fiber-reinforced gypsum mounted on or against said tray units and secured thereto.

The present invention also provides a decking unit, for use in the construction of a roof deck as above described, comprising an element of glass-fiber-reinforced gypsum, a coating of foamed plastics material over said element and a covering layer of weather resistant plastics material over said foamed plastics layer. There may be a layer of conventional roofing felt or the like weatherproofing material over said covering layer.

Conveniently the glass-fiber-reinforced gypsum (hereinafter sometimes referred to as GRG) is the product described in British Patent specification No. 1,204,541 which contains approximately ten per cent by weight of randomly oriented chopped glass fibers. The remainder of the GRG composition is fully hydrated calcium sulphate, i.e., $CaSO_4 \cdot 2H_2O$, formed by combining the hemihydrate $CaSO_4 \cdot \frac{1}{2}H_2O$ with sufficient water, e.g., about 18.6 per cent by weight. The composition also may contain other incidental additives for achieving smoothness, whiteness, desired colorings, improved bonds with the glass-fiber-reinforcement, etc. Such additives might include, for example, powdered clay, pigments, dyes, sizes, binders, surfactants, reactive silicone primers or mold release agents.

As described in the aforementioned British Pat. No. 1,204,541, GRG compositions possess useful flexural strength, impact resistance, tensile strength and densities. The materials are suggested in British Patent No. 1,204,541, for "making glass fibre reinforced gypsum plaster boards, mouldings or extrusions for constructional use, for example, in the manufacture of wall, floor, ceiling or roof structures, doors or cabinets. Such articles can be arranged to have good fireproof characteristics and high strength, particularly flexural strength and impact strength."

BRIEF DESCRIPTION OF THE DRAWING(S)

FIG. **1** is a perspective illustration of a tray unit;

FIG. **2** is a perspective illustration of a decking unit;

FIG. **3** is a fragmentary perspective illustration of a roof deck structure employing the tray units of FIG. **1** and the decking units of FIG. **2**;

FIG. **4** is a perspective illustration of an alternate embodiment of a roof deck structure employing the tray units of FIG. **1** and the decking units of FIG. **2**;

FIG. **5** is a cross-sectional illustration showing a preferred side joint connection of the decking units of FIG. **2**;

FIGS. **6** and **7** are enlarged fragmentary cross-sectional illustrations of the roof deck structures of FIGS. **3** and **4** respectively.

DESCRIPTION OF THE PREFERRED EMBODIMENTS(S)

Referring to FIG. **1**, there is illustrated a typical tray unit **10** which is formed from GRG so as to have a flat base **11**, formed vertical side walls **12**, and re-entrant flanges **13**. The width of the tray unit **10** between the vertical side walls **12** is selected as a convenient construction module, for example, **45** centimeters. The height of the tray unit **10** from the bottom of the base **11** to the top of the re-entrant flange **13** likewise is selected according to the strength requirements of the tray unit **10** and may be about 4 centimeters, although deeper trays of 6 centimeters and more are comprehended. The re-entrant flanges **13** have a width approximately 2.5 centimeters each. The thickness of the tray unit **10** from skin to skin is conveniently carried by two workmen.

Referring to FIG. **2**, the decking unit includes a GRG decking unit **14**, a factory applied coating **15** of foamed organic resin such as foamed polyisocyanurate or foamed polyurethane, and a covering layer **16** of weather resistant plastics substance such as a urethane elastomer film or PVF or PVC film. Optionally and preferably the covering layer **16** also includes one factory applied layer **29** or conventional roofing felt on top of a suitable weather resistant coating. The GRG decking unit **14** includes a substantially flat web **17** presenting a substantially flat top surface **17a**; a central pedestal **18** which is merely a thickened integral region of the unitary GRG decking unit **14**; and end connection portions generally designated by the numerals **19, 20.** In a preferred embodiment illustrated in FIG. **2**, the end connection portion **19** includes, as shown more particularly in FIG. **5**, a terminal shoulder **21** extending horizontally from the web **17** and having its upper surface coplanar with the bottom surface of the web **17**; a channel **22** having a first side wall **23** connecting its bottom with the web **17**; a second side wall **24** connected to the terminal shoulder **21** to provide a groove **25** disposed lengthwise of the GRG decking unit **14** between the terminal shoulder **21** and the web **17.** The channel **22** extends below the bottom surface of the terminal shoulder **21.**

The corresponding lateral end connection **20** includes a lateral pedestral portion **26** which constitues a thickened rib integral with the web **17.** Extending to the side of the web **17** is a tongue **27** with a terminal depending rib **28.** The rib **28** engages the groove **25** whereby the tongue **27** rests upon the terminal shoulder **21.** The undersurface of the terminal shoulder **21** is coplanar with the undersurface of the lateral pedestal portion **26** whereby a lateral pedestal can be formed by connecting the lateral end connections **19, 20.** The lateral pedestal includes the underside of the terminal shoulder **21** and the underside of the lateral pedestal

portion **26.** The upper surface of the web **17** is essentially flat. Typically the thickness of the web **17** will be 0.5 to 0.6 centimeter, but it may be more or less. The thickness of the central pedestal **18** may be 1.0 to 1.2 centimeter as may the thickness of the lateral pedestal portion **26.** The effective or cover width of the GRG decking unit **14** is twice the width of the tray unit **10** of FIG. **1.** Accordingly, if the tray unit **10** of FIG. **1** is, as preferred, about 45 centimeters, then the preferred width of the decking unit **14** of FIG. **2** will be about 90 centimeters.

The GRG decking unit **14** may be formed as a continuous element which is cut into lengths of 4 to 8 meters, which can be conveniently handled by two workmen. The thickness of the organic foamed resin coating **15** is preferably 1.0 to 2.0 centimeters. The width of the central pedestal **18** along its underside about 6 centimeters, i.e., more than the width of two reentrant flanges **13** appearing in FIG. **1.**

A preferred embodiment of the roof deck structure is illustrated in FIG. **3** wherein the roof is supported by generally parallel purlins **30.** Individual tray units **31***a*, **31***b* are installed on the purlins **30** in spaced-apart relation by means of suitable spacing jigs. The tray units **31***a*, **31***b* are secured to the purlins **30** by means of suitable fasteners such as explosive-driven pins **32,** or screws, extending through the base of the trays **31***a*, **31***b* and through a flange of the purlin **30.**

A decking unit **34***a* is applied above the pair of the tray units **31***a*, **31***b*. The central pedestal **18** rests upon the reentrant flange **13***a* of one tray unit, and the terminal shoulder **21***a* rests upon the re-entrant flange **13***b* of the said tray unit **31***a*. The channel side wall **24***a* (see FIG. **5**) abuts the inbound edge of the re-entrant flange **13***b*. The tongue **27***c*, of the decking unit **34***c*, rests upon the shoulder **21***a* of the neighboring decking unit **34***a*. It will be observed (FIG. **3**) that the organic foamed resin coating **15***a* of the decking unit **34***a* abuts the corresponding foamed resin coating **15***b*, **15***c*, respectively, of the decking units **34***b*, **34***c*. Similarly the outer covering layers **16***c*, **16***a*, **16***b* of the decking units **34***c*, **34***a*, **34***b*, respectively, is butted along joints **35, 36** to form a more or less continuous complanar top surface for the roofing assembly.

The decking units are joined to each other and to the underlying tray units in the manner more clearly illustrated in FIG. **6** wherein a suitable fastener **37** is driven through the tongue **27***a*, the shoulder **21***b* and a re-entrant flange **13***b*. The decking unit **34***a* and the underlying tray unit **31***a* may be joined by a fastener **38,** driven through the central pedestal **18** and through the re-entrant flange **13***a*. The fasteners **37, 38** may be explosive driven pins or threaded fasteners or any other suitable fastening devices. A cylindrical core (not shown) may be removed from the covering layer **16** and the organic foamed resin coating **15** to provide access for mounting fasteners **37, 38.** The number and spacing of the fasteners **37, 38** will be determined by the spacing between purlins **30** and the anticipated loading of the structure.

Considering the roof structure of FIG. **3** from the underside, it should be apparent that a viewer located in the subjacent building space can observe only the relatively smooth flat undersurface of the base **11** of the tray units **31***a*, **31***b* and the relatively smooth undersurface of the decking unit **34***a* which is located between (for example) the side walls **12***a*, **12***b*. Because of the smooth, relatively attractive appearance of GRG materials, no additional finishing is required to complete the ceiling structure. If desired, the undersurface may be painted or otherwise decorated.

The alternative embodiment of a roof structure, shown in FIG. **4,** employs abutted ones of the tray units of FIG. **2** as the supporting component of the roof structure in contrast to the spaced-apart tray units presented in FIG. **3.** It will be observed that the roofing structure of FIG. **4** differs from the roofing structure of FIG. **3** by the inclusion of additional tray units identified by the numerals **40, 41.** The numeral **42** has been assigned to the supporting purlin in FIG. **4.** The corresponding joint elements of the roof structure of FIG. **4** are presented in FIG. **7** wherein the side walls **12***c* of the tray unit **41** abuts the side wall **12***a* of the tray unit **31***a*. The re-entrant flanges **13***c*, **13***a* have coplanar upper surfaces which engage the undersurface of the central pedestal **18.** Suitable fasteners **43** are employed to secure the base **11***d* of the tray unit **41** to the purlin **42.** Suitable fasteners **44** extend through the central pedestal **18** and the re-entrant flange **13***c*. The fasteners **44** are installed in staggered relation with the fasteners **38** in order to minimize development of localized stresses in the central pedestal **18.**

The tray unit **41** has its side wall **12***d* in abutment with the side wall **12***b* of the tray unit **31***b*. A suitable fastener **45** is provided to extend through the lateral pedestal portion **26** and the re-entrant flange **13***d*. The fasteners **45** are provided in staggered relation with the fasteners **37** to minimize the development of localized stresses in the joint assembly.

Referring to the roof structure of FIGS. **4** and **7,** it will be noted that the undersurface as viewed by an observer located in the subjacent building space presents for inspection an essentially flat undersurface consisting of the bottom surfaces of the abutted tray units **31***a*, **41, 31***b*.

One of the properties of GRG articles is a sensitivity to moisture. It will be observed that the GRG components of the present roofing structure are disposed in such manner that they are protected from moisture. In the final assembly of a roof, two or more layers of roofing felt will be applied by the building installers over the covering layer **16** of the assembled decking elements.

The present building roof components are delivered to the job site in a ready-to-install condition. The roof is assembled from essentially two components plus fasteners, i.e., the tray unit of FIG. **1** and the decking unit of FIG. **2.** Subsequent application of additional plies of roofing felts complete the installation. Because one ply of the roofing felt can be shop installed, less on-site labor is required to complete the roof.

Because the roofing structure consists essentially of non-combustible components, the structure of FIG. **3** will achieve one-half hour fire ratings and the structure of FIG. **4** will easily achieve one hour fire ratings. The present roofing structure is intended to span distances of about 4 meters. By providing somewhat deeper tray units, i.e., deeper than 4 centimeters, spans of up to 7 meters can be readily achieved with an assembly according to the invention. The factory installed organic foam coating **15** provides acoustical and thermal insulation for the resulting roof structure.

I claim:

1. A roof deck structure comprising a plurality of tray units of glass-fiber-reinforced gypsum, and decking units also of glass-fiber-reinforced gypsum mounted above and secured thereto, the decking units each have an effective width twice the width of a tray unit and each comprises a substantially flat web, a central pedestal constituted by a thickened region of said web, and end connection portions; the connection portion at one end comprising a terminal shoulder extending horizontally from and beneath the flat web, and a channel extending lengthwise of the tray unit between said web and said terminal shoulder; and the connection portion at the other end comprising a thickened rib integral with the web, a tongue extending horizontally from said thickened rib and terminating with a depending rib which engages in a channel of the adjacent decking unit with said tongue resting upon the terminal shoulder of the adjacent decking unit.

2. A roof deck structure comprising a plurality of tray units assembled side by side above roof supporting beams, each such tray unit being fabricated from glass-fiber-reinforced gypsum and including a generally horizontal flat base, generally vertical side walls and horizontal flanges extending inwardly from the tops of the said side walls over the said flat base;

and also including a plurality of decking units disposed above the said tray units, each of the said decking units having an effective width which is twice the width of the tray unit and each decking unit comprising a substantially flat web, a central pedestal constituted by a thickened region of the said web, and end connection portions; the end connection portion at one end comprising a terminal shoulder extending horizontally from and beneath the flat web, and a channel extending lengthwise of the tray unit between the said web and the said terminal shoulder; and the end connection portion at the other end comprising a thickened rib integral with the web, a tongue extending horizontally from said thickened rib and terminating with a depending rib which engages in a channel of the adjacent decking unit with the said tongue resting upon the said terminal shoulder of the adjacent decking unit;

fastening means extending between a said horizontal flange and the said central pedestal; and fastening means extending between a said horizontal flange and the said thickened rib.

3. The roof structure of claim 2 wherein the top of each decking unit is coated with a layer of foamed organic plastics and a layer of weather-resistant plastic coating is applied to the top of the said layer of foamed organic plastics.

4. The roof deck structure of claim 3 wherein a layer of roofing felt is applied to the top of the said weather-resistant plastics coating.

5. A roof deck structure comprising a plurality of thin-wall tray units of glass-fiber-reinforced gypsum, and preformed, generally flat decking units also of glass-fiber-reinforced gypsum mounted above and secured thereto, said decking units presenting overlapping longitudinal edge portions which overly a longitudinal edge portion of a subjacent tray unit and which are secured thereto.

6. The roof deck structure of claim 5, wherein said tray units have a horizontal flat base, vertical side walls, and horizontal flanges extending inwardly from the tops of said side walls over said flat base.

7. The roof deck structure of claim 5, wherein said decking units include substantially flat top surfaces, a layer of foamed plastics material covering the top surfaces of the glass-fiber-reinforced gypsum, and a layer of weather-resistant plastics material applied to the top of said layer of foamed plastics material.

8. The roof deck structure of claim 7, wherein the said layer of foamed plastics material is foamed polyisocyanurate.

9. The roof deck structure of claim 5, wherein said preformed decking units each have a longitudinal edge coincident with a longitudinal edge of one tray unit.

10. The roof deck structure of claim 5, wherein said tray units are assembled in side abutted relation.

11. The roof deck structure of claim 5, wherein said tray units are assembled in spaced-apart relation.

12. The roof deck structure of claim 5, wherein said tray units and said decking units are assembled in mutually parallel relation.

13. The roof deck structure of claim 5, wherein the space between said decking units and said tray units remains empty.

14. A roof deck structure comprising a plurality of thin-wall tray units of glass-fiber-reinforced gypsum, and preformed, genrally flat decking units also of glass-fiber-reinforced gypsum mounted above and secured thereto; said tray units having a horizontal flat base, vertical side walls, and horizontal flanges extending inwardly from the tops of said side walls over said flat base, said tray units being assembled in spaced-apart relation; and said decking units each including a substantially flat web, and a central pedestal constituted by a thickened region of said web; one horizontal flange of each tray unit being engaged with and secured to the central pedestal of one of said decking units.

15. A roof deck structure comprising a plurality of thin-wall tray units of glass-fiber-reinforced gypsum, and preformed, generally flat decking units also of glass-fiber-reinforced gypsum mounted above and secured thereto; said tray units having a horizontal flat base, vertical side walls, and horizontal flanges extending inwardly from the tops of said side walls over said flat base, said tray units being assembled in side abutted relation; and said decking units each including a substantially flat web, and a central pedestal constituted by a thickened region of said web; adjacent horizontal flanges of certain adjacent side abutted tray units being engaged with and secured to said central pedestal.

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