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(54) **REINFORCEMENT OF SANDWICH LOAD CARRYNG PANEL**

VERSTÄRKUNG EINES LASTTRAGENDEN SANDWICH PANEELS

RENFORT DE PANNEAU PORTEUR DE CHARGE DE TYPE SANDWICH

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(56) References cited:

WO-A-96/06241 US-A- 3 037 589
US-A- 3 204 324 US-A- 4 370 828

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Description

Field of technology

[0001] Sandwich load carrying panel, reinforcement of sandwich load carrying panel, load carrying frame, attachment of sandwich load carrying panels, heat transfer, fire safety.

Description of technical problem

[0002] Cutouts in construction sandwich load carrying panels, or construction panels cause mechanical properties of sandwich load carrying panels to significantly deteriorate. Due to this problems the sandwich load carrying panels must be reinforced on weak points which is usually carried out with sub-frames of various materials or reduction of distances between supports of sandwich load carrying panels.

[0003] The present solution is solving technical problem of reinforcement of construction sandwich load carrying panels weakened due to cutouts in panels whereas the invention is technically simple and affordable. Invented reinforcement of sandwich load carrying panels does not cause additional heat loss, does not cause deterioration of fire safety and at the same time it is appropriate fundament for quality building of windows, doors and other elements of construction elements, air ducts ...

State of the art

[0004] The solutions currently available for cutouts of sandwich load carrying panels do not offer solutions by the manufacturers of sandwich load carrying panels to improve mechanical properties deteriorated due to cutouts (e.g. due to windows, doors, ...).

[0005] US 3,037,589 shows the panel (wall) according to the preamble of claim 1 having inner metal skin and outer metal skin, and insulation filler between them which may be of any suitable light weight insulation material

[0006] So far the manufacturers of sandwich load carrying panels have been forwarding information to buyers or assembly crews that appropriate sub-frame has to be constructed of steel, aluminum or similar beams of any material capable of load carrying said panel cannot sustain due to cutout..

[0007] Construction of sub-frame in so far known solutions requires knowledge of additional horizontal (or vertical) beams for attaching of edge of cutout of sandwich load carrying panel whereas this sub-frame is usually covered with decorative edge. From the inner side this sub-frame can usually be seen and usually bothersome for the buyer.

[0008] During past years much research was done on influence of size and form of cutout on loss of load carrying capacity of sandwich load carrying panels. For that purpose several experiments were carried out in various institutions, universities and companies. The computa-

tions are usually performed using differential or integral numerical methods (finite element method, finite difference method, finite volume method, boundary element method ...) whereas finite element method can be found most frequently.

[0009] The basic criteria for said experiments and computations are in particular:

- loss of load carrying capacity from viewpoint of bending stress needed to be taken over by sandwich load carrying panels and causing deformation in attachment point (where failure occurs), and
- problem of limiting load carrying capacity due to failure on middle support-buckling of lower metal sheet (due to stress due to various temperatures the sandwich load carrying panels deforms itself and buckles on middle support-therefore fails)

[0010] In the literature several publications can be found for determining various factors and limitations during use of sandwich load carrying panels with cutouts, however, with no shown solutions for increase of load carrying capacity of panels weakened by cutouts. In particular cases were analyzed, deformations determined and failure locations shown for simulation of various loads on different sandwich load carrying panels.

Description of new solution

[0011] Described invention shows reinforcement of sandwich load carrying panel or construction panel by replacing visible sub-frame with a frame built into the sandwich load carrying panel as defined in claim 1.

[0012] This invention relates to system of strengthening or self-carrying sandwich panel on weakened spots. Typical weakening is cutout in said panel for building in of windows, doors, air ventilation needs, or general penetrations. The system shown in this application has significantly increased load carrying capability deteriorated due to cutout of part of sandwich load carrying structure whereas the sandwich panel is comprise of two thin load carrying covering layers and soft shear carrying core. The outer layers may be of different materials, for example of any metal sheet or thin layer of carbon fiber or glass fiber with joining polymer material. The core can be comprised of various materials such as for example polyurethane foam, mineral wool, glass wool, honeycomb or any other preferred insulation filling.

[0013] Self carrying sandwich panels may be straight, bent, finned or designed in any other manner which does not limit the scope of this invention. In addition, the essence of this invention is not limited by form of weakening or cutout.

[0014] As far as cutout stress is concerned the reinforcement is performed in such a fashion to take over as much as basic load as possible. In this invention presented reinforcement of sandwich load carrying panel takes over at least 80% of basic load. The reinforcement frame

should not be too rigid as this would result in inability to bent partially with sandwich load carrying panel. If the frame is appropriately slim (i.e. correctly rigid) this is beneficial as the whole system operates similarly to sandwich load carrying panel which bends during loading and returns in initial position. If the frame would be too rigid this would mean particularly problematic situation for confection between frame and sandwich load carrying panel and for failure of glue due to large local shear stress. On the other side too rigid frame would result in higher investment in material for the frame (costs).

[0015] For correct embodiment of solution shown in this application of reinforcement of sandwich load carrying panel is of particular relevance choice of frame of appropriate elasticity so the frame partially takes over the loads and behaves under these loads similarly to sandwich load carrying panel of full cross-section.

[0016] With building in the frame there is reduced transfer of load onto the neighboring load carrying panels which favors allowable distances between supports which have been preselected based on experiments for each type of product and system of built (single field, two field, several field). With solution as shown one may use tables of allowable distances and static calculations also for sandwich load carrying panels with cutouts as the system is known and can be officially recognized using standardized tests as statically verified system.

[0017] Solution as shown in this invention also satisfies requirements of construction physics:

no heat bridges, satisfies requirements for fire safety etc. In addition the invention shows reinforcement of sandwich load carrying panels as appropriate foundation for quick and quality assembly of construction elements and ventilation or air conditioning units into said panels.

[0018] Typical examples of use of said reinforcement of sandwich load carrying panels are cutouts for insertion of windows or doors whereby on each panel one or several cutouts can be made.

[0019] Below the essence of invention is presented in more detail with description of preferred embodiments and attached figures whereby the figures form part of this patent application and show:

Figure 1 shows sandwich load carrying panel 1 not forming part of the invention reinforcement frame 2, load carrying cover layer 3, shear carrying core 4, insulation interface 5.

Figure 2 shows sandwich load carrying panel 1, reinforcement frame 2, load carrying cover layer 3, shear carrying core 4, insulation interface 5.

Figure 3 shows reinforcement frame 2, load carrying cover layer 3, shear carrying core 4, glue 6.

Figure 4 shows sandwich load carrying panel 1, reinforcement frame 2, load carrying cover layer 3, shear carrying core 4, insulation interface 5, connecting load carrying element 7.

Figure 5 shows reinforcement frame 2, load carrying cover layer 3, shear carrying core 4, insulation interface 5, attachment element 8.

Figure 6 shows reinforcement frame 2, load carrying cover layer 3, shear carrying core 4, connecting load carrying element 7, attachment element 8.

[0020] As shown in fig. 1 sandwich load carrying panel 1 not forming part of the invention is comprised of two thin load carrying cover layers 3 and shear carrying core (filling core) 4. Through sandwich load carrying panel 1 there is penetration or cutout (for insertion of construction elements, for need of ventilation ...) whereby the load carrying capacity of said panel 1 is significantly lowered. To increase load carrying capacity of weakened sandwich load carrying panel 1 there are reinforcement 2 glued on both sides on load carrying cover layers 3 using glue 6 (figure 3), said reinforcements 2 interconnected with interfaces capable of carrying shear, preferably insulation interfaces - bridges 5. Necessary number of insulation interfaces - bridges 5 depends on size and form of said cutout. Part of load is transferred onto glued reinforcements which would otherwise be carried by cutout part of the sandwich load carrying panel 1. Each of reinforcements 2 forms axially and bending stress resistant frame which is formed according to shape of penetration. Each of reinforcements 2 is glued along the edges of cutout onto respective load carrying cover layer 3 of sandwich load carrying panel 1. With gluing the continuous transfer of load from thin load carrying cover layer 3 onto reinforcement 2 is achieved.

[0021] The embodiment in figure 2 shows each of sandwich load carrying panels 1 is comprised of two thin load carrying cover layers 3 and shear carrying core (filler core) 4. Through sandwich load carrying panel 1 there is penetration or cutout (for insertion of construction elements, for need of ventilation ...) whereby the load carrying capacity of said panel 1 is significantly lowered. To increase load carrying capacity of weakened sandwich load carrying panel 1 there are reinforcement 2 glued on both sides on load carrying cover layers 3 using glue 6 (figure 3), said reinforcements 2 interconnected with interfaces capable of carrying shear, preferably insulation interfaces - bridges 5. Necessary number of insulation interfaces - bridges 5 depends on size and form of said cutout. Part of load is transferred onto glued reinforcements which would otherwise be carried by cutout part of the sandwich load carrying panel 1. In case of weakened point (cutout) which is performed or extended into two or more panels said sandwich load carrying panels 1 are interconnected using connecting load carrying elements 7 (fig. 4), and attached using attachment elements 8.

ments 8. Said attachment elements 8 may be screws, rivets or any other attachment elements, however, attachment can be also achieved using any other means (gluing, soldering ...) which does not limit the scope of this invention. By using two or more sandwich load carrying panels 1 each of reinforcements 2 forms axially and bending stress resistant frame which is formed according to shape of penetration. Each of reinforcements 2 is glued along the edges of cutout onto respective load carrying cover layer 3 of sandwich load carrying panel 1. With gluing the continuous transfer of load from thin load carrying cover layer 3 onto reinforcement 2 is achieved.

[0022] For interconnection of reinforcements glued on both sides of sandwich load carrying panel 1 used insulation interfaces are thermal insulating resulting in prevention of establishment of heat bridges.

[0023] The subject of this invention relates also on cutouts where particular side of cutout does not border on sandwich load carrying panel (such as for example assembly or insertion of doors) which does not limit the scope of this invention.

[0024] For gluing of reinforcement 2 onto sandwich load carrying panel 1 glue 6 is used with shear module larger than 10 MPa and adhesiveness larger than 5 MPa.

[0025] Use of invention according to this application results in significant reduction in use of materials and at the same time in improving of aesthetics of sandwich load carrying panels as opposed to currently used subframes.

[0026] It is self evident that the invention as described herein can be used in different embodiment which does not alter the essence of this invention limited by the subsequent claims.

Claims

1. A reinforced sandwich load carrying panel (1) comprising reinforcement frames (2), cover layers (3), a core (4), insulation interfaces (5), said cover layers (3) are two thin load carrying cover layers (3), and said core (4) is a shear carrying core (4), and said sandwich load carrying panel (1) is comprising weakenings such as penetration or cutout, wherein to increase load carrying capacity of said weakened sandwich load carrying panel (1) there are Z reinforcement frames (2) glued on both sides of said sandwich load carrying panel (1) onto said thin load carrying cover layers (3) using glue (6), said reinforcement frames (2) interconnected to each other with insulation interfaces (5) capable of carrying shear,
characterized in that
said weakenings of two or more of said sandwich load carrying panels (1) are interconnected using connecting load carrying elements (7); and attached one to another using attachment elements (8).

2. Panel according to claim 1, **characterized in that** the reinforcement frames (2) of load carrying panel (1) carry at least 80% of basic load.

3. Panel according to any of claims 1 to 2, **characterized in that** the reinforcement frames are appropriately elastic in order to partially take over loads and behaves under these loads similarly as sandwich load carrying panel of full cross section.

4. Panel according to any of claims 1 to 3, **characterized in that** using of built-in reinforcement frames reduces transfer of load onto adjacent sandwich load carrying panels whereby the allowable distances between supports can be kept, said allowable distances determined for each type of product and system of assembly.

5. Panel according to any of claims 1 to 4, **characterized in that** the reinforcement frames have such rigidity to bend along with sandwich load carrying panel and returns into original position after load has ceased.

6. Panel according to any of claims 1 to 5, **characterized in that** each of reinforcement frames (2) is glued along the edges of said cutout onto respective load carrying cover layer (3) of said sandwich load carrying panel (1).

7. Panel according to any of claims 1 to 6, **characterized in that** each of reinforcement frames (2) forms axially and bending stress resistant frame which is formed according to shape of penetration.

8. Panel according to any of claims 1 to 7, **characterized in that** for gluing of reinforcement frames (2) onto sandwich load carrying panel (1) glue (6) is used with shear module larger than 10 MPa and adhesiveness larger than 5 MPa.

9. Panel according to any of claims 1 to 8, **characterized in that** interfaces for shear carrying interconnection of reinforcement frames (2) of sandwich load carrying panels (1) are made of thermal insulation material.

10. Panel according to any of claims 1 to 9, **characterized in that** number of said interfaces depend on number and shape of cutouts.

11. Panel according to any of claims 1 to 10, **characterized in that** each panel can feature one or more cutouts.

Patentansprüche

1. Verstärktes lasttragendes Sandwich Paneel (1), das Verstärkungsrahmen (2), Deckschichten (3), einen Kern (4), Isolierschnittstellen (5) umfasst, wobei die Deckschichten (3) zwei dünne lasttragende Deckschichten (3) sind und wobei der Kern (4) ein Schertragender Kern (4) ist und wobei das lasttragende Sandwich Paneel (1) Schwächungen wie Durchdringungen oder Ausschnitte umfasst, wobei es zum Erhöhen der lasttragenden Kapazität des geschwächten lasttragenden Sandwich Paneels (1) Verstärkungsrahmen (2) aufweist, die an die dünnen lasttragenden Deckschichten (3) an beiden Seiten des lasttragenden Sandwich Paneels (1) mit Klebstoff (6) befestigt sind, wobei die Verstärkungsrahmen (2) miteinander durch Isolierschnittstellen (5) verbunden sind, die in der Lage sind, Scher zu tragen, **dadurch gekennzeichnet, dass** die Schwächungen von zwei oder mehreren der lasttragenden Sandwich Paneele (1) miteinander durch verbindungslasttragende Elemente (7) verbunden sind und durch Bindungselemente (8) aneinander befestigt sind.
2. Paneel nach Anspruch 1, **dadurch gekennzeichnet, dass** die Verstärkungsrahmen (2) des lasttragenden Paneels (1) zumindest 80 % der Grundlast tragen.
3. Paneel nach einem der Ansprüche 1 bis 2, **dadurch gekennzeichnet, dass** die Verstärkungsrahmen angemessen elastisch sind, um teilweise Last zu übernehmen, und sich unter dieser Last ähnlich wie ein lasttragendes Sandwich Paneel mit vollständigem Querschnitt verhalten.
4. Paneel nach einem der Ansprüche 1 bis 3, **dadurch gekennzeichnet, dass** die Anwendung der eingebauten Verstärkungsrahmen den Lasttransfer auf benachbarte lasttragende Sandwich Paneele reduziert, wobei die zulässige Distanz zwischen Stützen eingehalten werden kann, wobei die zulässige Distanz für jeden Produkttyp und jede Art des Montagesystems bestimmt wird.
5. Paneel nach einem der Ansprüche 1 bis 4, **dadurch gekennzeichnet, dass** die Verstärkungsrahmen eine solche Rigidität aufweisen, dass sie sich entlang des lasttragenden Sandwich Paneels biegen und nach der Belastung wieder in die Ursprungsposition zurückgehen.
6. Paneel nach einem der Ansprüche 1 bis 5, **dadurch gekennzeichnet, dass** jeder der Verstärkungsrah-

men (2) entlang der Ausschnittkanten auf die jeweilige lasttragende Deckschicht (3) des lasttragenden Sandwich Paneels (1) mit Klebstoff befestigt ist.

7. Paneel nach einem der Ansprüche 1 bis 6, **dadurch gekennzeichnet, dass** jeder der Verstärkungsrahmen (2) einen axial belastbaren und biege-resistenten Rahmen bildet, der nach der Form der Durchdringung gebildet ist.
8. Paneel nach einem der Ansprüche 1 bis 7, **dadurch gekennzeichnet, dass** zum Kleben der Verstärkungsrahmen (2) auf das lasttragende Sandwich Paneel (1) Klebstoff (6) mit einem Schermodul größer als 10 MPa und einem Haftvermögen größer als 5 MPa verwendet wird.
9. Paneel nach einem der Ansprüche 1 bis 8, **dadurch gekennzeichnet, dass** die Schnittstellen für scherttragende Verbindungen der Verstärkungsrahmen (2) der lasttragenden Sandwich Paneele (1) aus thermischem Isoliermaterial bestehen.
10. Paneel nach einem der Ansprüche 1 bis 9, **dadurch gekennzeichnet, dass** die Anzahl der Schnittstellen von der Anzahl und Form der Ausschnitte abhängt.
11. Paneel nach einem der Ansprüche 1 bis 10, **dadurch gekennzeichnet, dass** jedes Paneel einen oder mehrere Ausschnitte umfassen kann.

Revendications

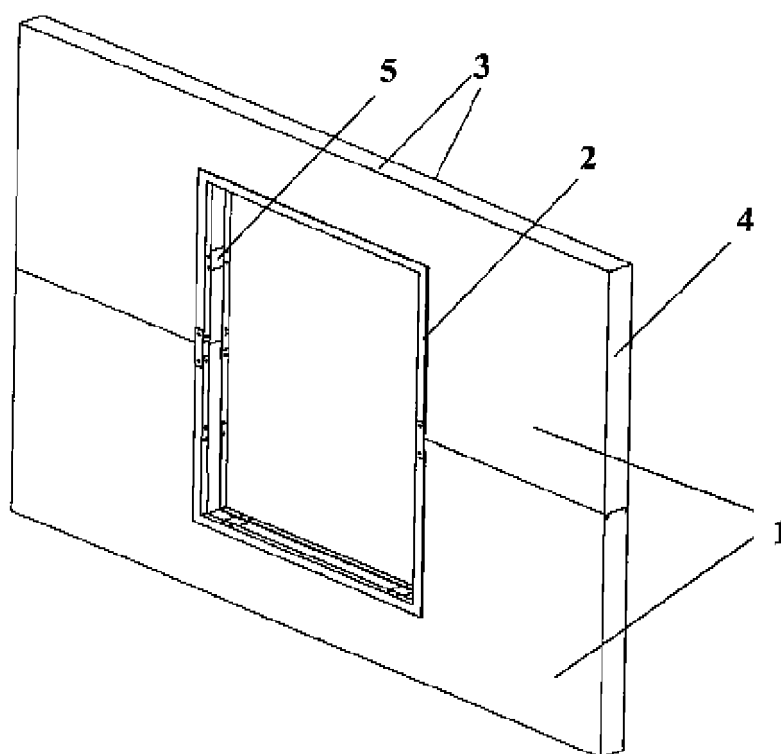
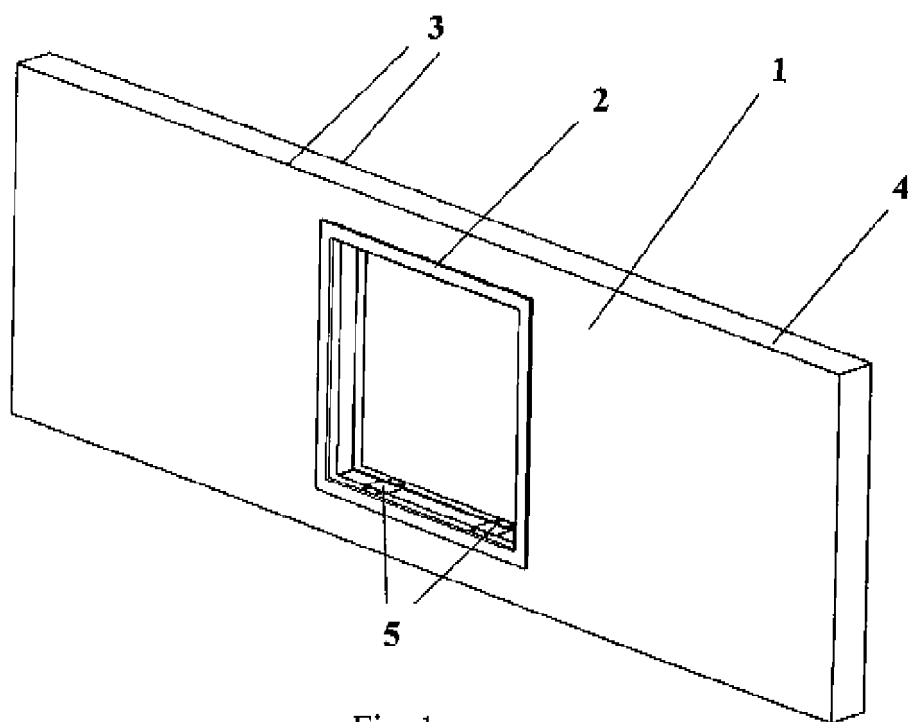
1. Panneau sandwich de support de charge (1) renforcé comprenant des cadres de renfort (2), des couches de revêtement (3), une âme (4), des interfaces isolantes (5), lesdites couches de revêtement (3) étant constituées de deux fines couches de revêtement (3) de support de charge, et ladite âme (4) étant une âme (4) supportant le cisaillement, et ledit panneau sandwich de support de charge (1) comprenant des parties d'affaiblissement telles qu'une pénétration ou une découpe, dans lequel, pour augmenter la capacité de support de charge dudit panneau sandwich de support de charge (1) affaibli, des cadres de renfort (2) sont collées des deux côtés dudit panneau sandwich de support de charge (1) sur lesdites fines couches de revêtement (3) de support de charge au moyen d'une colle (6), lesdits cadres de renfort (2) étant reliés les uns aux autres au moyen d'interfaces isolantes (5) pouvant supporter le cisaillement, **caractérisé en ce que** lesdites parties d'affaiblissement desdits deux panneaux sandwichs de support de charge (1), ou plus,

sont reliées les unes aux autres au moyen d'éléments (7) de support de charge de liaison, et sont fixées les unes aux autres au moyen d'éléments de fixation (8).

2. Panneau selon la revendication 1, **caractérisé en ce que** les cadres de renfort (2) du panneau de support de charge (1) supportent au moins 80 % de charge de base. 5
3. Panneau selon l'une quelconque des revendications 1 et 2, **caractérisé en ce que**, de façon appropriée, les cadres de renfort sont élastiques afin de supporter partiellement des charges et de se comporter sous ces charges de la même manière qu'un panneau sandwich de support de charge de section transversale totale. 10 15
4. Panneau selon l'une quelconque des revendications 1 à 3, **caractérisé en ce que** l'utilisation de cadres de renfort intégrés diminue le transfert de charge sur des panneaux sandwichs de support de charge adjacents, ce qui permet de maintenir les distances admissibles entre les supports, lesdites distances admissibles étant déterminées pour chaque type de produit et de système d'assemblage. 20 25
5. Panneau selon l'une quelconque des revendications 1 à 4, **caractérisé en ce que** les cadres de renfort ont une rigidité telle qu'ils fléchissent conjointement avec le panneau sandwich de support de charge et reprennent leur position originale lorsque la charge n'est plus appliquée. 30
6. Panneau selon l'une quelconque des revendications 1 à 5, **caractérisé en ce que** chacun des cadres de renfort (2) est collé le long des bords de ladite découpe sur une couche de revêtement (3) de support de charge respective dudit panneau sandwich de support de charge (1). 35 40
7. Panneau selon l'une quelconque des revendications 1 à 6, **caractérisé en ce que** chacun des cadres de renfort (2) forme un cadre résistant aux contraintes axiales et de flexion qui est formé conformément à la forme de pénétration. 45
8. Panneau selon l'une quelconque des revendications 1 à 7, **caractérisé en ce que**, pour le collage des cadres de renfort (2) sur le panneau sandwich de support de charge (1), il convient d'utiliser une colle (6) ayant un module de cisaillement supérieur à 10 MPa et une adhésivité supérieure à 5 MPa. 50
9. Panneau selon l'une quelconque des revendications 1 à 8, **caractérisé en ce que** des interface de liaison de support de cisaillement entre cadres de renfort (2) de panneaux sandwichs de support de charge 55

(1) sont constituées d'un matériau thermo-isolant.

10. Panneau selon l'une quelconque des revendications 1 à 9, **caractérisé en ce que** le nombre desdites interfaces dépend du nombre et de la forme de découpes.
11. Panneau selon l'une quelconque des revendications 1 à 10, caractérisé en ce que chaque panneau peut être **caractérisé par** une ou plusieurs découpes.



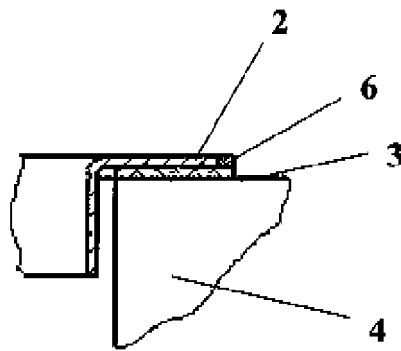


Fig. 3

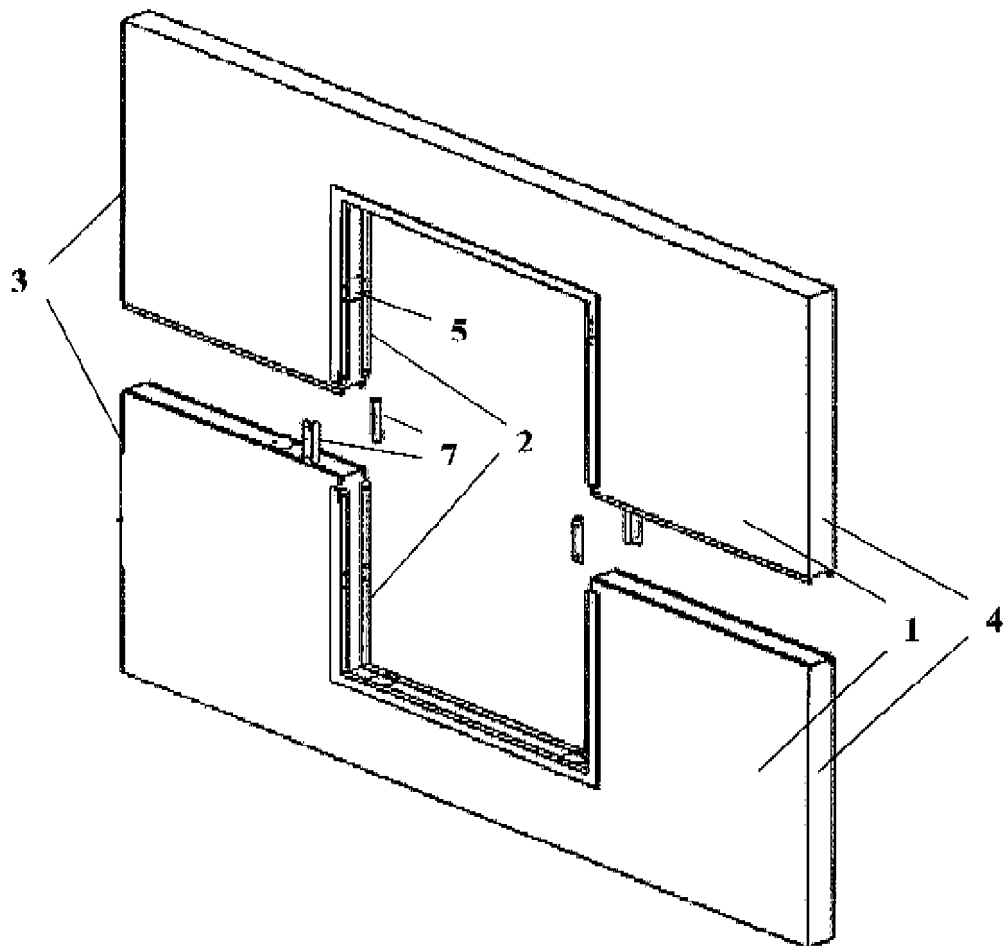


Fig. 4

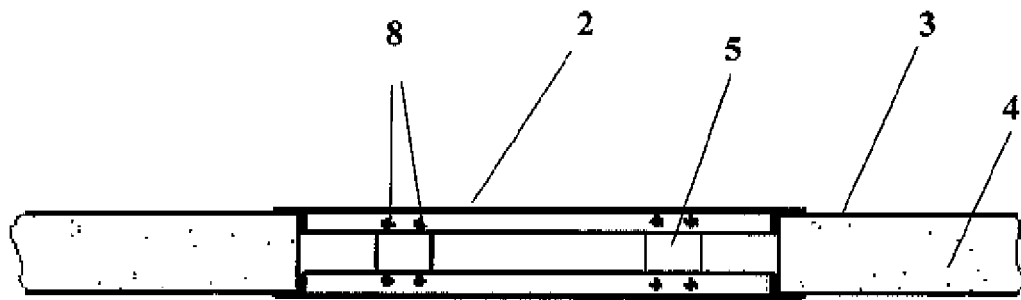


Fig. 5

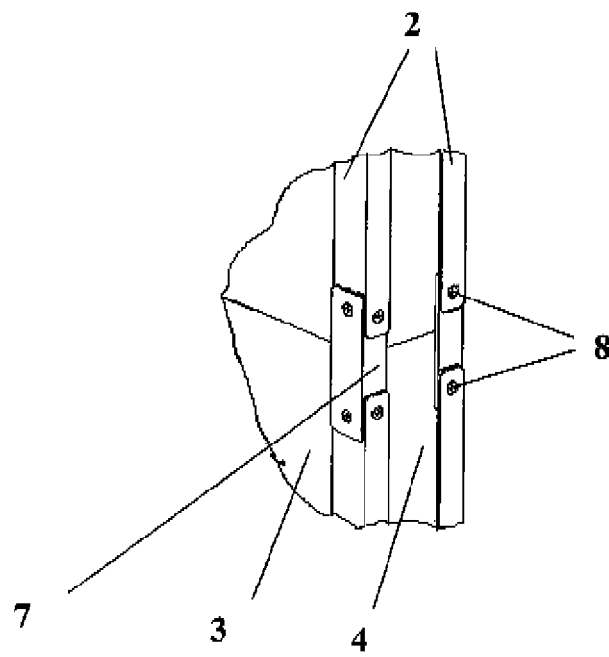


Fig. 6

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 3037589 A [0005]