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(12) # EUROPEAN PATENT APPLICATION

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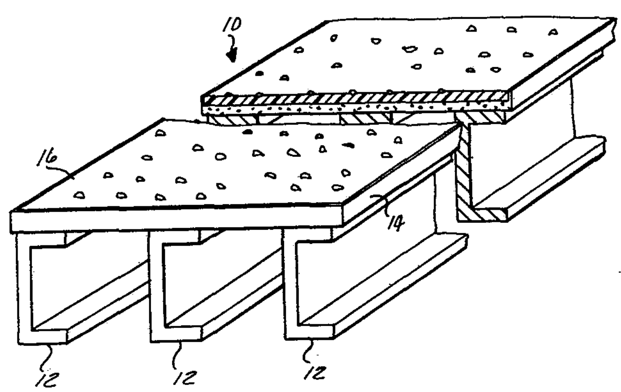
(54) **Composite building panel.**

(57) This building panel is comprised of at least one metal reinforcing member (12); a layer (14) which comprises glass fibre, this layer being fastened to the metal reinforcing member(s); and a three-dimensionally cross-linked polyester resin layer (16) which abuts the glass fibre layer.



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"COMPOSITE BUILDING PANEL"

This invention relates to a lightweight, composite building panel.

Many modern day buildings utilize substantial amounts of brick, glass, and pre-cast cement in order to form their exterior structures. Cement is relatively heavy and expensive, and forms cast from it are bulky; thus, construction with cement parts often is impractical.

The prior art has attempted to provide components which possess many of the advantages of cement but which are substantially cheaper and lighter; it has not been entirely successful in so doing.

Some relevant references encountered by the Applicants during the preparation of this application include United States Patents Nos.2,839,442 (a process for preparing a lightweight structural panel having a smooth continuous facing), 3,616,144 (a wall tile comprising a core portion, a facing layer, and a backing layer wherein the core portion comprises a particulate filler material and a resinous binder), 3,660,199 (a process for preventing measling upon the heating of an epoxy resin-glass fibre laminate), 3,745,052 (a building panel with high relief aggregate face), 3,953,629 (a synthetic concrete laminate), and 4,001,474 (a honeycomb panel cellular structure).

According to the present invention, there is provided a composite building panel which comprises at least one metal reinforcing member; a layer comprising glass fibre fastened to the metal reinforcing member(s);

and a three-dimensionally cross-linked polyester resin layer which abuts said glass fibre-comprising layer.

For a better understanding of the invention and to show how the same can be carried into effect, reference will now be made, by way of example only, to the accompanying drawings, wherein

FIGURE 1 is a perspective view of the front of the composite building panel of this invention, the view showing additionally a section through the panel;

FIGURE 2 is a perspective view of the three-dimensionally crosslinked polyester resin layer of the composite building panel being formed in situ in a pan which consists essentially of the glass fibre layer of the building panel; and

FIGURE 3 is a cross-sectional view of an alternative form of building panel embodying this invention; and

FIGURE 4 is a detail of Figure 1 shown in section and to an enlarged scale.

Referring to Figure 1 of the drawings, composite building panel 10 is comprised of at least one metal reinforcing member 12, a layer 14 comprising glass fibre which is fastened to the metal reinforcing member(s) 12, and a three-dimensionally cross-linked polyester resin layer 16 which lies on the glass fibre layer 14. Fastening means, such as screw 18 (see Figure 4), may be used to secure the glass fibre layer 14 to the metal reinforcing member 12. The screw 18, as shown, is a double headed screw which is used to penetrate and fix the fibre layer to the member 12. By employing a double headed screw a portion thereof extends above the fibre layer. Hence, when the resin is cast on the fibre layer, it encapsulates the extension or second head portion 19. Thus, by employing a double headed screw both a mechanical bond and a chemical bonding is achieved. Of course, other mechanical fasteners may be used, if desired.

Aggregate particles may be embedded in the polyester layer to impart an aesthetic appearance to the composite.

Figures 1 and 4 show a first form of composite building panel embodying this invention, in which there are included metal reinforcing member(s) 12, a glass fibre layer 14, a three-dimensionally cross-linked polyester resin layer 16, and, optionally, (and not shown) other layer(s) of material (s) known to those in the art to be useful in laminated building panels such as strone aggregate, or a mould finish. For example, layers of for example epoxy resin, polyester resin, concrete, synthetic concrete, butadiene copolymer resin, polyethers and glass fibres may be used in constructing a composite building panel of this invention in addition to the aforementioned essential glass fibre and polyester layers. A building panel of this invention preferably contains from 2 to 20 composite layers.

Figure 3 shows an alternative form of composite building panel embodying this invention which is comprised of at least two metal channel-sectioned reinforcing members 112. A glass fibre layer 114 is attached to these metal reinforcing members, in the manner heretofore described with respect to Figures 1 and 4, and the spaces 117 between the metal reinforcing members are filled with cellular cement or other lightweight, usually cellular, material, for example polyurethane foam, polystyrene foam, gypsum, or other light-weight organic or inorganic material. It is preferred to use a cement or other foam material with a density of from 48 to 480 kg/m^3, the most preferred material having a density of from 40 kg/m^3.

The cellular material adds heat qualities or thermal insulative characteristics as well as fire retardency to the composite of the invention. The composite further includes a lath 116 secured to the opposite side of the reinforcing members 112 from that of the glass fibre layer 114. The lath surface, thus, defines an interior wall structure which may be plastic covered or otherwise finished to form an interior wall. The lath may be secured to the frame or channel members by any suitable means including fasteners, welding or the like.

A polyester resin is cast upon the glass fibre layer 114 to form a layer 118 which defines an exterior wall. The layer 118 may be impregnated with aggregate particles or further coated. In any event, the lath, channel members, foam, glass fibres and resin composite all cooperate to define a building panel structure which includes both interior and exterior finished walls.

In constructing this form of building panel, a plurality of reinforcing members are arrayed and interconnected into a suitable network. Then, a lath is secured to one end of the members. Next, a formable material is placed in the spaces 117 between the reinforcing members and foamed *in situ*. Next, the glass fibre-filled layer is deposited onto the opposite end of the reinforcing members. This can be done by affixing a fibre pan thereto or, alternatively, spraying the fibre layer thereonto. In this regard it must be noted that the surface 119 defined by the channel or frame members and the foam which fills the spaces therebetween constitutes a mould for the spraying of the glass fibre.

In constructing a building panel embodying this invention, glass fibre layer 14 is bonded to a three-dimensionally cross-linked polyester resin layer 16 or 118. The bond may be mechanical in nature and may be created by the use of fastening means well known to the art. In such instances the resin is cast independently and away from the fibre layer 14 or 114. It is preferred, however, that the bond be created by forming layer 16 (or 118) *in situ* in place on glass fibre layer 14 (or 114). In this embodiment, to layer 14 is charged the reactants required to prepare the three-dimensionally cross-linked polyester resin layer 16. Layer 16 is formed right on top of layer 14. A double headed fastener 18, as shown in Figure 4, is enclosed by the resin and serves as an auxiliary fastener or bonding member.

A three-dimensionally cross-linked polyester resin is used to prepare the building panel of this invention. There are at least two methods for preparing the three-dimensionally cross-linked polyester resin. In the first method, the polymerization reaction is conducted with two monomers in which the functionality of one monomer is at least two and the functionality of the other monomer is more than two. In the second method, a linear, unsaturated polyester is reacted with a vinyl-type monomer to produce an unsaturated polyester resin. It is preferred to use a three-dimensionally cross-linked unsaturated, polyester resin to prepare the structures of this invention.

The unsaturated polyester resins preferably used to prepare the panel of this invention are well known to those skilled in the art. They may be produced by reacting a linear, unsaturated polyester with an unsaturated, vinyl-type monomer.

Linear, saturated polyesters may be prepared from dibasic acids and dihydric alcohols. If either or both of the bifunctional reactants contains unsaturation, linear unsaturated polyesters are formed; when they are cured with the vinyl-type monomer, cross-linking occurs among the individual linear polymer chains and the unsaturated polyester resin is formed.

Unsaturated polyester resins known to the art may be used in the panel of this invention; and they may be prepared by methods well known to the art. Thus, for example, they may be prepared by the procedures described in B. Golding, Polymers and Resins, pp. 303-314 (Van Nostrand Company, Inc., New Jersey, 1959); J. Stille, Introduction to Polymer Chemistry, pp. 90-93 (John Wiley and Sons, Inc., New York, 1962); R.S.Morrell (ed.), Synthetic Resins and Allied Plastics (Oxford University Press, London, 1951); Bjorksten Research Laboratories, Inc., Polyesters and Their Applications (Reinhold Publishing Co., New York, 1956); and the like. The various unsaturated polyester resins described in these publications may be used in the structures of the present invention. The processes, initiators, linear unsaturated polyesters, and unsaturated vinyl-type compounds described in these publications may be used to prepare unsaturated polyester resins which are useful in the panel of this invention.

It is preferred that the crosslinked polyester resin used in the panel of this invention contain a filler. It is preferred to use from 10 to 50 percent (by combined weight of filler and polyester resin) of filler. It is more preferred to use from 15 to 30 percent (by weight) of filler. In the most preferred embodiment, from 20 to 25 percent of filler is employed.

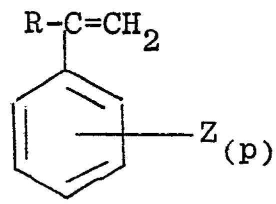
Any of the fillers well known to those skilled in the art may be used in the crosslinked polyester resin. Furthermore, one may employ other materials in the cross-linked polyester resins where one desires to achieve a particular end result. Such materials include, without limitation, adhesion promoters; antioxidants; antistatic agents; antimicrobial agents; colourants; heat stabilizers; light stabilizers; fillers; reinforcing agents; and other materials well known to those skilled in the art which have been or could be used with polymer compositions and which are described, e.g., in Modern Plastics Encyclopedia, Vol. 52, No.10A, McGraw-Hill, Inc., New York, New York (1975).

The above described materials which may be used in the crosslinked polyester resins can be employed in any amounts which will not substantially adversely affect the properties of these compositions. Thus, the amount used can be zero (0) per cent, based on the total weight of the composition, up to that percent at which the composition can still be classified as a resin. In general, such amount will be from 0 percent to 80 percent.

It is preferred that the filler used be a silica sand.

The filler may be incorporated into the polyester resin by means well known to those in the art. Thus, for example, it may be mixed with the linear, unsaturated polyester and/or the unsaturated, vinyl-type compound prior to the time these components are reacted together to form the unsaturated polyester resin. Other methods of incorporating the filler into the resin which are known to the art also may be used.

In preferred practice, the aforementioned vinyl-type monomer is of the formula:



wherein R is selected from hydrogen, lower alkyl of from 1 to 6 carbon atoms, and halogen; Z is selected from vinyl, hydrogen , chlorine, and lower alkyl of from 1 to 6 carbon atoms; and p is 0 or a whole number of from 1 to 5.

The most preferred vinyl-type monomer is styrene. When it is used, it is preferred to use from 30 to 70 percent (by combined weight) of styrene. In an even more preferred embodiment, from 40 to 60 percent (by combined weight) of styrene is used. In the most preferred embodiment, from 45 to 55 percent (by combined weight) of styrene is utilized.

In one procedure for producing a building panel embodying this invention, after glass-filled layer 14 or 114 is formed, wooden slats are placed around the sides of glass-filled layer 14 or 114 to form a boundary; the reactants required to form three-dimensionally cross-linked polyester resin layer 16 or 118 are poured on top of layer 14 or 114 and the slats prevent these reactants from flowing off over the top of glass-filled layer 14 or 114. After polyester resin 16 or 118 has hardened, the wooden slats are removed. In another procedure which can be appreciated best by reference to Figure 2, glass fibre layer 14 is formed with sides 20 which act as boundaries and restrain the reactants from flowing off of the top of glass fibre layer 14 after they have been charged.

Glass fibre layer 14 is preferably comprised of from 25 to 100 percent (by weight) of glass fibre. It is particularly preferred that glass fibre layer 14 be comprised of from 30 to 80 percent (by weight) of glass fibre. In a more preferred embodiment, glass fibre layer 14 is comprised of from 33 to 60 percent of glass fibre.

Any material which may be filled with glass fibre may be used in glass fibre layer 14. Thus, for example, one may use glass-filled epoxy resin or glass-filled polyester, in glass fibre layer 14. When glass-filled epoxy resin is used in glass fibre layer 14, the epoxy resin used may be as described in the Encyclopedia of Polymer Science Technology, Vol. 6. pp. 209-270 (Interscience, New York, 1967).

In general, the epoxy resins that may be employed in the practice of the present invention may be those which are known in the art, although it is preferred to use DGEBA (diglycidyl ethers of bisphenol A). Detailed descriptions of suitable epoxy resins, modifiers, curing agents, accelerators, fillers, glass cloths, manufacturing conditions, etc., may be found in the Encyclopedia of Polymer Science and Technology, Vol. 6, pp. 209-270 (Interscience Publishers, New York, 1967) and in the Handbook of Epoxy Resins, by Henry Lee and Kris Neville (McGraw-Hill, New York, 1967).

The preferred epoxy resins, of the DGEBA type, are made by the reaction of bisphenol A with excess epichlorohydrin in an inert atmosphere under alkaline conditions to neutralize the hydrogen chloride resulting from the condensation. Instead of using alkali, Friedel-Crafts catalysts may be employed, such as zinc chloride or boron trifluoride, followed by dehydrohalogenation with a compound such as an aluminate, silicate or zincate in a substantially non-aqueous medium. The epoxide equivalents of such compounds are generally in the range of 150 to 1,000 and usually are from 200 to 600. The average molecular weights are from 340 to 1,500, preferably 340 to 1,200.

Instead of DGEBA, other epoxides, such as the glycidyl ethers of glycerol, glycidyl ethers of bisphenol

F, polyglycol glycidyl ethers, glycidyl ethers of tetrakis (hydroxyphenyl) ethane, phenyl glycidyl ethers and epoxylated novolacs, may be used. Furthermore, various mixtures of epoxy resins may be employed, either as physical mixtures of different types of epoxides or as chemical combinations, having different resin-forming portions reacted into one epoxide molecule. Additionally, the epoxy resins may be utilized with other types or resins so as to obtain desired modifications of physical and chemical properties.

In one preferred procedure, the glass fibre layer 14 is glass-filled polyester. It is preferred that this glass-filled polyester be glass-filled linear unsaturated polyester. The preparation of these linear, unsaturated polyesters has been described hereinabove and is well known to those skilled in the art.

The preferred unsaturated polyesters are those thermosetting materials which, when properly catalyzed, convert from a liquid state to infusible solids. This polymerization reaction, usually termed "curing", may be initiated through the addition of a catalyst (polymerisation initiator) such as an organic peroxide catalyst.

In one procedure, the layer comprising glass fibre consists essentially of glass-filled polyester with which has been admixed from 0.5 to 5.0 percent (by combined weight of glass-filled polyester and peroxide catalyst) of peroxide catalyst.

Useful organic peroxide catalysts include, for example, methyl ethyl ketone peroxide, benzyl peroxide, dimethyl peroxide, butyl peroxide, cumylmethyl peroxide, t-butyl-t-pentyl peroxide, t-butyl diphenylmethyl peroxide, dicumyl peroxide, 1,2-dioxane, triphenylmethane peroxide, dilauryl peroxide, dibenzoyl peroxide, methyl isobutyl ketone peroxide and methyl amyl ketone peroxide, as well as mixtures thereof. The preferred catalyst is methylethyl ketone peroxide.

It is preferred that, after the glass-filled polyester has been admixed with the catalyst, the glass-filled polyester be cured under ambient conditions.

In one procedure, the three-dimensionally cross-linked polyester resin layer is formed by admixing methyl ethyl ketone peroxide with the linear, unsaturated polyester, and styrene and thereafter allowing this layer to cure under ambient conditions.

The metal reinforcing member may be constructed of any metal commonly used in the building trades art. The term "metal", as used in this specification, includes one or more electropositive elements and alloys. Thus, for example, steel, iron, brass, aluminium, copper, lead, chromium, bronze, and the like are metals which may be used in the reinforcing member. The metal reinforcing member is preferably comprised of at least about 50 percent by weight of one or more of these metals.

The metal reinforcing member may be in any shape which will lend structural integrity to the building panel of this invention.

It should be noted that where the three-dimensionally cross-linked polyester is cast _in situ_, some portion thereof will invade interstices of the glass fibre layer. Because the peroxide catalyst used in the polyester layer is preferably, the same as the peroxide used with the glass fibre, no adverse effect occurs because of this commingling.

The following Example is presented to illustrate the invention and should not be deemed to be limitative thereof. Unless otherwise stated, all parts are by weight, all temperatures are in degrees centigrade, and all volumes are in millilitres.

EXAMPLE

One hundred parts of chopped glass fibre were mixed with two hundred parts of Polylite® 32-131 polyester (an unsaturated, liquid polyester with a viscosity of 1300-1800 cps and a density of 1.14-1.16 kilograms per litre which was purchased from the Reichhold Chemicals, Inc. of

White Plains, New York). To this mixture were added two parts of methyl ethyl ketone peroxide and the mixture was allowed to cure at room temperature for from thirty to forty-five minutes. The chopped glass fibre mixture thus produced was sprayed onto a bed of spaced apart channels having the spaces therebetween filled with a 400 kg/m^3 density cement. After the glass fibre composite had set, it was attached to the channel members using suitable mechanical fasteners. Thereafter, wooden slats were erected around the perimeter of the glass fibre polyester layer to form a boundary and a mixture of Polylite® polyester and styrene (in a weight of ratio of 45/55) was charged to the top of the glass fibre layer. About 0.75 parts of methyl ethyl ketone peroxide per hundred parts of polyester/styrene mixture were added to this mixture, and the polyester/styrene mixture was allowed to cure at room temperature for about 120 minutes.

Claims:

1. A composite building panel which comprises at least one metal reinforcing member (12), a layer (14) comprising glass fibre fastened to the metal reinforcing member(s); and a three-dimensionally cross-linked polyester resin layer (16) which abuts said glass fibre-comprising layer.

2. The building panel of claim 1, wherein the layer which comprises glass fibre is a glass fibre filled polyester layer or a glass fibre filled epoxy resin layer.

3. The building panel of claim 2, wherein the glass-filled polyester is a glass-filled, linear unsaturated polyester layer.

4. The building panel of claim 3, wherein the glass fibre-filled polyester is admixed with from 0.50 to 5.0 percent (by combined weight of glass-filled polyester and peroxide) of an organic peroxide.

5. The building panel of any one of the preceding claims wherein the cross-linked polyester resin is an unsaturated polyester resin which is cross-linked with a vinyl monomer in the presence of an organic peroxide catalyst.

6. The building panel of claims 4 and 5, wherein the peroxide admixed with the glass-filled polyester is the same as the peroxide catalyst.

7. The building panel of claim 6, wherein the peroxide is methyl ethyl ketone peroxide.

8. The building panel of any one of the preceding claims, wherein the glass fibre layer contains from 25 to 100 percent by weight of glass-fibre material.

9. The building panel of any one of the preceding claims which comprises: a plurality of reinforcing members spaced apart from each other; and which further comprises

(a) a lath (116) secured to ends of the reinforcing members thereby to form an enclosed structure; and

(b) a foamable material disposed in enclosed structure in spaces (117) which exist between the reinforcing members, the glass-fibre layer being affixed to the reinforcing members at the ends thereof opposite to that at which the lath is affixed.

10. The building panel of claim 9 wherein the foamable material is a foamable cement which has been foamed in situ.

11. The building panel of any one of the preceding claims, wherein the cross-linked polyester layer contains from 10 to 50 percent, by weight, of a filler.

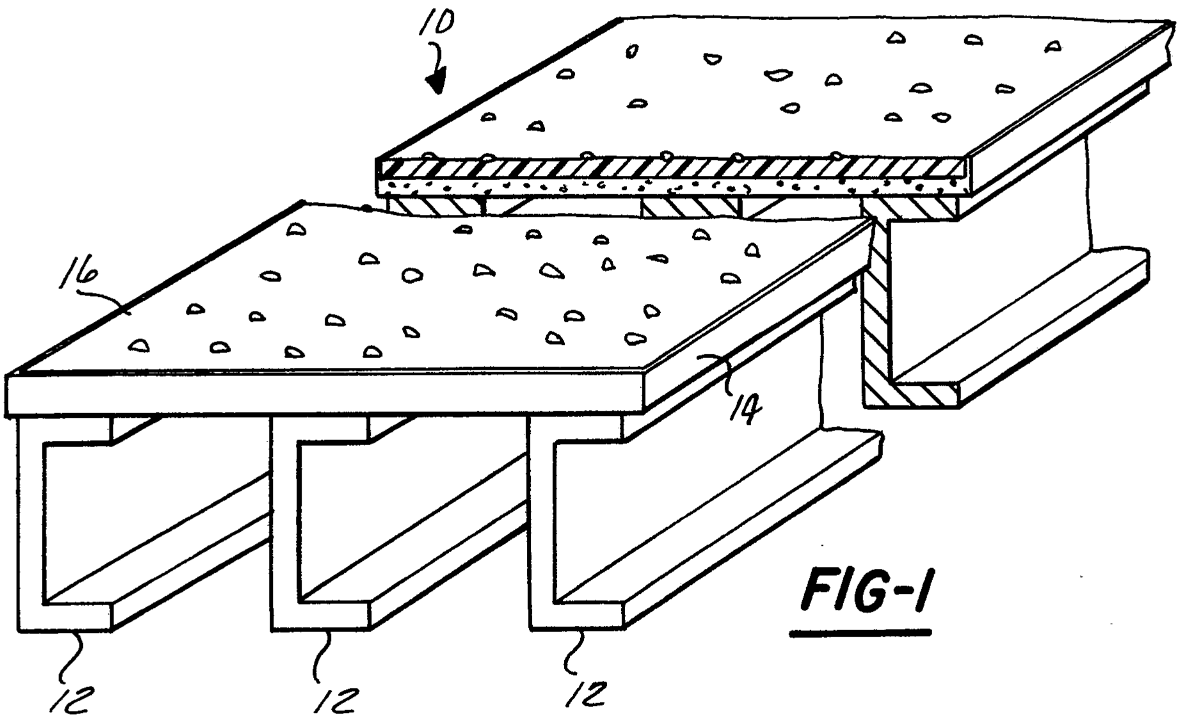


FIG-1

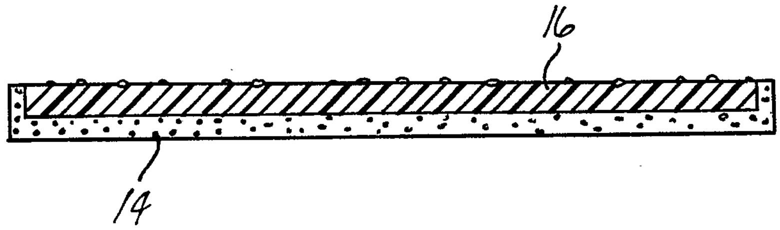


FIG-2

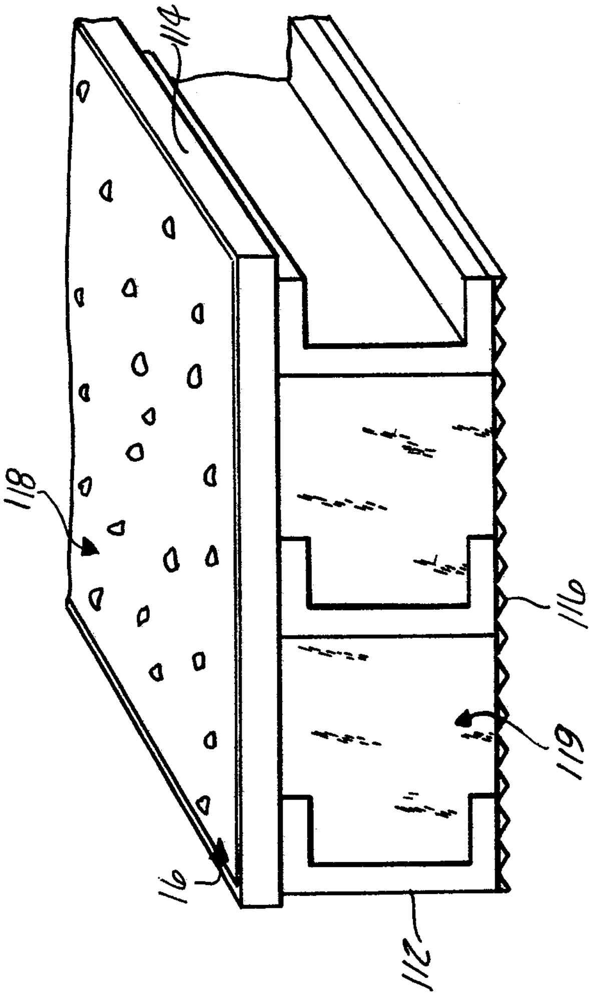


FIG-3

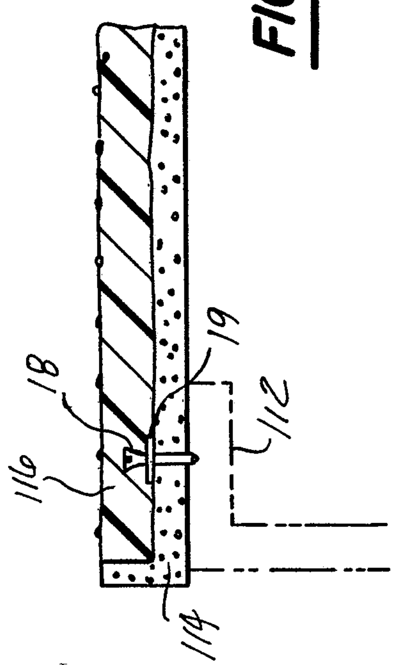


FIG-4

European Patent Office

EUROPEAN SEARCH REPORT

0060356

Application number
EP 81 30 1136

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
	BE - A - 769 018 (DEMORTIER) * page 2, lines 26-30; page 3, lines 13-15, 27-31; figure 1 *	1,9,10
	GB - A - 1 117 811 (RESIFORM) * page 1, lines 67-86; page 2, lines 1-16; figure 2 *	1,2,11
	US - A - 3 194 708 (FOURCADE) * column 4, lines 40-64; column 5, lines 12-24; figure 7 *	1,2,9
	GB - A - 1 224 028 (ST. GOBAIN) * page 1, lines 60-70; page 3, lines 42-67 *	1-3,5-7

CLASSIFICATION OF THE APPLICATION (Int. Cl.)

E 04 C 2/20
2/38
2/26

TECHNICAL FIELDS SEARCHED (Int. Cl.)

E 04 C

CATEGORY OF CITED DOCUMENTS

X: particularly relevant
A: technological background
O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention
E: conflicting application
D: document cited in the application
L: citation for other reasons

&: member of the same patent family, corresponding document

X The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	23-11-1981	DALL'ANESE

EPC Form 1503.1 06.78