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(54) **PREFABRICATED GLASS FIBER REINFORCED CONCRETE WALLPANEL**

VORGEFERTIGTES WANDELEMENT AUS GLASFASERVERSTÄRKTEM BETON

PANNEAU MURAL PREFABRIQUE EN BETON RENFORCE PAR DES FIBRES DE VERRE

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(56) References cited:
EP-A- 0 183 526 WO-A-93/12303

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Description

DESCRIPTION OF INVENTION

[0001] The present invention relates to a self heat isolated, light and prefabricated glass fiber reinforced concrete (GRC) wallpanel and a method for producing same.

BACKGROUND OF INVENTION

[0002] In terms of the state of the art currently there are 4 types of prefabric wallpanel production methods:

- a) Iron reinforced concrete panel: These panels have an sq/m weight of 400 kg, does not contain heat isolation and because of weight create problems while transportation and mounting.
- b) Heat isolated concrete panel: obtained by putting 5 cm thick hard polystyrene foam sheet among 10 cm thick two panels and comprises same weight and mounting problems.
- c) Sandwich system panel: These panels are obtained by covering all sides of Styropor foam blocks with Fiber reinforced cement. It can provide heat isolation and lightness but it is not possible to mount to concrete tabliers and creates problems as times pass by. For these reasons production is abandoned.
- d) Fiber reinforced cement (GRC) lining plates: They are steel carcassed plates that have 12 mm section thickness and used to cover general columns, present walls and to provide forms on surface. Heat isolation is done by placing isolation plates behind them after mounting.

[0003] Document EP 0183526 discloses a building panel having an outer layer of fibre reinforced cement cast in a mould, with a mesh reinforcement arrangement embedded in the cement layer.

[0004] Document WO A 9312303 describes a building panel comprising two parallel opposed spaced apart facing sheets made from fibre reinforced concrete and an intermediate core of light weight fomed concrete. A reinforcing bridging member is disposed fully within the foamed concrete core and is bonded to the facing sheets.

[0005] Since there is strict rigidity in all types of these panels they do not have any movement freedom against building straps and building movements.

[0006] In view of the above mentioned present state of the art, subject of this application is the solution of the known problems.

[0007] Panels produced according to the present state of the art have a panel thickness of 20-25 cm in order to prevent cracks and breaking of iron mounting in the panel. In this case sq/m weight of the panel is about 400-450 kg. And this causes problems in trans-

porting and mounting of large scale panels, also brings huge loads over building stude frame concrete. In our invention panel thickness does not exceed 10-15 cm and panel weight is about 90-100 kg. This enables easy transportation and mounting of the panel, weight load to building concrete decreases to minimum and amount of iron used in building stude frame concrete is decreased.

[0008] In the panels produced according to the present state of the art there is a need for further heat isolation and this requires various isolation materials and a further process, labor use and extra cost.

[0009] In our invention since cellular structure and air spaces in foam concrete function as an isolation material there is no need for further heat isolation process.

Second advantage of heat isolation with foamconcrete is that since it is possible to produce concrete with requested densities while forming foam concrete, depending on the heat values of the area that the panel is to be used, panels having various isolation values of Lambda values 0.065 to 0.500 and K values 0.29 to 3.33.

[0010] Panels produced according to the present state of the art can not contain forms other than some basic shapes, because iron reinforced concrete technology itself does not allow it. In our invention since GRC is a material that can be molded in any form, every kind of architectural design form can be given to the panels.

[0011] Panels produced according to the present state of the art are heavy and rigid panels. They don't have the freedom of movement apart from building and the ability to accommodate to the movements such as building movements, ground movements and straps. Thus there are cracks and openings in joint gaps among the panel in the course of time. In our invention GRC shell which forms the outer side of panel is fixed to the panel steel stude frame with flexible anchorage rods and panel stude frame is suitable for being fixed to the building tabliers with anchorage plates. For this reason when transition of movements of the building to the panel body, flexible anchorage rods bend and the panel is not effected by movements of the building.

BRIEF DESCRIPTION OF DRAWINGS

[0012] In practice GRC panels can vary depending on the architectural plan and subject of the application is described in more detail by the enclosed drawings which are presented just to explain the invention and have no intention to limit the scope of the invention. They have the following characteristics which form the invention.

Figure 1) An outside view of a finished window spaced panel. On the front view there is shown (A-A) plan section and (B-B) plan section which are going to be shown in next figures.

Figure 2) Inner detail view of panel in vertical (A-A) section.

a - building tabliers
 b - GRC shell
 c - Omega sectioned steel stude frame
 d - Flexible anchorage rods
 e - Pads connecting flexible anchorage rods to GRC shell inner surface 5
 f - Foam concrete filling
 g - foam concrete equipment straw steel
 h - anchorage plates in four comers of panel from which panel is going to be welded 10
 i - brace clamp welded to anchorage plate
 j - steel band screwed to building tabliers
 k - Joint gap isolation material (Polysulphit)
 m - brace clamp on which the above panel is going to be placed. 15

Figure 3) Inner detail view of panel in (B-B) vertical section:

a - building tabliers
 b - GRC shell
 c - Omega sectioned steel stude frame
 d - Flexible anchorage rods
 e - Pads connecting flexible anchorage rods to GRC shell inner surface 25
 f - Foam concrete filling
 g - foam concrete equipment straw steel
 h - anchorage plates in four comers of panel from which panel is going to be welded
 i - brace clamp welded to anchorage plate 30
 j - steel band screwed to building tablier
 k - Joint gap isolation material (Polysulphit)
 m - brace clamp on which the above panel is going to be placed 35

Figure 4) Section of panels connection section to building tablier.

a - building tabliers
 b - GRC shell
 c - Omega sectioned steel stude frame
 d - Flexible anchorage rods
 e - Pads connecting flexible anchorage rods to GRC shell inner surface
 f - Foam concrete filling 45
 g - foam concrete equipment straw steel
 h - anchorage plates in four comers of panel from which panel is going to be welded
 i - brace clamp welded to anchorage plate
 j - steel band screwed to building tablier 50
 k - Joint gap isolation material (Polysulphit)
 m - brace clamp on which the above panel is going to be placed 55

Figure 5) Flexible anchorage detail

c - Steel stude frame
 d - Flexible rod

e - GRC pad
 b - GRC shell
 n - the part which is going to provide flexibility by inclinations

Figure 6) View of steel stude frame on which there is flexible anchorage rods and anchorage plates on 4 corners:

c - Omega sectioned steel stude frame
 d - Flexible anchorage rods
 h - steel plates by which stude frame is going to be connected to building tabliers.

DETAILED DESCRIPTION OF INVENTION:

[0013] In GRC panel of the invention obtained by providing a composite product by joining two different elements which have different characteristics and use, advantages are obtained which are formed by joining characteristics of two elements and thus there is obtained novel self heat isolated, light and prefabricated GRC wallpanel.

[0014] In known state of the art Fiber reinforced cement is a type of cement which is formed by alkali resistant glass fiber and has the strength of reinforced cement-sand mortar, can be molded and can be casted in section thickness of 10-12 mm. On the other hand, foam concrete is a type of air foamed concrete that is obtained by foaming a foamer liquid chemical by an air generator and mixing this foam with cement mortar. Because of the air bubbles contained it provides perfect heat isolation, moreover it is light.

[0015] The present invention relates to a self heat isolated, light and prefabricated GRC wallpanel obtained by joining these two materials in a form of a panel and a method for producing this.

[0016] 10-12 mm thick GRC shell is formed (Figure 2,3-b) by spraying GRC mortar inside steel or glass fiber reinforced plastic (CTP) panel mold prepared according to the requested architectural form. Spraying of GRC mortar is done by concrete pump and spray guns built for this purpose.

[0017] Steel stude frame (Figure 2,3-c) (Figure 6) designed to provide wind load, essential weight etc. mechanic characteristics is going to be placed inside the formed GRC shell. On this stude frame there is placed flexible anchorage rods with 50 cm distance from each other. Also there is provided steel anchorage plates (Figure 2,3-h)(Figure 6-h) on four comers of steel stude frame which are going to be fixed to steel straps on the building. Thus, it is displaced inside steel stude frame GRC shell (b) which both carries the GRC and also the panel by fixing to building tablier. After this process flexible anchorage rods are padded to steel stude frame by GRC mortar (Figure 2,3,4-e)(Figure 5-e). One end of

these 6-10 mm section thick, 1-15 long flexible anchorage rods are fixed to steel stud frame and the other end is fixed to GRC shell. There is a 6-8 cm free section in between (Figure 5-c). This free section on the rod provides the flexibility. When there is a movement in the building and panel these flexible rods bend and prevent the movement from transmitting to the rigid section. As a result this causes the ground movements, building movements and tasman from being transmitted to the panel.

[0018] After placing flexible anchorage rods (Figure 6-d) and steel stud frame (Figure 6) containing mounting plates (Figure 6-h) into GRC shell and after each flexible anchorage rod is padded to GRC shell (Figure 2,3,4-e), a layer of straw steel is placed in order to function as a filling to the foam which will be poured into shell and prevent cracks and openings that may happen there, and is fixed from a few points to the steel stud frame (c). After this stage, panel is formed by putting foam concrete into GRC shell (Figure 2,3,5-f).

[0019] Panel is sent to curing chamber together with its mold, is taken out of the mold after the curing period and sent to construction area where it is going to be mounted.

Claims

1. Heat isolating, light and prefabricated wall panel comprising a glass fiber reinforced concrete shell (b), forming the outer side of the panel, an omega sectioned steel stud frame (c), suitable for being fixed to the Building tabliers with anchorage plates, placed inside said glass fiber reinforced concrete shell, and foamed concrete filling the shell, **characterised in that** said glass fiber reinforced concrete shell is fixed to said steel stud frame by means of flexible anchorage rods (d), wherein one end portion of said rods is fixed to said steel stud frame and the other end portion is fixed to said glass fiber reinforced concrete shell inner face by means of glass fiber reinforced concrete mortar pads and in which the portion between the ends is a free section that provides the flexibility.
2. Self heat isolated wall panel according to claim 1, in which said flexible anchorage rods are L-shaped elements.
3. Self heat isolated wall panel according to any preceding claims, in which said flexible anchorage rods are placed with 50 cm distance from each other.
4. Self heat isolated wall panel according to claim 1, in which said anchorage plates are placed on four corners of said steel stud frame and in which said anchorage plates are fixed on steel straps on the building tablier.

5. Self heat isolated wall panel according to claim 1, in which said foam concrete provides heat isolation.
6. Self heat isolated wall panel according to any preceding claims, in which the isolation values vary in the range of Lambda values between 0,065 and 0,500 and K values between 0,029 and 3,33.
7. Self heat isolated wall panel according to any preceding claims, in which layer of straw steel is placed on the steel stud frame as a filling of the foam concrete in order to prevent the possible cracks and openings on said foam concrete.
8. Self heat isolated wall panel according to any preceding claims, in which the panel thickness is about 10-15 cm.
9. Self heat isolated wall panel according to any preceding claims, in which the panel weight is 90-100 kg for each meter square.
10. Self heat isolated wall panel according to any preceding claims, in which any kind of architectural design form is given to the panel.
11. A method for producing a self heat isolated wall panel according to any preceding claims comprising the steps of:
 - a) preparing a steel or glass fiber reinforced plastic panel mould with desiderate architectural forms and designs;
 - b) spraying glass fiber reinforced concrete mortar into said panel mould and forming a 10-12 mm thick glass fiber reinforced concrete shell;
 - c) placing inside the formed glass fiber reinforced concrete shell a steel stud frame designed to provide wind load, particular weight and mechanical characteristics;
 - d) providing the steel stud frame with flexible anchorage rods with 50 cm distance from each other and providing the steel stud frame with anchorage plates on the four corners of the steel stud frame;
 - e) Padding the flexible anchorage rods to the inner face of the glass fiber reinforced concrete shell by means of glass fiber reinforced concrete mortar pads;
 - f) Placing a layer of straw steel on the steel stud frame;
 - g) Filling into the glass fiber reinforced concrete shell the foam concrete as to form the panel;
 - h) Sending the panel to the curing chamber inside the mould;
 - i) Removing the panel from the mould.

Patentansprüche

1. Wärmedämmendes, leichtes und vorgefertigtes Wandelement mit einer glasfaserverstärkten Betonschale (b), die die Außenseite des Wandelements bildet, einem einen Querschnitt in Form eines Omegas bzw. offenen Rechtecks aufweisenden Stahlstützrahmen (c), der mit Hilfe von Verankerungsplatten an den Gebäudefronten befestigt werden kann und sich innerhalb der glasfaserverstärkten Betonschale befindet, und Schaumbeton, der die Füllung der Schale bildet, **dadurch gekennzeichnet, dass:**
 - die glasfaserverstärkte Betonschale am Stahlstützrahmen durch flexible Verankerungsstangen (d) befestigt ist, wobei ein Endbereich der Stangen am Stahlstützrahmen und der andere Endbereich mittels aus glasfaserverstärktem Betonmörtel bestehenden Wülsten an der Innenfläche der glasfaserverstärkten Betonschale befestigt ist, und wobei zwischen den Enden ein freier Bereich entsteht, der für Flexibilität sorgt.
2. In sich wärmedämmendes Wandelement nach Anspruch 1, bei dem die flexiblen Verankerungsstangen L-förmige Elemente sind.
3. In sich wärmedämmendes Wandelement nach einem der vorhergehenden Ansprüche, bei dem die flexiblen Verankerungsstangen jeweils im Abstand von 50 cm zueinander angeordnet sind.
4. In sich wärmedämmendes Wandelement nach Anspruch 1, wobei die Verankerungsplatten an den vier Ecken des Stahlstützrahmens vorgesehen sind, und wobei die Verankerungsplatten an Stahlbändern auf der Gebäudefront befestigt sind.
5. In sich wärmedämmendes Wandelement nach Anspruch 1, bei dem der Schaumbeton zur Wärmedämmung dient.
6. In sich wärmedämmendes Wandelement nach einem der vorhergehenden Ansprüche, wobei die Isolierungswerte bei den Lambda-Werten zwischen 0,065 und 0,500 und bei den K-Werten zwischen 0,029 und 3,33 variieren.
7. In sich wärmedämmendes Wandelement nach einem der vorhergehenden Ansprüche, bei dem auf den Stahlstützrahmen eine Lage Baustahlmatte aufgebracht ist, die als Füllung für den Schaumbeton vorgesehen ist, um mögliche Risse und Öffnungen auf dem Schaumbeton zu verhindern.
8. In sich wärmedämmendes Wandelement nach ei-

nem der vorhergehenden Ansprüche, bei dem die Wanddicke ca. 15 cm beträgt.

9. In sich wärmedämmendes Wandelement nach einem der vorhergehenden Ansprüche, wobei das in sich wärmedämmende Wandelement ein Gewicht von ca. 90 bis 100 kg pro Quadratmeter hat.
10. In sich wärmedämmendes Wandelement nach einem der vorhergehenden Ansprüche, das in jeder beliebigen architektonischen Designform ausgebildet ist.
11. Ein Verfahren zur Herstellung eines in sich wärmedämmenden Wandelements nach einem der vorhergehenden Ansprüche, das die folgenden Schritte umfaßt:
 - a) Vorbereiten einer stahl- oder glasfaserverstärkten Wandelement-Kunststoffform mit der gewünschten architektonischen Designform;
 - b) Einsprühen von glasfaserverstärktem Betonmörtel in die Wandelement-Kunststoffform und dadurch Formen einer 10-12 mm dicken glasfaserverstärkten Betonschale;
 - c) Platzieren eines Stahlstützrahmens in das Innere der geformten glasfaserverstärkten Betonschale zur Bereitstellung von Windlast-, besonderer gewichtstechnischer und mechanischer Eigenschaften;
 - d) Versehen des Stahlstützrahmens mit flexiblen Verankerungsstangen in einem Abstand von jeweils 50 cm voneinander und Versehen des Stahlstützrahmens mit Verankerungsplatten in den vier Ecken des Stahlstützrahmens;
 - e) Anbringen der flexiblen Verankerungsstangen an der Innenfläche der glasfaserverstärkten Betonschale durch Wülste aus glasfaserverstärktem Betonmörtel;
 - f) Anbringen einer Lage Baustahlmatte auf dem Stahlstützrahmen;
 - g) Einfüllen des Schaumbetons in die glasfaserverstärkte Betonschale, um das Wandelement zu formen;
 - h) Einbringen des sich in der Form befindenden Wandelements in die Aushärtungskammer; und
 - i) Herausnehmen des Wandelements aus der Form.

Revendications

1. Panneau mural léger et préfabriqué, thermiquement isolant comprenant une coquille de béton renforcé par des fibres de verre (b), formant le côté extérieur du panneau, un châssis de montants en acier découpés en oméga (c), approprié pour être

- fixé aux tabliers d'un bâtiment avec des plaques d'ancrage placées à l'intérieur de ladite coquille en béton renforcé par des fibres de verre, et du béton mousse remplissant la coquille, **caractérisé en ce que** ladite coquille en béton renforcé par des fibres de verre est fixée audit châssis de montants en acier au moyen de tiges d'ancrage souples (d), où une première partie d'extrémité desdites tiges est fixée audit châssis de montants en acier et l'autre partie d'extrémité est fixée à ladite face inférieure de coquille en béton renforcé par des fibres de verre au moyen de supports de mortier en béton renforcé par des fibres de verre et où la partie entre les extrémités est une section libre qui confère la souplesse.
2. Panneau mural thermiquement isolant selon la revendication 1, dans lequel lesdites tiges d'ancrage souples sont des éléments en forme de L.
 3. Panneau mural thermiquement isolant selon l'une quelconque des revendications précédentes, dans lequel lesdites tiges d'ancrage souples sont placées à 50 cm de distance les unes des autres.
 4. Panneau mural thermiquement isolant selon la revendication 1, dans lequel lesdites plaques d'ancrage sont placées aux quatre coins dudit châssis de montants en acier et dans lequel lesdites plaques d'ancrage sont fixées sur des étriers en acier du tablier du bâtiment.
 5. Panneau mural thermiquement isolant selon la revendication 1, dans lequel ledit béton mousse confère l'isolation thermique.
 6. Panneau mural thermiquement isolant selon l'une quelconque des revendications précédentes, dans lequel les valeurs d'isolation varient dans la plage de valeurs de λ entre 0,065 et 0,500 et de valeurs K entre 0,029 et 3,33.
 7. Panneau mural thermiquement isolant selon l'une quelconque des revendications précédentes dans lequel une couche de grillage métallique est placée sur le châssis de montants en acier en tant que charge du béton mousse de manière à empêcher les éventuelles fissures et ouvertures sur ledit béton mousse.
 8. Panneau mural thermiquement isolant selon l'une quelconque des revendications précédentes dans lequel l'épaisseur du panneau est d'environ 10 à 15 cm.
 9. Panneau mural thermiquement isolant selon l'une quelconque des revendications précédentes dans lequel la masse du panneau est de 90 à 100 kg par mètre carré.
 10. Panneau mural thermiquement isolant selon l'une quelconque des revendications précédentes dans lequel tout type de forme de conception architecturale est donné au panneau.
 11. Procédé de production d'un panneau mural thermiquement isolant selon l'une quelconque des revendications précédentes comprenant les étapes consistant à :
 - a) préparer un moule de panneau en acier ou en matière plastique renforcée par des fibres de verre présentant les formes et conceptions architecturales désirées,
 - b) pulvériser un mortier de béton renforcé par des fibres de verre dans ledit moule de panneau et former une coquille de béton renforcé par des fibres de verre épaisse de 10 à 12 mm,
 - c) placer à l'intérieur de la coquille de béton renforcé par des fibres de verre formée un châssis de montants en acier conçu pour résister à la charge du vent et conférer un poids particulier et des caractéristiques mécaniques,
 - d) munir le châssis de montants en acier de tiges d'ancrage souples espacées de 50 cm les unes des autres et munir le châssis de montants en acier de plaques d'ancrage aux quatre coins du châssis de montants en acier,
 - e) recevoir les tiges d'ancrage souples sur la face intérieure de la coquille de béton renforcé par des fibres de verre au moyen de supports de mortier de béton renforcé par des fibres de verre,
 - f) placer une couche de grillage métallique sur le châssis de montants en acier,
 - g) charger le béton mousse dans la coquille de béton renforcé par des fibres de verre de manière à former le panneau,
 - h) envoyer le panneau à la chambre de durcissement à l'intérieur du moule,
 - i) ôter le panneau du moule.

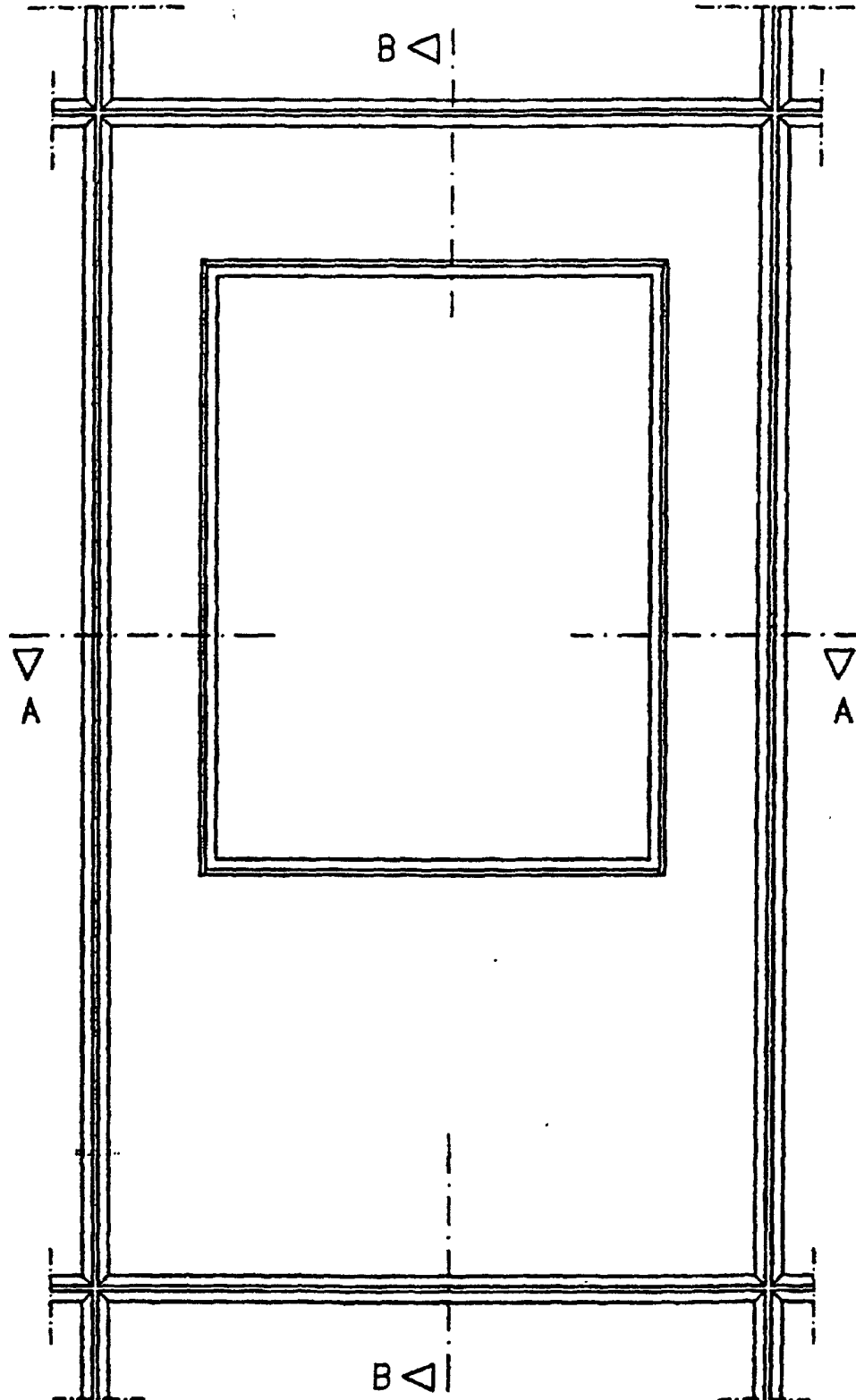


FIGURE-1

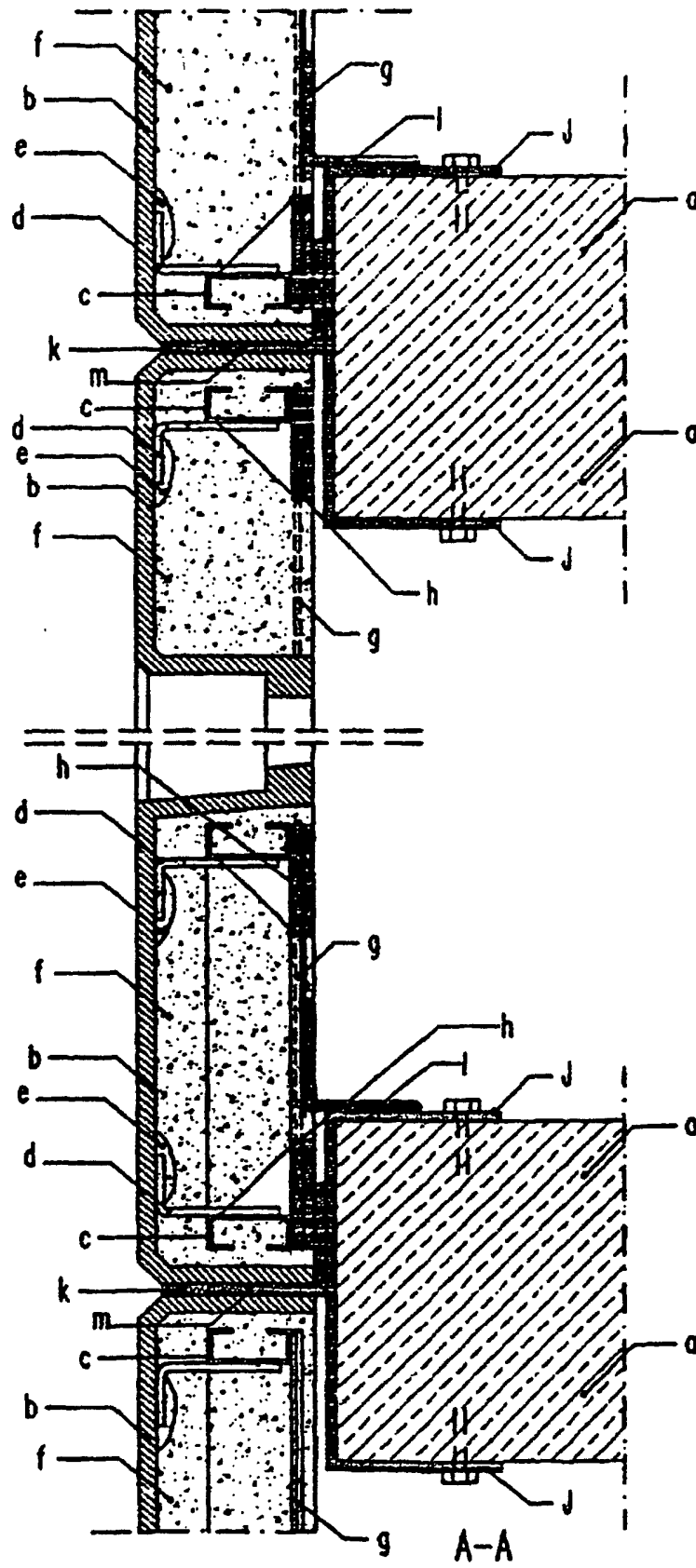
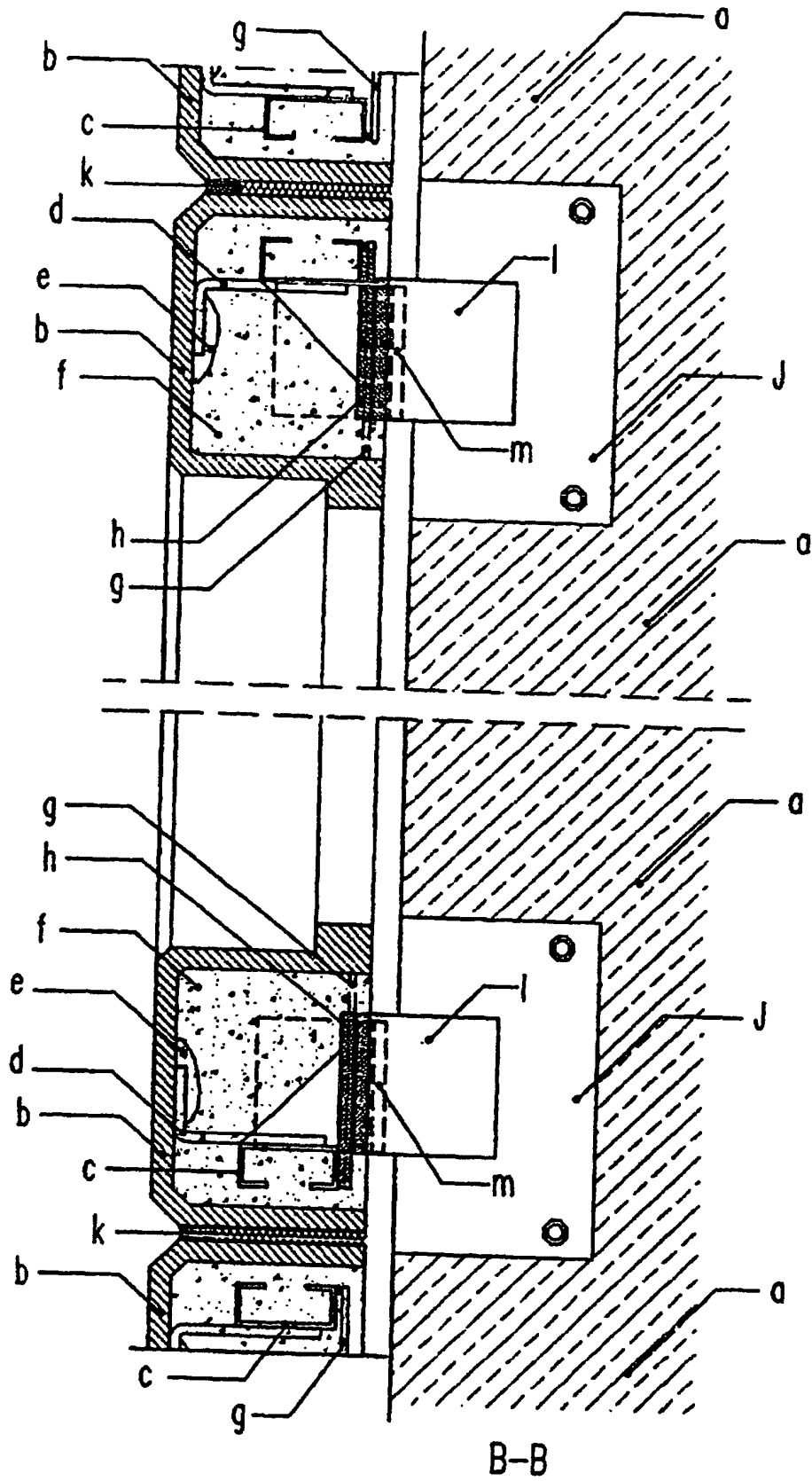
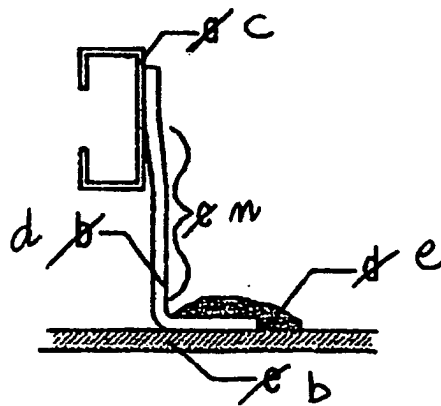
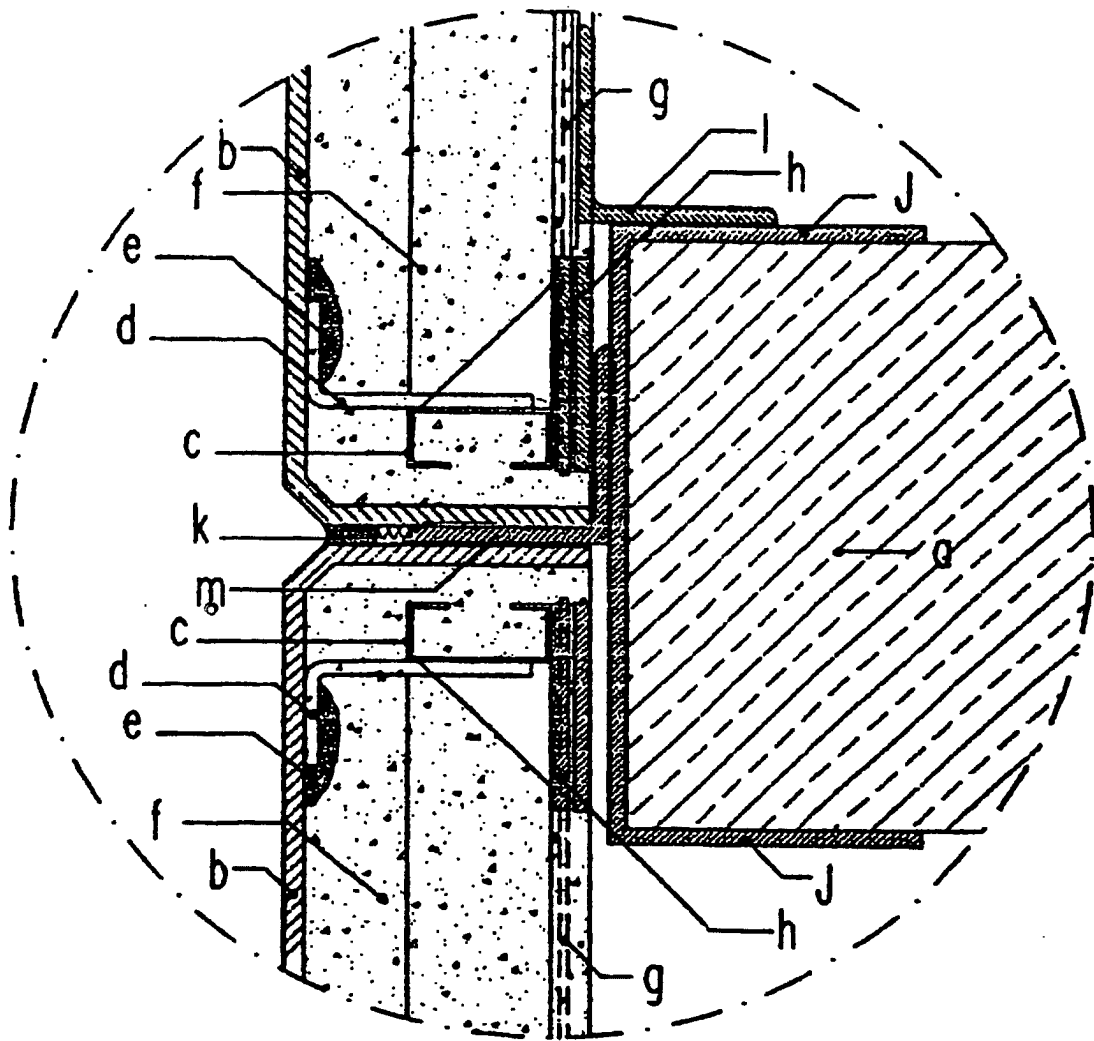


FIGURE-2





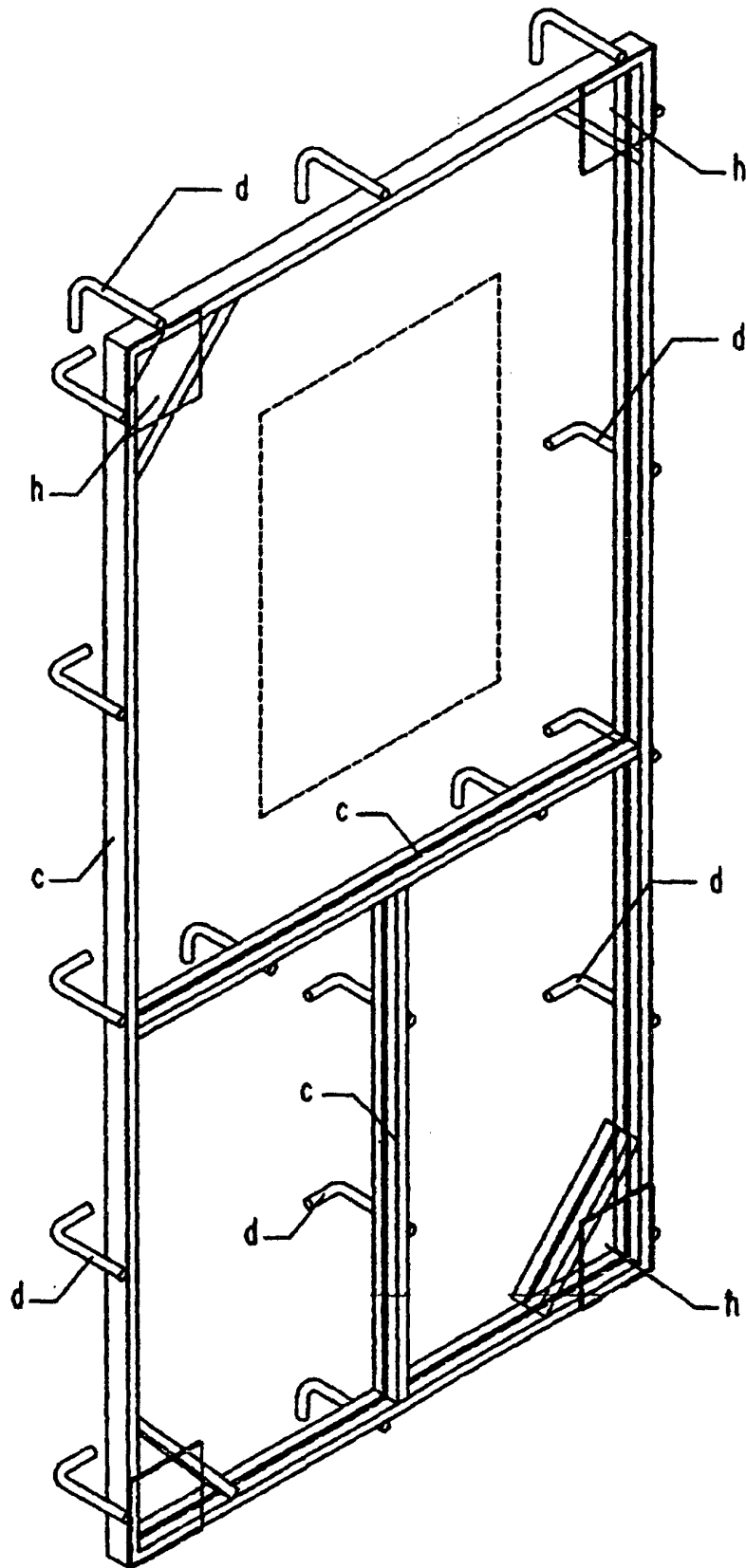


FIGURE-6