Aug. 12, 1969 A. ALGRAIN ET AL 3,460,303

MULTIPANE GLAZING UNIT

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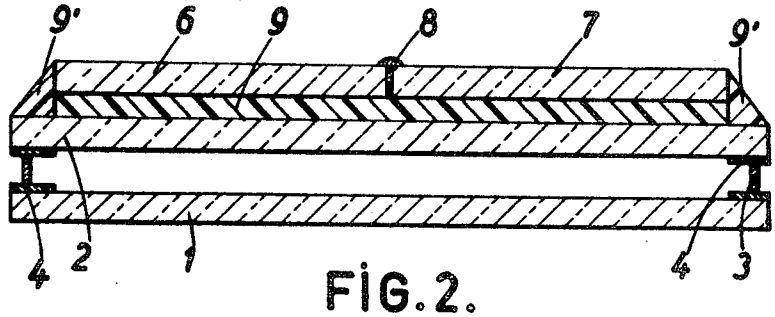

FIG. 2.

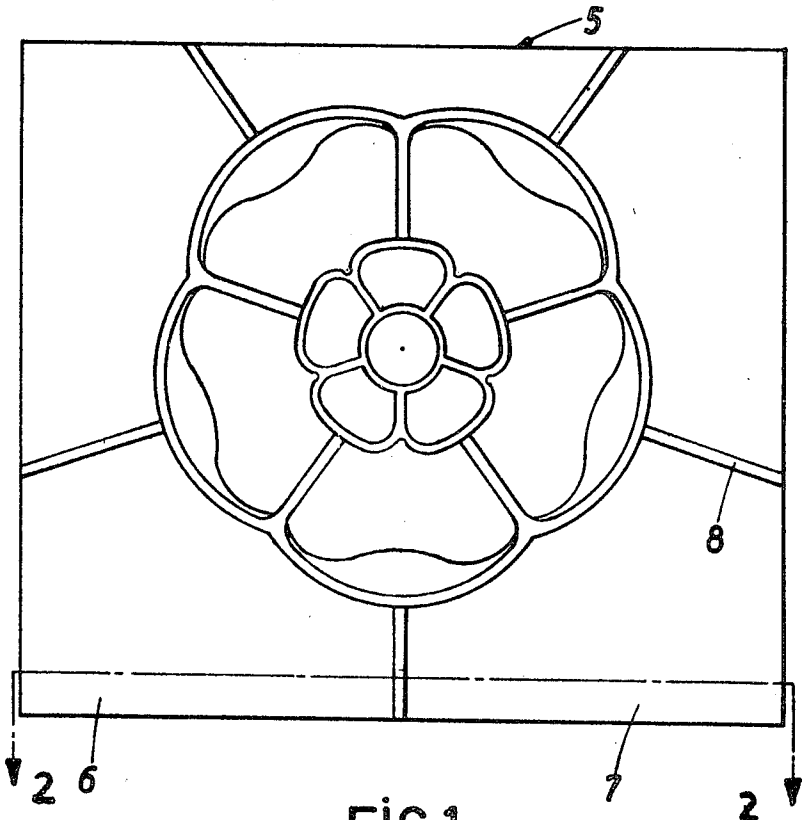

FIG. 1.

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FIG.3.

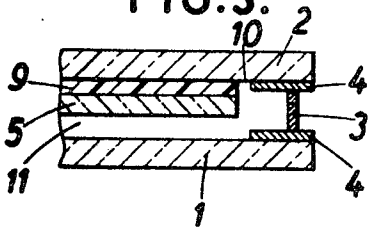


FIG.4.

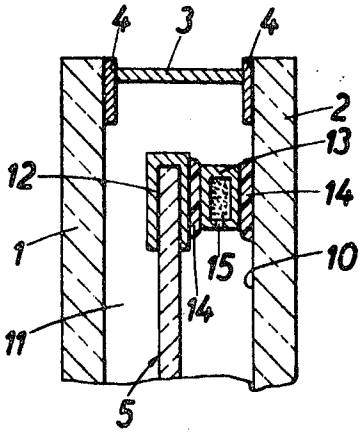


FIG.6.

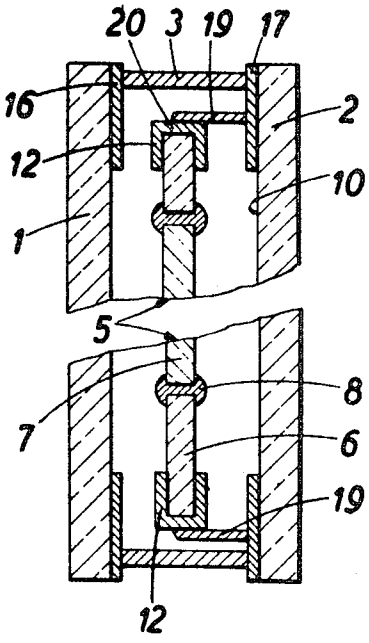
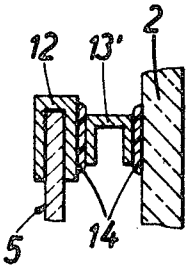


FIG.5.



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MULTIPANE GLAZING UNIT

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FIG.7.

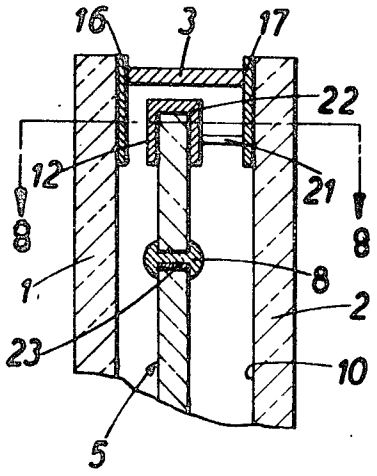
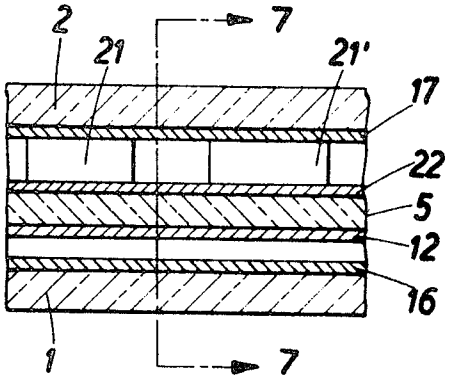


FIG.8.



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MULTIPANE GLAZING UNIT

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Int. Cl. B44f *1/08;* E06b *3/30, 3/66*
U.S. Cl. 52—314 12 Claims

ABSTRACT OF THE DISCLOSURE

A glazing unit composed of a multiple pane window, a leaded colored window and resilient connecting means connecting the colored window to one of the panes of the multiple pane window, the resilient means being deformable for compensating for differences in thermal expansion between the colored window and the pane to which it is connected.

The present invention relates to glazing units, and more particularly to decorative glazing units incorporating a leaded colored window.

A conventional leaded colored, or co-called stained glass window, is an assembly of panes of colored glass inserted in a lattice formed by lead bars welded to one another and formed with grooves into which the edges of the panes are inserted. In large stained glass windows, some of the lead bars are duplicated by iron bars to impart greater rigidity to the assembly. The shape of the lattice and the colors of the panes can be skillfully combined to produce a geometrical pattern or a pattern of figures. For many centuries, stained glass windows have been used for the decoration of window openings, the art having reached its peak in the 13th century, as many Gothic buildings bear witness.

Multiple-sheet glazings have, of course, become widely used in recent decades. They are formed by at least two sheets of glass or some other transparent or translucent material having their margins joined, e.g., soldered, together or to an intervening or frame member or members, to form a closed box. Such glazings have particular advantages including good heat and sound insulating properties.

Leaded colored windows, however, have not been employed in multiple-sheet glazings because the substitution of one of the sheets of such glazings by a leaded colored window would give rise to difficulties in sealing the space between the glazings against ingress of moisture. Moreover, the differences in the thermal coefficient of expansion of leaded and unleaded glazing would cause thermal stresses to be set up in the unit. In this connection, it is observed that panes of colored glass absorb solar heat more strongly than uncolored glass.

According to the present invention, however, a glazing unit comprising two or more transparent or translucent sheets secured at their peripheral portions to spacing means so as to form therewith a hollow closed structure, and a leaded colored window connected by resilient means to one of said sheets in facing parallel relationship thereto, has been prepared. By virtue of the resilient connection between the colored window and one of the sheets of the hollow structure, the occurrence of harmful stresses is thereby obviated.

It is, therefore, a principal object of the present invention to provide a multiple-sheet glazing unit incorporating a leaded colored window whereby the inherent disadvantages of previous assemblies are eliminated.

It is a further object of the present invention to provide a glazing unit comprising two or more transparent or translucent sheets and a leaded colored window connected by resilient means to one of said sheets in facing parallel relationship thereto.

Additional objects and advantages of the present invention will become apparent upon consideration of the following description when taken in conjunction with the accompanying drawings in which:

FIGURE 1 is a front view of a glazing unit according to the present invention.

FIGURE 2 is a sectional view taken along line 2—2 of FIGURE 1.

FIGURES 3 to 6 show in section parts of further units according to the present invention.

FIGURE 7 is a sectional view taken along line 7—7 of FIGURE 8.

FIGURE 8 is a sectional view taken along line 8—8 in FIGURE 7.

In the different figures, like elements are denoted by the same reference numerals.

The glazing unit shown by FIGURES 1 and 2 is formed by two glass sheets **1**, **2** connected together in spaced relationship by lead strips **3** disposed between their margins and soldered to tinned copper strips **4** which adhere to the sheets **1**,**2**. The sheets **1** and **2** and the strips **3** form a closed box. A stained glass window **5** is formed by a number of panes of colored glass, **6**, **7** assembled by lead bars **8**. The window **5** is glued to the sheet **2** by a thick resilient layer **9** of transparent adhesive such as polyvinyl butyral. The layer **9** can deform slightly to compensate for differences in expansion as between the window **5** and the sheet **2**. The thickness of the adhesive layer **9** is selected in relation to the characteristics of the material used, so as satisfactorily to adsorb differences in expansion. For instance, the required thickness of the layer **9** is greater in proportion as the panes **6**, **7** are more intensely colored and therefore liable to become more strongly heated by the sun's rays. A thickness of 1 mm. is generally adequate.

The lead bars **8** are T-shaped in cross section and have no flange on the side of the adhesive layer **9** so as to avoid reducing its thickness and resilience.

It is also advantageous to protect the adhesive layer **9** against the weather; more particularly moisture. Although the actual means used for sealing the glazing unit in a frame will provide protection, it is preferable to use a sheet **2** which is larger than the window **5** and to dispose a seal **9'** against the edges of the window **5** and the layer **9**. This seal can, for example, be formed by an organic polysulphide.

In the embodiment according to FIGURES 1 and 2, the stained glass window, outside of the transparent sheets, can be seen without the interposition of any other transparent sheet.

Referring now to FIGURE 3, the colored glass window **5** is in this embodiment glued to the inwardly facing surface **10** of sheet **2** so that the window lies in the interior **11** of the box. The window **5** is therefore satisfactorily protected against deterioration caused from sources such as dust and weathering.

In the embodiment illustrated in FIGURE 4, the glazing again comprises two sheets **1**, **2** of glass attached to one another by lead strips **3** welded to tinned copper strips **4**. The stained glass window **5** is inserted in a frame **12** formed by aluminum U-channel pieces. The window **5** is attached to the inner face **10** of the sheet **2** by means of connecting members **13** glued to frame **12** on the one hand and to the surface **10** of the sheet **2** on the other hand by layers **14** of resilient adhesive based, e.g., on an organic polysulphide or silicone. Each of the members **13** (which in this case extend along all the margins of the window **5**) is a rectangular tube filled with a highly water-absorbent agent, advantageously silica gel. The silica gel

is in communication with the atmosphere in the interior space **11** of the box via apertures **15** and keeps the atmosphere dry and prevents water condensation inside the glazing unit.

In the embodiment illustrated in FIGURE 4, the resilience of the connection between the stained glass window and the box is due principally to the presence of the adhesive layers **14**. A greater resilience can be achieved by using members **13** which are readily deformable due to the resilience of the material of such members and/or to their geometric form. Plastic material can be used as a resilient material for forming the members **13** and they may be of U-section for promoting the required resilience of the connection.

In the embodiment illustrated in FIGURE 5, the stained glass window **5** is inserted in a frame **12** and this frame is attached to the sheet **2** by channel pieces **13'** glued to frame **12** and sheet **2** by adhesive layers **14**. In this embodiment, the connection is more resilient than in the embodiment illustrated in FIGURE 4 because the connecting pieces **13'** as well as the adhesive layers are resilient.

Referring to FIGURE 6, the glazing unit shown in this figure is formed by two sheets **1**, **2** of glass connected together by lead strips **3** welded to tinned copper strips **16**, **17**, similar to, but larger than, the strips **4** in the previously described embodiments. The stained glass window **5** is formed by colored glass panes such as **6**, **7** assembled by I-shaped lead bars **8**. The window **5** is inserted in a U-shaped tinned mild steel frame **12**; the latter material is advantageously used, since it can readily be soldered to alloys having a lower melting point. The frame **12** can be soldered to the bars **8** extending to the marginal portions of the window **5** to improve the stability of the assembly.

Lead strips **19** are soldered to the web **20** of the frame **12** of the window **5** and to the tinner copper strips **17**. In this assembly, the resilience of the connection is provided by the strips **19** and these strips also stiffen the frame **20** and thus further improve the dimensional stability of the window **5**. U-shaped strips may be used at only two opposed margins of the window **5**, instead of forming a frame by such strips, the window then being connected to strips **17** by strips **19** disposed only at such two opposed margins.

The only difference between the glazing unit shown in FIGURES 7 and 8 and the unit illustrated in FIGURE 6 is the manner in which the stained glass window **5** is attached to the surface **10** of the sheet **2**. In the embodiment according to FIGURES 7 and 8, the resilient connection is formed by a series of small lead pieces (only two of which, **21** and **21'**, are shown) soldered to the strips **17** and the flange **22** of the tinned mild steel frame **12**. The substitution of the spaced pieces such as **21**, **21'** for strips **19** extending without interruption along the margins of window **5** increases the resilience of the connection. Moweover, the soldering of such pieces to a flange rather than to the web of the frame enables a window **5** of given dimensions to be conveniently accommodated in a unit of smaller over-all dimensions. In order to improve the dimensional stability of the stained glass window, some of the lead bars **8** forming the window lattice are reinforced by steel stiffening members **23** disposed in at least one of the grooves of the I-shaped bars **8**.

In all of the illustrated embodiments, the sheets **1**, **2** are connected together by lead strips **3** soldered to copper strips **4**, but other method of forming such connection can be utilized. A suitable alternative means comprises, for example, gluing a piece of angled section between the marginal portions of the sheets **1**, **2**. As a further alternative, a glazing unit according to the invention can comprise more than two sheets to improve heat or sound properties.

Advantageously, sheet **1** or **2** can consist of light-diffusing glass, i.e., glass roughened by chemical treatment or sand blasting. In that case the unit is installed so that the diffusing sheet is disposed on the side from which the stained glass window is not to be viewed, for instance, the outside of a building. Such a glass ensures a good distribution of the light reaching the stained glass window, which may be an advantage in some cases.

Light reflected from the surface of the glazing may cause trouble in cases in which the stained glass window is enclosed in the box-like structure. Although the reflection can produce interesting effects in some cases, it can be considerably reduced by depositing one or more nonreflecting layers on at least one of the transparent glass sheets so that all the qualities of the stained glass window can be appreciated without interference. Highly heat-reflecting layers can also be used to reduce the extent to which the stained glass window is heated by the sun's rays.

It can thus be seen that the transparent or translucent sheets, and the panes of the leaded colored window may be made of glass. Although other light-transmitting materials may be used in the alternative, in the preceding description of the invention the material employed has been assumed to be glass and the leaded colored windows have been referred to as stained glass windows. It is to be recognized that alternative materials can be advantageously employed.

In addition to the advantages of the invention already mentioned, there is a further advantage that the resilient connection to some extent, depending on the way this connection is achieved, absorbs forces due to vibration, impact and other causes, to which the hollow structure may be subjected and which would otherwise be more completely transmitted to the stained glass window.

By way of example, the stained glass window may be attached by at least one resilient layer of adhesive to one of the sheets forming a wall of the hollow structure. This is a very simple way of carrying out the invention and has the further advantage of giving continuous support to the stained glass window, the mechanical strength of which is relatively low since it is formed with a lattice of lead bars which are easily deformed.

The stained glass window may be disposed inside of the hollow structure or outside of it. In the latter case the stained glass window and forms a very satisfactory base for position of a transparent element between the spectator and the window. On the other hand, if the stained glass window is disposed inside of the hollow structure, the decorative element of the glazing is given better protection.

As an alternative to attachment of the stained glass window by at least one adhesive layer extending over the whole area of such window, the window may be attached to one of the sheets forming a wall of the structure by means of a resilient connecting member or members disposed between the marginal portions of the stained glass window and the wall. This arrangement permits a very resilient connection between the stained glass window and the supporting sheet. Moreover, this feature permits easier separation of the colored window from its support, which is very useful in case of accidental breakage of the glazing.

Advantageously, the stained glass window is inserted in a U-shaped channel forming a frame to which said connecting member or members is or are connected. The connecting member or members can be attached either to the web or one of the flanges of the U-channel. The use of said frame improves the dimensional stability of the stained glass window and forms a very satisfactory base for attaching the connecting member or members, but the direct connection of such member or members to the stained glass window is not excluded.

The connecting member or members may be made of metal and may be soldered to a frame of the stained glass window and to a metal layer deposited on the surface of one of the sheets forming walls of the hollow box-like structure. Alternatively, the connecting members may be

glued to the frame of the stained glass window and a surface of a sheet. Each of the above embodiments has particular advantages and one or the other of them may be more suitable in a given instance, depending on the materials used.

The use of U-shaped connecting members has the advantage that they have an inherent resilience and if the members are held in place by resilient adhesive layers, the resilience of the connection as a whole is greater. If suitably formed, the connecting members can hold quantities of dehydrating agent. This is an advantage when the stained glass window is located inside the hollow glazing unit because the dehydrating agent can absorb small quantities of moisture which may be present in, or gain access to the interior of the unit. For this purpose the connecting members can very suitably be of tubular form with apertures by which the interior of the tubes (containing the dehydrating agent) communicates with the interior of the box.

One of the walls of the box can advantageously be formed by a sheet of light-diffusing glass or an assembly of sheets containing a light-diffusing material such as glass fibers. This distributes the light very uniformly with consequent uniform illumination of the stained glass window.

Preferably at least one wall of the box comprises a sheet which is covered with a layer of material which reduces the reflection of light and/or reflects heat radiation. It is of advantage to reduce reflection of light from the surfaces of the glazing because the stained glass window can then be viewed more clearly and without interference. Such a layer can be formed by a material whose coefficient of refraction is substantially the geometrical mean between that of air and that of the material on which the layer is deposited. A nonreflecting deposit can also be built up by a number of layers. A number of layers can also be used to bring about heat reflection, and even to combine both effects by appropriate choice of the thickness of the layers. Reflection of heat radiation improves the temperature conditions in any premises in which the glazing may be used, and also reduces heating of the stained glass window by the sun's rays.

As already mentioned, it is not essential to the invention to use glass for the transparent or translucent sheets forming the box walls, or for the leaded colored window. As an alternative, transparent plastic materials, for instance polyacrylic plastic materials, can also be used. However, glass has qualities which make it the preferable material for carrying out the invention, i.e., it is very durable and stands up well to weathering. Moreover, glasses can be produced in very many colors which retain their tints satisfactorily, unlike coloring agents of plastic materials which are sensitive to various influences, more particularly ultraviolet radiation. All of these qualities of glass, therefore, combine to make it the most suitable material for the production and preservation of a work of art in the form of leaded colored windows.

It will be understood that the above description of the present invention is susceptible to various modifications, changes, and adaptations and the same are intended to be comprehended within the meaning and range of equivalents of the appended claims.

What is claimed is:

1. A glazing unit comprising, in combination: at least two panes each constituted by a light transmitting sheet and a connecting strip permanently attached to the periphery of the inner major surface thereof; spacing means disposed between said panes and secured to said strips thereof to form a hollow closed supporting structure with said panes; a leaded colored window; and resilient means connecting said window to only one of said panes, in facing relationship thereto, said resilient means being physically separate from said spacing means, so as to prevent the transmission of deformation forces between said spacing means and said window, and contacting only the peripheral portion of said window.

2. The glazing unit of claim **1** wherein at least one of said sheets is a sheet of light-diffusing glass.

3. The glazing unit of claim **1** wherein at least one of said sheets contains a light-diffusing material.

4. A glazing unit of claim **1** wherein at least one of said sheets is covered with a material which reduces light reflection.

5. A glazing unit of claim **1** wherein at least one of said sheets is covered with a layer of material which reflects heat radiation.

6. The glazing unit of claim **1** wherein said resilient means comprises at least one resilient layer of adhesive.

7. The glazing unit of claim **1** wherein said resilient means connecting said window to one of said sheets comprises at least one intervening resilient connecting member.

8. The glazing unit of claim **7** wherein there are a plurality of connecting members.

9. An arrangement as defined in claim **8** wherein each said connecting member is constituted by a strip of resilient metal.

10. An arrangement as defined in claim **9**, further comprising a U-section frame enclosing the edge of said leaded colored window, wherein said strips of resilient metal are connected to said frame.

11. An arrangement as defined in claim **10** wherein said resilient means further comprise a metal layer deposited on a surface of said one of said sheets, and each said strip is soldered to said frame and to said metal layer.

12. An arrangement as defined in claim **10** wherein each of said strips is glued to said frame and to said one of said sheets.

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