(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 189 612 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
26.05.2010 Bulletin 2010/21

(51) Int Cl.:
E06B 3/82 *(2006.01)* ***E06B 5/16*** *(2006.01)*

(21) Application number: **09252670.6**

(22) Date of filing: **24.11.2009**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO SE SI SK SM TR
Designated Extension States:
AL BA RS

(30) Priority: **24.11.2008 GB 0821451**

(71) Applicant: **NAN YA PLASTICS CORPORATION**
Taipei (TW)

(72) Inventor: **Chen Wang, Kuei-Yung**
Taipei (TW)

(74) Representative: **Carpmael, Robert Maurice Charles**
Marks & Clerk LLP
90 Long Acre
London WC2E 9RA (GB)

(54) A fireproof door panel structure

(57) The invention relates to a fireproof door panel (30) comprising a front surface plate (31) and a rear surface plate (32) formed as door leafs, a quadrilateral frame (33, 34, 35, 36) formed as a door frame, one or more sealing members (37) formed as outer edge sealing structures and a core material (40) formed as an inner sandwich structure, wherein the core material (40) possesses an excellent fire retardance and is made of material such as perlite plate, calcium silicate, wood or the single material of phenolic resin, chemical synthetic resin or composite plate. If the door is on fire, the core material (40) of the fireproof door blocks the fire, keeps the fire outside the room and prevents the flame from passing and spreading across the fireproof door.

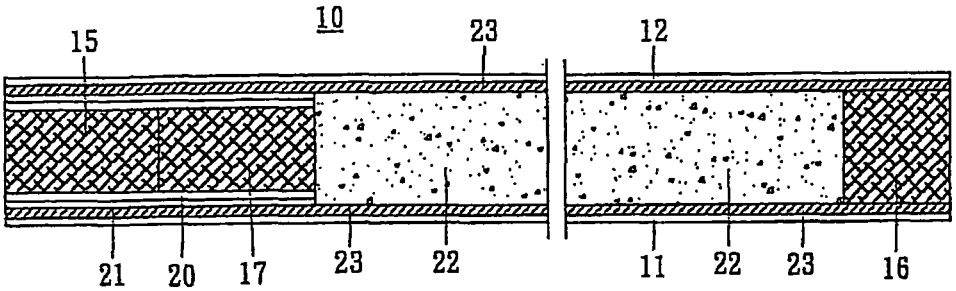

FIG. 1

EP 2 189 612 A2

Description

BACKGROUND OF THE PRESENT INVENTION

1. Field of the Present Invention

[0001] The invention relates to a fireproof door panel, particularly to a fireproof door panel structure having a polyurethane (PU) foam, or phenolic resin, or perlite plate or calcium silicate plate as its core material.

2. Description of Prior Art

[0002] Normally the fireproof structure of the conventional door panel is constructed by filling the inner side of the door panel with fireproof material such as foamed phenolics to form a solid door panel which can provide a fireproof effect by fire retardance of the foamed phenolics. When the door panel is on fire, even if the surface layer of the door panel is burned into ash the fire retardant material inside the door panel can still develop fireproof effect or the effect of blocking the fire out of the room and prevent the fire from spreading across the fireproof door.

[0003] The fireproof structure shown in Figs. 1 and 2 is a conventional plate type door panel 10 which is formed by covering the inner side of the surface plate 11, 12 with two magnesium oxide plates 23 having the same size as the surface plate 11, 12, and then filling the inner side of the door panel 10 with foamed phenolics 22. When the door panel 10 is on fire, the effect of blocking the fire out of the room is developed by the fire retardance of the foamed phenolics 22 and the magnesium plate 23.

[0004] However, an upper rail 13, a lower rail 14, a left stile 15 and a right stile 16 of the conventional plate type door panel 10 are mostly made of PVC foamed material, plastic injection forming material or wood. When the door is on fire, the PVC foamed material, plastic injection forming material and wood all are unable to resist fire, and are apt to burning, so that licking flames can run into the room through the gap between the door panel 10 and the doorframe due to the deformation or burning out of the door panel 10 caused by fire. Consequently, though the conventional type door panel 10 has adopted the fire retardance material such as foamed phenolics 22 and magnesium oxide plate 23, or even further adopts knob reinforcing material 17, heat insulating plate 20 or reinforcing material 21 etc., there is room for further improvement of fireproof property of the conventional type door panel 10.

SUMMARY OF THE INVENTION

[0005] In view of the above-mentioned drawbacks of the conventional type door panel, it is an object of the invention to seek to mitigate them.

[0006] According to the invention there is provided a fireproof door panel structure, comprising a front surface plate and a rear surface plate formed as door leafs, a quadrilateral frame formed as a door frame, one or more sealing members formed as outer edge sealing structures and a core material formed as an inner sandwich structure, **characterized in that** the core material is formed by one or more of phenolic resin, perlite, calcium silicate or wood composite plate.

[0007] Thus in a door panel of a first aspect of the present invention, the structure comprises a front surface plate and a rear surface plate as door leafs, an upper rail, a lower rail, a left stile and a right stiles formed as a quadrilateral frame of the door panel and sandwich core materials to fill up the hollow of the door panel therein, and the core material is provided with excellent fire retardance and formed by phenolic resin, perlite plate, calcium silicate plate or wood composite plate.

[0008] In use of the invention if the door panel is on fire, the core material of the door panel can block the fire, prevent the fire from burning into the room and provide the effect of preventing the fire from spreading or burning across the door panel.

[0009] An improvement of the fireproof door panel of the invention may include having the front surface plate and the rear surface plate of the door panel made of SMC, BMC or FRP material of which the inner surface is covered with glass-fibre cloth, glass-fibre net or carbon-fibre cloth to form a flat type door panel with plane surface or the door panel carrying a rugged panel pattern.

[0010] A further improvement of the fireproof door panel of the invention may include having the quadrilateral frame of the door panel made of hard PVC, foamed PVC, PVC composite extrusion, hard wood block, high density press binding plate, multi-layer wood lamination, drawn and extruded unsaturated polyester (UP), stainless steel, galvanized and coated steel plate or calcium silicate plate.

[0011] Another improvement of the fireproof door panel of the invention may include having a sealing member for forming as an outer edge sealing structure of the fireproof door panel designed as a hard PVC sealing member, foamed PVC sealing member, PVC composite extrusion sealing member, calcium silicate plate sealing member, U-shaped aluminum sealing member or drawn-extruded U-shaped sealing member.

[0012] Yet another improvement of the fireproof door panel of the invention may include having the front surface plate or rear surface plate equipped with outer snap-connection means or inner snap-connection means or having the front surface plate and the rear surface plate assembled together by nailing the sealing member on the edges of the surface plate.

[0013] Further again another improvement of the fireproof door panel of the invention may include fastening on one of the frame members of the fireproof door panel a flat steel bar, a U-shaped steel bar or a rectangular cross-section steel pipe.

[0014] Further again an improvement of the fireproof door panel of the invention may include having one of the members of the quadrilateral frame of the door panel

coated with fireproof heat expansive material, or sticking magnesium oxide plate on the centre, lower or upper part of the door panel to improve the fire retardance of the fireproof door panel.

[0015] In an alternative aspect of the present invention there is provided a door panel structure, comprising a front surface plate and a rear surface plate formed as door leafs, a quadrilateral frame formed as a door frame, one or more sealing members formed as outer edge sealing structures and a core material formed as an inner sandwich structure, **characterised in that** the surface plates are equipped with snap-connection means for allowing the front surface plate and a rear surface plate to be snap-connected together.

[0016] In another alternative aspect of the present invention there is provided a door panel structure, comprising a front surface plate and a rear surface plate formed as door leafs, a quadrilateral frame formed as a door frame, one or more sealing members formed as outer edge sealing structures and a core material formed as an inner sandwich structure, **characterised in that** a piece of edge sealing material is attached on one of the surface plates for forming one of the outer edge sealing structures, that piece of edge sealing material being able to be trimmed such that the door can be trimmed to a desired size.

[0017] In another alternative aspect of the present invention there is provided a door panel structure, comprising a front surface plate and a rear surface plate formed as door leafs, a quadrilateral frame formed as a door frame, one or more sealing members formed as outer edge sealing structures and a core material formed as an inner sandwich structure, **characterised in that** a magnesium oxide plate, a flat steel bar, a U-shaped bar or a rectangular steel tube or pipe is fastened to at least one of the members of the quadrilateral frame.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] Fireproof door panel structures embodying the invention are hereinafter described, by way of example, with reference to accompanying schematic drawings.

Fig. 1 is a schematic drawing showing the cross section of the fireproof structure of a conventional plate type door panel;

Fig. 2 is a longitudinal cross-sectional drawing of the convention plate type door panel shown in Fig. 1;

Fig. 3 is a schematic drawing of the SMC fireproof door panel of the invention;

Fig. 4 is a cross-sectional drawing along line 4-4 of the fireproof door panel in Fig. 3 for showing the structure of the fireproof door panel;

Fig. 5 is a cross-sectional drawing along line 5-5 of the fireproof door panel in Fig 3 for showing the structure of the fireproof door panel;

Fig. 6 is a partial enlargement of the cross-sectional drawing to illustrate different structures of the fireproof door panel according to the invention;

Fig. 7 is a partial enlargement of the cross-sectional drawing to illustrate further different structures of the fireproof door panel of the invention;

Fig. 8 is a cross- sectional diagram of a rectangular steel pipe adapted on the fireproof door panel according to the invention to improve the bending strength of the fireproof door panel;

Fig. 9 is a cross- sectional diagram showing the assembly of the fireproof door panel according to the invention comprising a front surface plate and a rear surface plate provided with rugged panel patterns or equipped with outer snap-connection means for snap connection;

Fig. 10 is a cross- sectional diagram showing the assembly of the fireproof door panel according to the invention comprising a front surface plate and a rear surface plate provided with rugged panel patterns or equipped with inner snap-connection means for snap connection; and

Figs. 11 to 14 are further cross-sectional diagrams showing the assembly of door panels according to further embodiments of the invention, each comprising a front surface plate and a rear surface plate provided with rugged panel patterns and equipped with inner snap-connection means for snap connection. The embodiments differ in the construction of their sealing members and stiles/rails.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0019] Shown in from Fig. 3 to Fig. 5, the fireproof door panel 30 of the invention is generally constructed by two pieces of surface plate of door panel which form a front surface plate 31 and a rear surface plate 32 (as considered in use) of the door panel 30, and further comprises an upper rail 33, a lower rail 34, a left stile 35 and a right stile 36 (again as considered in use) to form a quadrilateral frame of the fireproof door panel 30, one or more sealing member 37 formed as an outer edge sealing structure, and core materials 40 to form an inner sandwich structure of the fireproof door panel 30.

[0020] The front surface plate 31 and the rear surface plate 32 is made of fibre reinforced plastic (FRP), by a sheet molding compound (SMC) method, or by a Bulk Molding Compound (BMC) method, which inner side can be bound with one or more layers of glass-fibre cloth, or glass-fibre net or carbon-fibre cloth and which outer appearance can be shaped as a flat door panel as shown in Fig. 6, or a kind of surface plate having rugged panel pattern 31 a, 32a as shown in Fig. 9, or a kind of surface plate equipped with outer snap-connection means 31 b, 32b on outer edge sealing structure as shown in Fig. 9, or a kind of surface plate shown in one of Figs. 10, 12, 13 or 14 on which a piece of edge sealing material 37a is attached for being able to be trimmed to the desired size to form the surface plate of door panel as well as

equipped with inner snap-connection means 31 c, 32c.

[0021] And, the surface of the front surface plate 31 and the rear surface plate 32 can be designed as plain and smooth surface without wood grain or as a surface decorated with imitating solid wood grain, but the reverse side of the surface plate has a rough surface to increase the binding force when the surface plate is bound to the core material with adhesive.

[0022] The upper rail 33, the lower rail 34, the left stile 35 and the right stile 36 are formed as a quadrilateral frame and assembled with the front surface plate 31 and the rear surface plate 32 to form the fireproof door panel 30. Therefore, the material for the upper rail 33, the lower rail 34, the left stile 35 and the right stile 36 must have the property of high strength and high fire retardance such as hard PVC, foamed PVC, PVC composite extrusion, drawn and extruded UP, hard wood, high density press binding plate, multi-layer wood lamination, stainless steel frame, galvanized and coated steel plate or calcium silicate plate. Or, one of the members of the quadrilateral frame of the door panel 30 shown in Fig. 6 shall be coated with fireproof and heat expansive material, or selectively a magnesium oxide plate 50 is stuck on the centre, upper layer or lower layer of the member of the quadrilateral frame to increase its ability of fire retardance.

[0023] Shown in from Fig. 6 to Fig. 8, on the outer side of the upper rail 33, the lower rail 34, the left stile 35 and the right stile 36 a flat steel bar 39a, or a U-shaped steel bar 39b or a rectangular steel pipe or tube 39c is attached to increase the bending strength of the fire proof door panel 30 of the invention.

[0024] Also shown in Figs. 5 and 6, along the outer edge of the left stile 35 and/or the right stile 36 of the fireproof door panel 30 of the invention a sealing member 37 can be installed. The sealing member 37 shall also have high strength, fire resistance and fire retardance, and shall be made of hard PVC, foamed PVC, PVC composite extrusion, calcium silicate plate, wood or drawn-extruded UP, or can adopt U-shaped aluminum sealing material 60 for the outer sealing structure of the fireproof door panel 30 to increase its fire retardance.

[0025] The core material 40 formed as a sandwich structure inside the fireproof door panel 30 of the invention can be made of fireproof material such as formed phenolics to form a solid core, but the more preferred structure is to adopt directly one or more sheets of perlite plate or calcium silicate plate to form the core 40 of the fireproof door panel, or in the way as shown in Fig. 6, on the inner side of the front surface plate 31 and the rear surface plate 32 to attach a sheet or piece of magnesium oxide plate 38 with the same size as the front surface plate 31 and the rear surface plate 32, and then install one or more sheets or pieces of perlite plate, calcium silicate plate or wood composite plate to form the core 40 of the fireproof door panel 30. The core can alternatively be, or can additionally comprise, a polyurethane (PU foam). When the door panel 30 is on fire the core material 40 can block or help to block the fire and keep the fire out of the room, and prevent the fire from spreading across the door.

[0026] Referring next to Figure 11, there is shown a further embodiment of door panel, again having stiles 35, 36, rails 33, 34, a front surface plate 31, a rear surface plate 32 and a core 40 therebetween. It also has the snap-connection means 31c, 32c for connecting the two surface plates together. Figure 12 likewise has these features, but in another embodiment of door panel. The embodiment of Figure 11 has a steel reinforcement member 39c between the core 40 and the or each stile 35, and perhaps between the core 40 and the rails 33, 34 (not shown). Further, it has a multi-component sealing member 37, 37a provided along the outside of the right stile 35 (with the snap-connection means 31 c, 32c sandwiched therebetween). The embodiment of Figure 12, however, instead has a substantial thickness W of sealing member - preferably between 20mm and 100mm thick, and often it might be thicker than the depth D of the door panel. The depth D of the door panel is typically between 35mm and 50mm. The thicknes D of the sealing member provides a large degree of adjustability for the door panel since a significant amount of one or more of the edges of the door panel can be trimmed off the edges of the door panel without compromising the structural integrity of the door panel, whereby it can be adapted to fit in a number of different vent sizes.

[0027] The multi-component sealing member 37,37a can be formed of similar or identical materials to those described above in relation to the earlier embodiments, or it may be made from wood, e.g. a hard wood block or a laminated veneer lumber (LVL) component, or one or more calcium silicate plates, or combinations thereof, such that either each component or one or more of the components is made of a particular material, and with the remaining components being made from one or more of the other possible materials described above.

[0028] The present invention also provides for additional permutations of the above features. For example, the multiple components of the multi-component sealing member 37, 37a can be split across the snap-connection means, or it may have three or more different materials in that multi-component sealing member. Further, the frame, i.e. the stiles and rails, can be made of multiple elements, perhaps being split across the snap-connection means. For example, as shown in the further embodiment of Figure 13, the sealing member 37 could be made of PVC, and it can be retained onto the edge of the door panel for example by inturned lips 41 of the front and rear surface plates 31, 32, those lips 41 either engaging over the outside perimeter of the door panel, as shown in Figures 13 or 14 or locating within slots in the component of the sealing member, as shown in Figures 10 or 11. It might otherwise be held in place with a friction fit, or with adhesive. There could then be a three or more layer laminated veneer lumber component (LVL) 43, followed by the snap-connection means 31 c, 32c. That LVL

component 43 forms the main structure of the stile, extending along effectively the full height of the door. Internal of that LVL component, however, there can also be provided a lock block 44, for completing the multi-component stile. That lock block is the member into which a door lock can be morticed. It can extend substantially the full length of the door panel. However, typically it extends only along a part length of the door panel since deeply morticed locks are not typically installed at the top or bottom of a door panel. Usually the lock block estends only along about 1/3 of the length of the door. It is usually made of a lighter weight, or softer, wood than the LVL component, the latter generally being made of a hardwood. This allows the easier processing of the door for fitting of the lock, and also allows the door to be made more economically.

[0029] The arrangement in Fig. 14 differs to that of Fig. 13, however, in that the stile is not split by the snap-connection means 31 c, 32c. Instead the snap connection means 31 c, 32c splits the sealing member 37 from the stile.

[0030] Returning to the feature of the inturned lips 41, as discussed above they are formed in the front and rear surface plates 31, 32. They serve an additional function: in addition to securing the sealing member 37, they also allow workers, when assembling the door panel, to use the lips 41 for quickly determining whether the assembly of the door panel is correct and they allow the elements to be kept tight. For example, the lip can provide enough grip to hold the sealing member 37 in the correct place as the door panel is bonded together. This therefore saves time in the manufacturing process.

[0031] Finally, it should be observed that the core 40 in the last four embodiments (Figs 11 to 14) is preferably PU foam, although the fire resistant cores described above can also, i.e. alternatively, be used.

[0032] As concluded from the above, the door panels 30 of the invention provide not only the effect of preventing licking flames of fire from penetrating or passing the door through the gap along the edges of the door panel but can also have the effect of forming a fire-wall with its core material 40 which possesses not only the properties of high heat resistant and fire retardance but also the property of no deformation caused by fire. The structure of the frame also provides improvements. The present invention therefore provides a better fireproof property for door panels 30, whereby the invention can be developed to block fires and prevent fires from rapidly passing the door panel and spreading across the door into a room or space closed by the door panel.

Claims

1. A fireproof door panel structure, comprising a front surface plate and a rear surface plate formed as door leafs, a quadrilateral frame formed as a door frame, one or more sealing members formed as outer edge sealing structures and a core material formed as an inner sandwich structure, **characterized in that** the core material is formed by one or more of phenolic resin, perlite, calcium silicate or wood composite plate.

2. A fireproof door panel structure according to claim 1, wherein the front surface plate and/or the rear surface plate comprises an outer snap-connection means or an inner snap-connection means.

3. A fireproof door panel structure according to claims 1 or claim 2, wherein to one of the members of the quadrilateral frame is fastened a flat steel bar, a U-shaped bar or a rectangular steel tube or pipe.

4. A fireproof door panel structure according to any of claims 1 to 3, wherein on one of members of the quadrilateral frame there is installed a magnesium oxide plate.

5. A door panel structure, comprising a front surface plate and a rear surface plate formed as door leafs, a quadrilateral frame formed as a door frame, one or more sealing members formed as outer edge sealing structures and a core material formed as an inner sandwich structure, **characterised in that** the surface plates are equipped with snap-connection means for allowing the front surface plate and a rear surface plate to be snap-connected together.

6. A door panel structure, comprising a front surface plate and a rear surface plate formed as door leafs, a quadrilateral frame formed as a door frame, one or more sealing members formed as outer edge sealing structures and a core material formed as an inner sandwich structure, **characterised in that** a piece of edge sealing material is attached on one of the surface plates for forming one of the outer edge sealing structures, that piece of edge sealing material being able to be trimmed such that the door can be trimmed to a desired size.

7. A door panel structure, comprising a front surface plate and a rear surface plate formed as door leafs, a quadrilateral frame formed as a door frame, one or more sealing members formed as outer edge sealing structures and a core material formed as an inner sandwich structure, **characterised in that** a magnesium oxide plate, a flat steel bar, a U-shaped bar or a rectangular steel tube or pipe is fastened to at least one of the members of the quadrilateral frame.

8. A door panel structure according to any one of claims 5 to 7, wherein the core material is formed by one or more of polyurethane foam, phenolic resin, perlite, calcium silicate or wood composite plate.

9. A door panel structure according to any one of the preceding claims, wherein on an inner surface of the front surface plate and/or the rear surface plate is attached one or more layers selected from the group consisting of glass-fibre cloth, glass-fibre net or carbon-fibre cloth.

10. A door panel structure according to any one of the preceding claims, wherein the front surface plate and/or the rear surface plate is a flat type surface plate.

11. A door panel structure according to any one of the preceding claims, wherein the front surface plate and/or the rear surface plate has one or more rugged panel pattern thereon.

12. A door panel structure according to any one of the preceding claims, wherein the quadrilateral frame comprises a material or materials selected from the group hard PVC, foamed PVC, PVC composite extrusion, drawn-extruded UP, hard wood block, high density press binding plate, multi-layer wood lamination, stainless steel, galvanized and coated steel plate or calcium silicate plate.

13. A door panel structure according to any one of the preceding claims, wherein the sealing member comprises a material or materials selected from the group hard PVC sealing member, foamed PVC sealing member, PVC composite extrusion sealing member, calcium silicate sealing member or U-shaped aluminum sealing member.

14. A doorway, comprising a door panel structure according to any one of the preceding claims.

15. A building, including a door panel structure according to any of claims 1 to 13 or a doorway according to claim 14.

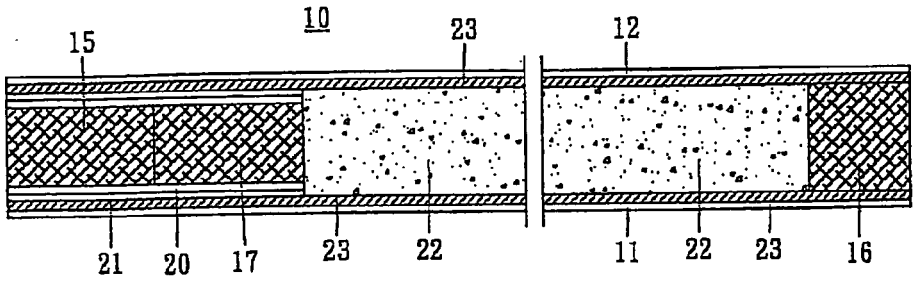

FIG. 1

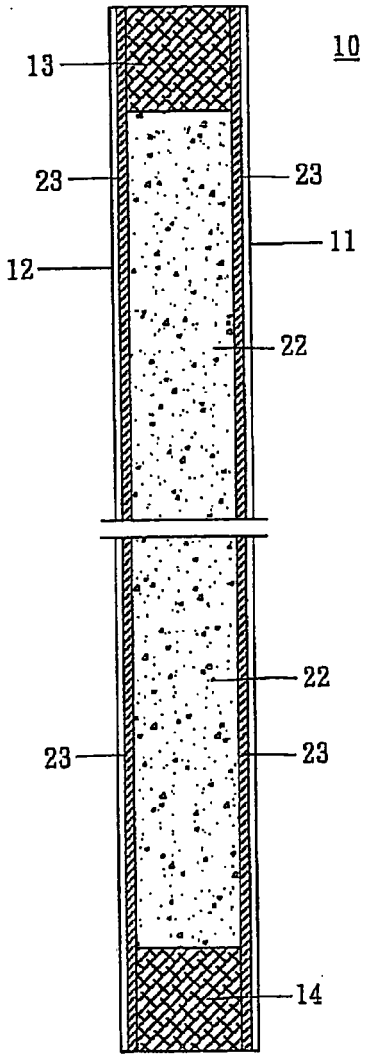

FIG. 2

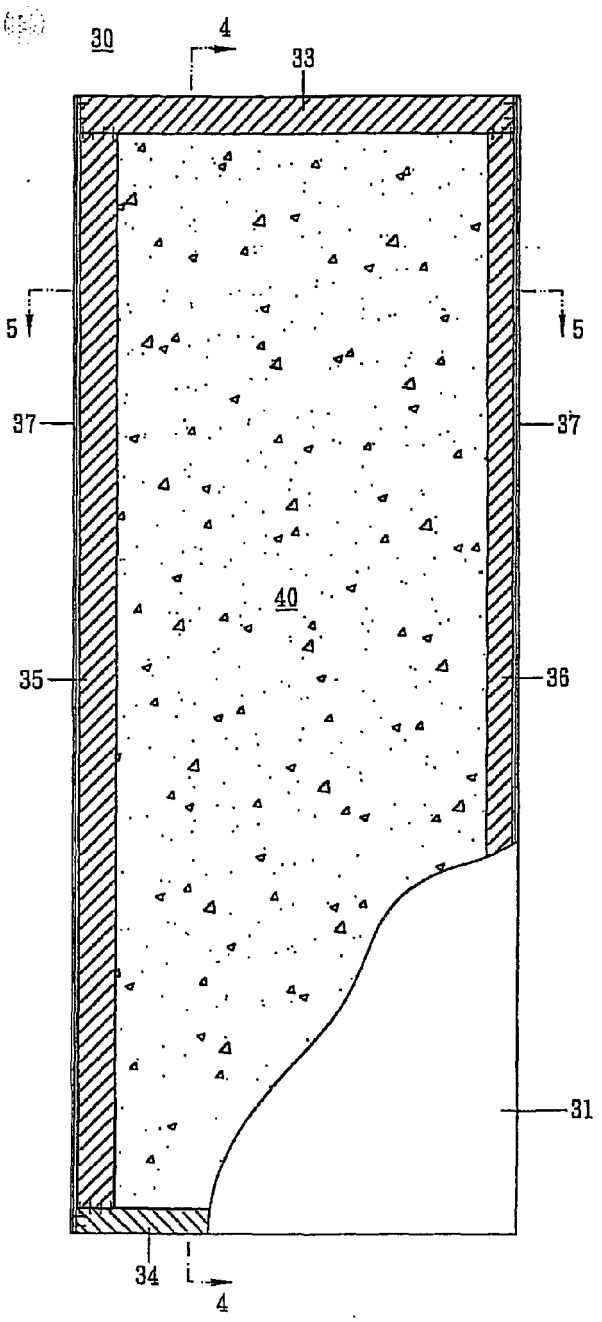

FIG. 3

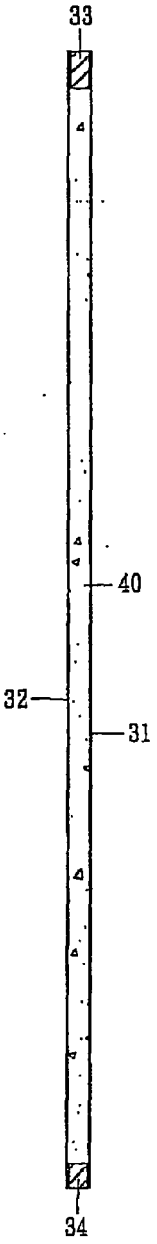

FIG. 4

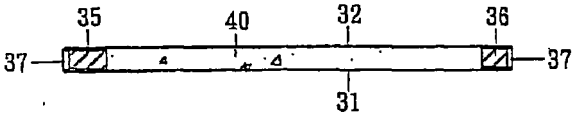

FIG. 5

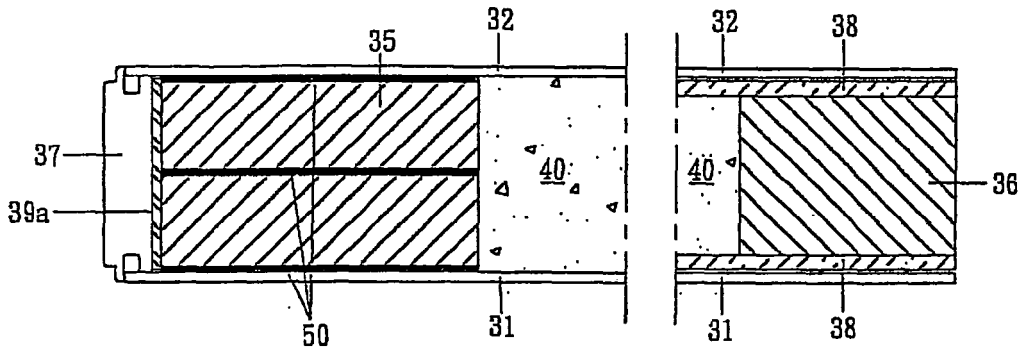

FIG. 6

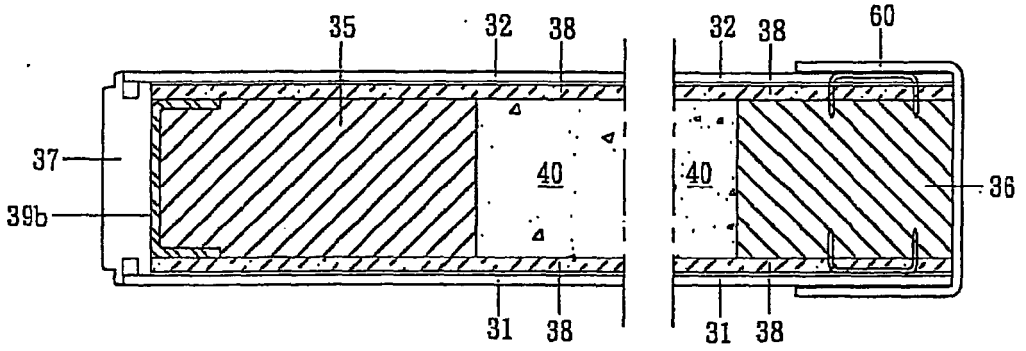

FIG. 7

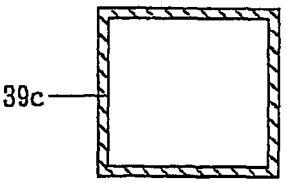

FIG. 8

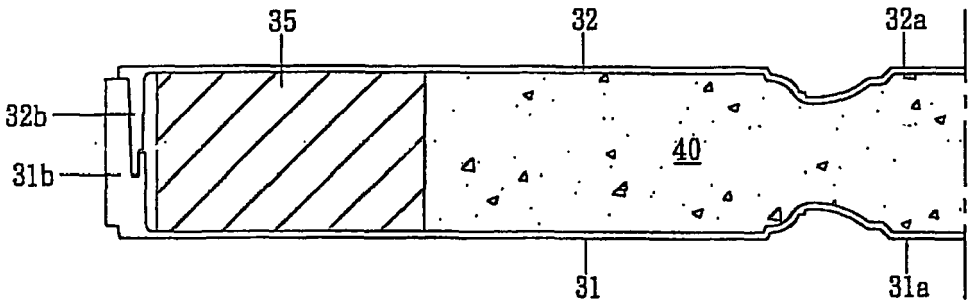

FIG. 9

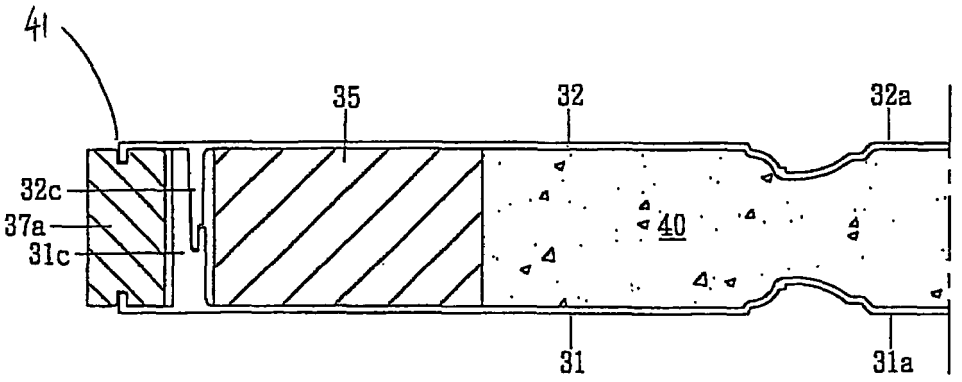

FIG. 10

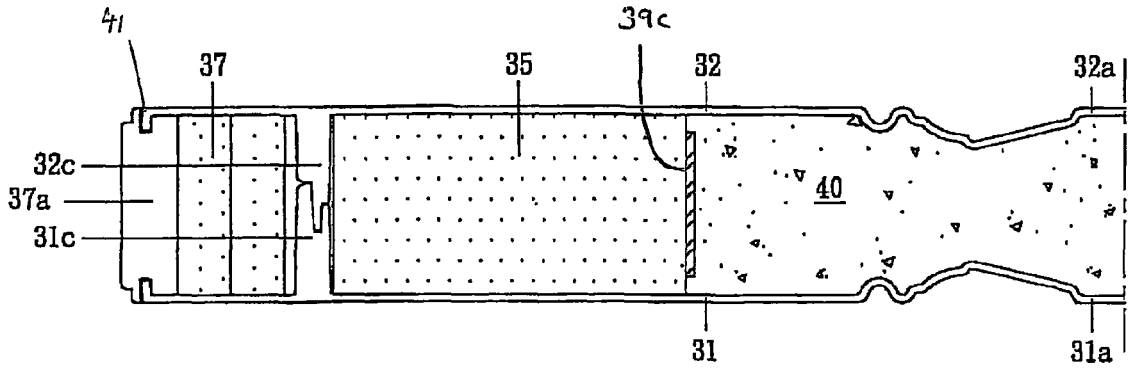
41
37
35
39c
32
32a
32c
37a
31c
40
31
31a

FIG. 11

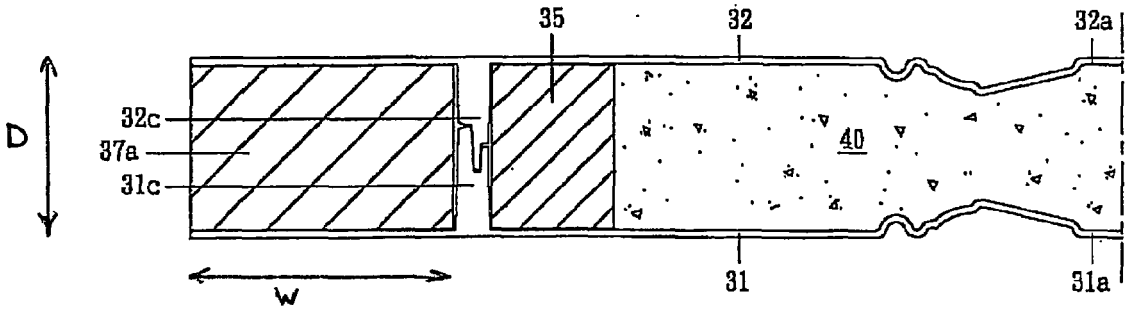
35
32
32a
D
32c
37a
31c
40
31
31a
W

FIG. 12

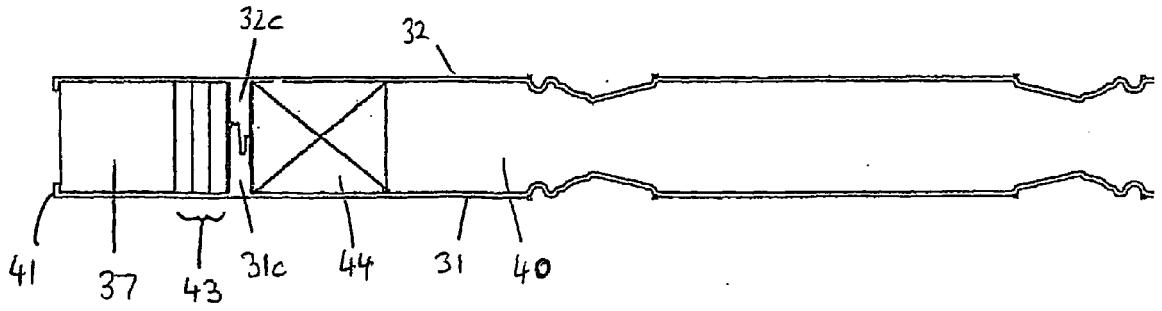

FIG. 13

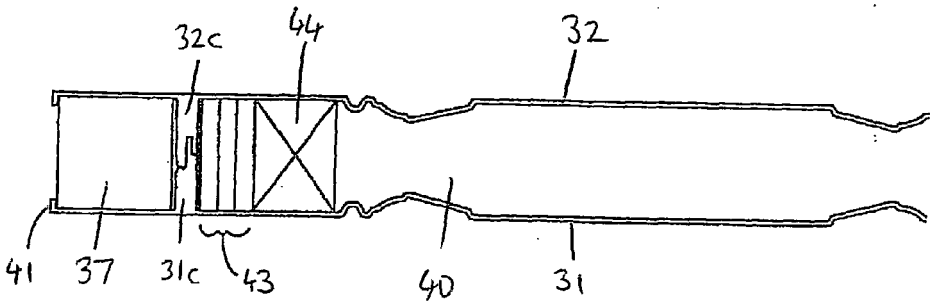

FIG. 14