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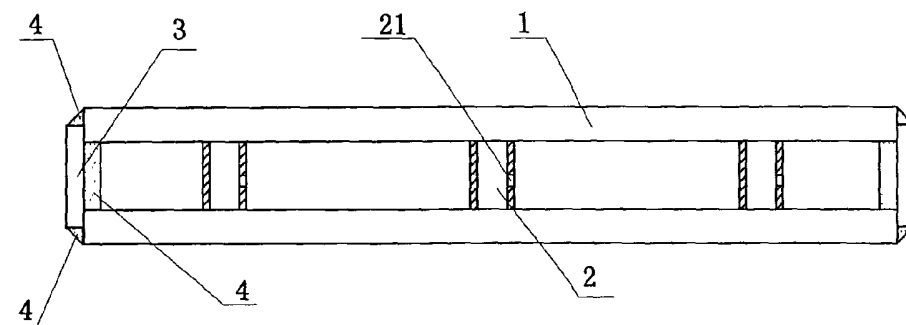
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(54) Title: HIGH THERMO AND SOUND-INSULATING EVACUATED GLASS PANEL DEVICE



(57) Abstract: A high thermo and sound-insulating evacuated glass panel device includes at least two planar glass sheets (1) and support means, hollow support pillar (2), disposed between said glass sheets; said support means has a penetrated portion (21, 22) on its surface or top portion for communicating its inner cavity with the space between two planar glass sheets (1); at the periphery of the planar glass sheet (1) an edge frame component (3) having low melting point glass powder (4) applied on its inner side is used to vertically seal and join to the periphery of said planar glass sheet (1). This invention employs hollow support pillars (2) as support means that can be used for manufacturing large-size high transmissible evacuated glass panel; said low melting point glass powder (4) melt and then make the edge frame component (3) joint to the periphery of planar glass sheet (1) that increases the ratio of qualitative finished evacuated glass panel and its service life.

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HIGH THERMO AND SOUND-INSULATING EVACUATED GLASS PANEL DEVICE

Technical Field

The present invention relates to a high thermo and sound-insulating evacuated glass device, particularly, an evacuated glass device, employing hollow support pillar as support means disposed between two planar glass sheets. The present invention concerns the technical field of glass manufacturing.

Background of the Art

The evacuated glass panel has achieved rapidly development through nearly a hundred year's investigation and research. Both the theoretical study and the scientific practice have proved that the evacuated glass panel is a practical material with good thermo and sound insulating performance, and widely used on doors and windows of building and thermo-shielding and insulating electric apparatus and equipment

The evacuated glass panel includes at least two planar glass sheets and edge seal component. After technologic evacuating the space between two planar glass sheets formed an evacuated glass panel with evacuated lamination. Because of atmospherical pressure effect it is possible to cause opposite adherence of two planar glass sheets of evacuated glass panel, in order to maintain the evacuated layer people always employs support means disposed between two planar glass sheets to resist the compressive deformation due to atmospheric pressure.

At present, people commonly employ most support pillar or support wire net as support means, and commonly employed material is glass, plastic or metal wire and flare. This method of supporting leads to unfavorable influence in two aspects. At first, when a large number of support means, particularly plastic or metal support means is employed, the transmissivity of evacuated glass panel is effected negatively, especially during manufacturing process of doors or windows, said support means may influence the people's line of sight through doors or windows, moreover, plastic support means can slowly release gas, after a period of time the degree of evacuation is greatly reduced, thereby decreasing thermo and sound-insulating performance.

Secondly, in order to not influence the people's line of sight, glass material is employed as support means whose bottom area must be made very small. However, this type of small support means can not be used for manufacturing large-size,

large-thickness evacuated glass panel. The reason is: when an evacuated glass panel has large thickness of evacuated layer, it means that glass support means must have higher height, nevertheless it is difficult for the high glass support pillar with limited bottom area to stand upright on surface of planar glass sheet, particularly during manufacturing large-size evacuated glass panel, a great deal of support glass pillars need to be placed on the surface of planar glass sheet designed to dispose support means, moreover, the pillars must be uniformly distributed and arranged. Therefore, it is very difficult to dispose support means and ensure it not fall during production process.

In addition, during production of evacuated glass panel, in order to maintain higher evacuated degree of evacuation the periphery of evacuated glass panel must be sealed, while the quality of seal treatment exerts a direct influence on operational performance and service life.

Traditional periphery seal is performed by melting, which places the low melting point glass powder in edge gap between two planar glass sheets. Under high temperature it melts and adheres to glass, so the sealing effect is achieved. The disadvantage of this method as follow:

1. The low melting glass powder is directly inserted in periphery gap between planar glass sheets for sealing, so that the effective area of evacuated large is decreased, thereby the volume of evacuated chamber is also decreased. The smaller the volume of evacuated chamber is, the lower the thermo and sound-insulating performance will be.
2. The large amount of low-melting point glass powder leads to large tensile stress near edge of glass, such tensile stress results in reducing the mechanical property of evacuated glass panel at last.
3. Because the low-melting point powder seals and joins two planar surfaces, such sealing method increases the probability of air leak, thereby decreasing the ratio of qualitatively finished evacuated glass panel and its life.

Summary of the Invention

The main object of the present invention is, regarding to the disadvantages of above-mentioned traditional method of disposing support means within evacuated glass panel, to provide a high thermo and sound-insulating evacuated glass panel device, which employs a hollow pillar as support means disposed between two planar glass sheets, thereby obtaining a higher support height under condition without or with slightly increasing the bottom area of support means, it is suitable for producing large-size evacuated glass panel.

The secondary object of the present invention is, regarding to the disadvantages of

above-mentioned traditional method of periphery sealing, to provide a high thermo and sound-insulating evacuated glass panel device, said evacuated glass panel device through which the low melting point glass powder melts and joins the edge frame component to periphery of evacuated glass panel, thereby increasing its service life and aesthetic sense.

Said above objects of this invention are realized through following technical schemes:

A kind of high thermo and sound-insulating evacuated glass panel device includes at least two planar glass sheets in any shape and support means disposed there between; the space between said two planar glass sheets is evacuated, a seal component is placed around the periphery of planar glass sheets, characterized in that said support means is a hollow support pillar, said hollow pillar has penetrated portion at its side or top surface for communication of its inner-cavity with the space between planar glass sheets, said hollow pillar is a cylinder or rhomb. Said sealing component has low melting point glass powder applied on its inner side and is used to vertically be sealed and joined to edge frame component around periphery of planar glass sheet.

The high thermo and sound-insulating evacuated glass panel device provided by this invention employs a hollow support pillar as support means disposed between planar glass sheets, thus making the support means far higher than that of traditional ones, nevertheless, contacting bottom area of support means and planar glass sheet does not increase or increase slightly increase, said hollow support pillar can be used for manufacturing large-size, high transmissible evacuated glass panel which can't be manufactured by traditional support means. During production process of evacuated glass panel, because hollow support pillar with wide bottom area is more easy to be placed on the surface of planar glass sheets in comparison with solid support means of same height. It's not easy to turn down in transportation of manufacturing evacuated glass panel, so that the practice operation is convenient and the operation effect is increased.

In addition, the high thermo and sound-insulating evacuated glass panel device provided by this invention employs low melting glass powder to melt and join the edge frame component to periphery of evacuated glass panel, no matter whether glass strip or metal frame is employed as edge frame component, because the sealing and joining surface is not planar, the edge frame has a right angle in contract to the surface of planar glass sheet, so the probability of air leak is greatly reduced, thereby leading to good sealing effect and increasing the ratio of qualitative finished evacuated glass panel and service life. The evacuated glass panel employing edge frame component for sealing has obviously decreased tensile stress around it's periphery and greatly increased mechanical strength. Because the sealing and joining surface is not planar, and the lateral surface of planar glass sheet is employed

as sealing and joining surface, so the effective area of evacuated glass panel is increased, thereby enlarging the volume of evacuated chamber and improving its operation performance. When the evacuated glass panel employs metal frame as a edge frame component, the metal frame makes the edge of sealed evacuated glass panel have higher mechanical strength. Moreover, the employing metal frame for sealing eliminates the need for additional outer frame, thereby reducing the cost of re-processing evacuated glass panel at later manufacturing stage.

Brief Description of the Drawing

Fig 1 is a schematic structure view of an embodiment according to this invention;

Fig 2 is a schematic structure view of another embodiment according to this invention;

Fig 3 is a schematic structure view of a hollow support pillar, employed in embodiment of Fig 1;

Fig 4 is a schematic structure view of another hollow support pillar employed in embodiment of Fig2.

Preferred embodiment

The present invention will be described in more details by way of embodiment with reference to accompanying drawings as follows.

Example 1

As shown in Fig 1, the structure of this embodiment according to the present invention is: two parallel placed planar glass sheets 1, which are supported by hollow support pillar 2 arranged in certain regulation, the periphery of planar glass sheets is vertically sealed and joined by a glass strip 3 from low melting point glass powder, the space between glass sheets is an evacuated space. In this embodiment the hollow pillar 2 is a cylinder made from transparent glass material, in order to insure the degree of evacuation and make the inner cavity of hollow pillar 2 is also evacuated, said hollow pillar2 has opened hole 21 for linking the inner cavity of hollow pillar 2 with the space between the planar glass sheets. When the evacuated glass panel manufacturing process advanced to evacuating procedure, the gas within hollow support pillar and space between planar glass sheets are simultaneously evacuated.

In this embodiment, glass strip 3 is used as material for edge sealing, after said glass strip3 has been cut into a width smaller than that of total thickness of the evacuated glass panel, the low melting point glass powder4 is melted on it's inner lateral

surface and adherently placed at the periphery of planar glass sheet 1. the glass strip 3 is assembled through a specific die, which has certain pressure and make the glass strip 3 and planar glass sheet 1 closely adhere to each other, during high temperature heating, the low melting point glass powder is melted to sinter the planar glass sheet 1 and glass strip 3 together, so the glass strip 3 is vertically sealed and joined on the periphery of the planar glass sheet1.

In this embodiment, because the practical contacting area of hollow support pillar and planar glass sheet is greatly reduced respecting to that of solid support pillar in same size, thereby obtaining a higher support height under condition of same contacting area, thus it can be used for manufacturing large-size evacuated glass panel.

At same time the movement resulted from transfer between operations in production process is not easy to cause turn down of the support pillar.

In addition, because the low melting point glass powder will possess flow ability after heating and melting, it can fully fill the space between the glass strip3 and planar glass sheet 1, thereby reducing the probability of air leak, increasing the ratio of qualitative finished evacuated glass panel and its life, moreover, the employment of lateral surface of planar glass sheet as sealing and joining surface can enlarge the volume of evacuated chamber, thereby increasing the operation performance and service life of evacuated glass panel.

Example 2

As shown in Fig 2, the structure of this embodiment according to the present invention is: two parallel placed planar glass sheet 1, which are supported by hollow support pillar 2 arranged in certain regulation, as the same as in the example 1, the hollow pillar 2 is a cylinder made from transparent glass material, in order to ensure the degree of evacuation and make the inner cavity of hollow pillar 2 also be evacuated, said hollow pillar 2 has notch 22 at its end portion for communicating of the inner cavity of hollow pillar 2 with space between the planar glass sheets, thereby ensuring the inner cavity of hollow pillar be in evacuated state.

In this embodiment a metal frame 3 that has low melting point glass powder on its inner side is put on periphery of the planar glass sheet 1, the metal frame 3 is made of an alloy having similar thermal coefficient of expansion to that of glass, such as iron-nickel-cobalt alloy.

When said alloy is a 4J6 iron-nickel-cobalt alloy, comprising: iron (Fe) 52%, nickel (Ni) 42%, cobalt (Co) 6%;

When said alloy is a NRS-2 iron-nickel-cobalt alloy, comprising: iron (Fe) 48%, nickel (Ni) 47%, cobalt (Co) 5%.

The metal frame 3 that has inner buckle through a specific die having certain

pressure makes the inner buckle enclose the periphery of planar glass sheet and closely adhere to each other. During high temperature heating the low melting point glass powder is melted to sinter the planar glass sheet 1 and metal frame 3 together, so the metal frame 3 is vertically sealed and joined on the periphery of the planar glass sheet 1.

In this embodiment, the effect hollow support pillar2 is the same as example 1, so further description is omitted. Because the low melting point glass powder will possess flow ability after heating and melting, it can fully fill the space between metal frame and planar glass sheet and make the sealing and joining surface at a right angle, thereby reducing the probability of air leak, increasing the ratio of qualitative finished evacuated glass panel and its life-time. The employment of metal frame 3 results in no need for other frames, thereby decreasing the cost of re-processing at later stage.

Figs 3,4 show the perspective view of hollow support pillar employed in above two examples with the difference in that:

The hollow support pillar in Fig 3 has opened hole 21 at its lateral surface communicating with inner cavity; the hollow pillar in Fig 4 has opened notch 22 at its top portion.

By means of hole 21 and notch 22 the inner cavity of hollow support pillar is communicated with the space between planar glass sheets is communicated.

At last, it should be noted that above-mentioned embodiments are employed only for description of the technical schemes of the present invention and should not be limited thereon, although the present invention has been detailedly described, it should be apparent to those of ordinary skill in the art that modifications and variations may be made without departing from the spirit and scope of the technical schemes of the present invention, all they should be included within the scope of appended claims.

Claims

1. A high thermo and sound-insulating evacuated glass panel device include at least two planar glass sheets in any shape and support means disposed between said two planar glass sheets; the space between said two planar glass sheets is evacuated, a seal component is placed around the periphery of planar glass sheets, characterized in that, said support means is a hollow support pillar, said hollow pillar has penetrated portion at its lateral or top surface for communicating the space between two planar glass sheets with the inner cavity of hollow support pillar.
2. The high thermo and sound-insulating evacuated glass panel device according to claim 1, wherein said hollow support pillar is a cylinder or rhomb.
3. The high thermo and sound-insulating evacuated glass panel device according to claim 1 or 2, wherein said hollow support pillar is two or more; said hollow support pillars are uniformly distributed between planar glass sheets.
4. The high thermo and sound-insulating evacuated glass panel device according to claim 1 or 2, wherein said hollow support pillar is transparent glass support pillar or metal support pillar.
5. The high thermo and sound-insulating evacuated glass panel device according to claim 1, wherein said sealing component is a edge frame component that have low melting point glass powder applied on its inner side used to vertically seal and join to the periphery of planar glass sheet.
6. The high thermo and sound-insulating evacuated glass panel device according to claim 5, wherein said edge frame component is a glass strip or a metal frame.
7. The high thermo and sound-insulating evacuated glass panel device according to claim 5 or 6, wherein the width of said glass strip is smaller than the total thickness of the evacuated glass panel, the glass strip is assembled through a specific die making it adhere to the periphery of planar glass sheet, after high temperature heating the low melting point glass powder on its inner side is

melted and solidified , the planar glass sheet and the glass strip is sintered together.

8. The high thermo and sound-insulating evacuated glass panel device according to claim 5 or 6, wherein said metal frame has a inner buckle for enclosing the periphery of planar glass sheet, said metal frame through a die is assembled and put on the periphery of planar glass sheet, after high temperature heating the low melting point glass powder is melted and solidified to sinter planar glass sheet and the metal frame together.
9. The high thermo and sound-insulating evacuated glass panel device according to claim 8, wherein said metal frame is made of an iron-nickel-cobalt alloy having similar thermal coefficient of expansion to that of glass.
10. The high thermo and sound-insulating evacuated glass panel device according to claim 9, wherein said iron-nickel-cobalt alloy comprise iron(Fe) 48~52%, nickel(Ni) 42~48%, cobalt(Co) 5~6%.

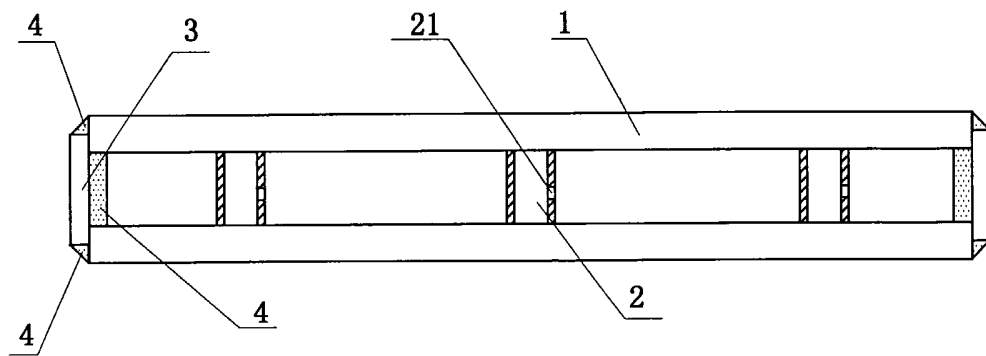


Figure 1

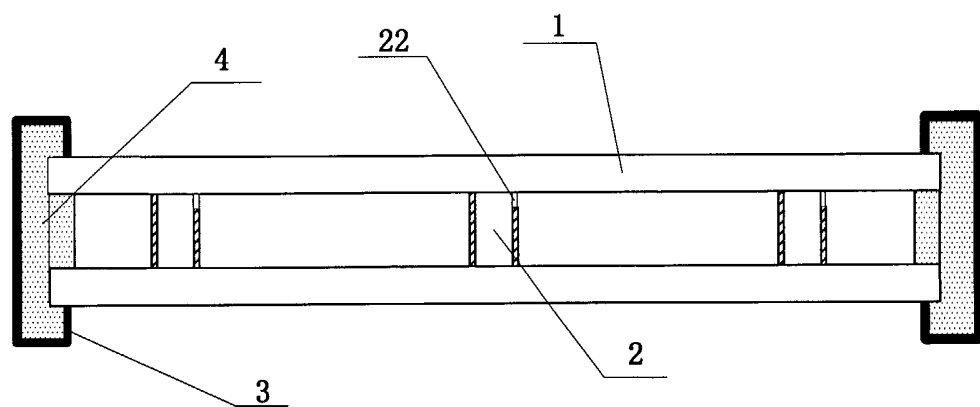


Figure 2

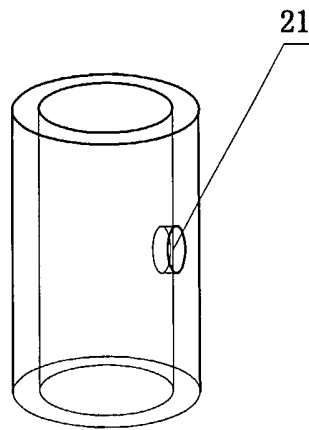


Figure 3

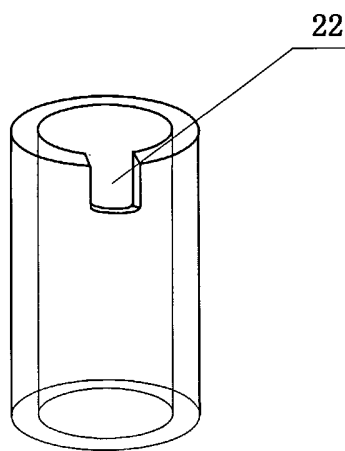


Figure 4

INTERNATIONAL SEARCH REPORT

International application No.

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A. CLASSIFICATION OF SUBJECT MATTER

IPC⁷ E06B3/66、E06B3/663、C03B23/24、C03C27/06

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC⁷ E06B、C03B、C03C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Chinese Patent Documents (1985~)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI, EPODOC, PAJ, CNPAT

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	CN,A,1206389 ((NIPG) NIPPON SHEET GLASS CO LTD) 27.Jan.1999 (27.01.1999)	1~6
A	The whole description; claim 1~10; figure 1~4	7~10
Y	CN,A,1128320((Jinguangheng) 07.Aug.1996 (07.08.1996)	1~6
	The whole description; claim 1~17; figure 1~9	7~10

☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	CN,A,1266470 ((NIPG) NIPPON SHEET GLASS CO LTD) 13.Sept.2000 (13.09.2000)	1~6
A	The whole description; claim 1~4; figure 1~7	7~10
Y	CN,A,1094475 (Wangminzhi) 02.Nov.1994 (02.11.1994)	1~6
A	The whole description; claim 1; figure 1~2	7~10
A	US,A,5657607 (University of Sydney) 19.Aug.1997 (19.08.1997) The whole description; claim 1~27; figure 1~13	1~10
A	US,A,3990201 ((FALB-I) FALBEL G) 09.Nov.1976 (09.11.1976) The whole description; claim 1; figure 1~4	1~10
A	DE,A,3615179 ((VIER-I) VIERT K P) 19.Feb.1987 (19.02.1987) The whole description; claim 1~5	1~10
A	WO,A,9957406 ((NIPG) NIPPON SHEET GLASS CO LTD) 11.Nov.1999 (11.11.1999) The whole description; claim 1~18; figure 1~61	1~10

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

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