

PATENT SPECIFICATION

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(54) SOUND INSULATION STRUCTURE

(71) We, YOSHIDA KOGYO K.K., of No. 1, Kandaizumi-cho, Chiyoda-ku, Tokyo, Japan, a Japanese body corporate, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in any by the following statement:—

The invention relates to sound insulation structures.

A conventional sound insulator structure in use for a window or door frame includes two sheets of glass arranged in a parallel-spaced relation to each other.

According to the known structure, however, the sound absorption or insulation is not satisfactory since when one sheet of glass receives sound waves from outside and is thereby caused to vibrate, the air in the space between the two sheets of glass is also caused to vibrate and cause the other sheet of glass to vibrate. This could be avoided by providing a greater space, that is, more than 30 cm, between the two sheets of glass. However, this is undesirable or sometimes impossible because windows or door frames for commercial use are not thick enough to allow such a structure to be arranged therein. If a window or door frame could be provided with such a thickness, it would require an opening of a building for a window or door that is thick enough to allow such a frame to be arranged therein. For this reason, the conventional structure has few uses or applications.

The invention consists in a sound insulator structure as set forth in claim 1.

As the sheets of glass are caused to vibrate in different manners when sound waves strike against the outer or inner sheet of glass, it is possible to obtain a good sound absorption or insulation by absorbing sound reflections that may follow vibrations of the sheets and window or

door frames.

The sound insulator structure constructed according to the invention may be used with door or window frames of metal or wood, or the frame may be of wood material base covered with metallic material.

There are two different ways of mounting the sound insulator structure in a window or door frame. One is that the sheet edge holding structure or glazing element is first set in a window or door frame with its grooves set in position and secured to the window or door frame by suitable means such as adhesive material. Three sheets of glass are then set in the grooves of the glazing element. The other is that three sheets of glass are first set in the glazing element, and the glazing element thus glazed is then mounted in a window or door frame.

The outer and inner sheets may be 3mm thick respectively, and the intermediate sheet may be 5mm thick.

If any gaps are present between the glazing element and the outer and inner sheets of glass held thereby or between the door or window frame and the glazing element, the sound absorption or insulation will be adversely affected. In order to avoid this, surfaces of contact between the glazing element and the window or door frame should preferably be provided with curved surfaces so that the contacted surfaces may be securely joined together by pressure or by adhesive material. The glazing element and the outer and inner sheets of glass held thereby are joined together by application of adhesive material, whereas the intermediate sheet of glass is set in the glazing element freely. When sound waves strike the outer or inner sheet of glass which is thereby caused to vibrate and influence the intermediate sheet of glass, the three sheets of glass are caused to vibrate

in different manners. This provides an effective means of absorbing or insulating noise due to vibration of the glass sheets and door frame.

- 5 Relatively small spaces such as 2.5 cm, for example, may be provided between the three sheets of glass arranged in a parallel-spaced relation, so that substantially half the amount of incoming sounds or noises
10 can be absorbed or insulated.

The invention will be further described by way of example with reference to the accompanying drawings.

In the drawings:—

- 15 Figure 1 is a front view of a preferred embodiment of the present invention;

Figure 2 is an enlarged sectional view taken along the line A-A of Figure 1;

- 20 Figure 3 is a sectional view, partly enlarged, of the embodiment of Fig. 1 set in a metallic door frame.

Figure 4 is a diagram showing variations of the acoustic transmission loss with sound frequency.

- 25 As has been described in brief, the present invention provides a sound insulator structure adapted to be set in a window or door frame, comprising three sheets of glass arranged in a parallel-spaced relation
30 to each other and at least one of which is of different thickness from the two others, and a glazing element of elastic material provided with grooves for encircling and holding the edges of the three sheets of
35 glass.

- By setting the structure in a door frame, for example it is possible to minimize the amount of noise produced by vibrations of the glass sheets and door frame when receiving incoming sound waves.
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A good sound absorbing or insulating effect can thus be obtained regardless of the material of the window or door frame used.

- Referring first to Figures 1 and 2, a
45 70mm wide glazing element B of rubber material is provided with grooves 4 and 5 encircling and holding the edges of the sheets of glass 1 and 2 of 3mm thickness, and a groove 6 for a sheet of glass 3 of 5
50 mm thickness. The grooves 4, 5 and 6 are parallel to each other, being spaced at an interval of about 2.5cm. Hollow portions 7 and 8 are provided between the grooves 4 and 6 and between the grooves 6 and 5,
55 respectively for receiving and supporting containers 10, 10 for desiccant material 9.

- When hollow portions 7 and 8 are of a rectangular shape, portions 7a and 8a are provided on the inner wall of the hollow
60 portions 7 and 8 for supporting the containers 10, 10.

- The surface areas 11 and 12 surrounding the spaces between the grooves 4, 5 and 6 or sheets of glass 1, 2 and 3 set therein are
65 covered with sound absorbing material

such as a felt or mohair layer, or fibres 13 of short length implanted in these surfaces.

It is possible first to set the sheets of glass 1, 2 and 3 in the corresponding
70 grooves 4, 5 and 6, so that the sheets are arranged in a parallel-spaced relation to each other. The glazing element B thus glazed is then mounted in a window frame 14 of wood material. In this case, the sheets of glass 1 and 2 are secured in the
75 grooves 4 and 5 by application of adhesive material whereas the sheet of glass 3 is freely supported in the groove 6. Reference numeral 15 is an opening of a building for a window frame, 16 is a rotary shaft
80 provided on a window frame of wood, 17 is a retaining member for holding the frame B in position, 18 is a protrusion provided on the inner wall of the frame 14, and 51 is packing.

The sheet of glass 1 is caused to vibrate upon receiving compression waves of sound which strike the sheet 1 from the arrow direction 19, followed by vibrations in the air in the space between the sheets 1 and 3.
90 As the sheet 3 differs in thickness from the sheet 1 and is freely held by its corresponding groove 6, the sound waves are attenuated to a considerable degree upon impact on the sheet 3, going forward to the sheet 2 where the waves are echoed and further attenuated to pass through the sheet 2 in the arrow direction 20.

The edge of the sheet 3 is not rigidly secured to or freely held by the groove 6 of the glazing element, so that the sheet 3 produces vibrations in a different manner from the other sheets 1 and 2, and the vibrations are absorbed by the glazing element B. This provides an effective
105 means of increasing the sound absorbing or insulating effect.

The spaces *a* and *b* between the sheets 1 and 3 and between the sheets 3 and 2 are connected to each other by means of gaps or clearances which are present at the edge of the sheet 3.

The pressures in the spaces *a* and *b* may change with variations of the temperatures outside or in a room, but such changes can be automatically adjusted by the presence of the gaps or clearances to such an extent that the pressures which strike against both sides of the sheet 3 are kept to a constant level.
120

If wind pressure is exerted on the sheet 1, the pressure in the space *a* becomes higher. This increases the resistance of the sheet 1 to pressure from outside.

A suitable number of holes 21 and 22
125 are provided to connect the spaces *a* and *b* to the hollow portions 7 and 8, respectively. The air in the spaces *a* and *b* is thus kept dry and at low humidity by the desiccant material 9 in the container 10.
130

Figure 3 is a sound insulator structure embodying the invention, which is set in a metallic door frame. A glazing element 36 of rubber material is first mounted in an aluminium sash. The glazing element 36 is provided with grooves 37, 38 and 39 for holding the edges of the sheets 41, 42 and 43. The sheets of glass 41, 42 and 43 are then set in their respective grooves with the sheets 41 and 43 rigidly secured by adhesive means and with the sheet 42 freely held. This is the same as described in Figure 1. The surface areas of the glazing element 36 surrounding the spaces *e* and *f* between the sheets 41 and 42 and between the sheets 42 and 43 are fibre-implanted surfaces 44, or may be roughened surfaces. The sheets 41 and 43 are 3mm thick whereas the sheet 42 is 5mm thick, but this is not limitative. Reference numerals 45 and 46 are hollow portions provided at opposite sides of the glazing element 36 for each housing a container 47 for desiccant material 48. Reference numerals 49 and 50 are holes provided to connect the hollow portions 45 and 46 to the spaces *e* and *f*.

There are two different manners of mounting the glazing element 36 in the aluminium sash 40. One is that the glazing element 36 is first mounted in the sash 40 and rigidly secured thereto by adhesive. The sheets of glass 41, 42 and 43 are then set in the grooves of the glazing element 36. The other is that the sheets 41, 42 and 43 are first set in the grooves to form a block of the sheets arranged in a parallel spaced relation; the glazing element 36 thus glazed is then mounted in the sash 40.

The shapes in section of the aluminium sash and the glazing element may be varied and are not limitative to the embodiments described heretofore provided that the glazing element is constructed such that its grooves hold the three sheets of glass securely in a parallel-spaced relation.

In Figure 4, a diagram is given to show variations of the acoustic transmission loss (dB) with sound frequency (Hz) for the following cases:

In the diagram, (1) is the case where three sheets of glass each of 5mm thickness are used, (2) is the case where the intermediate sheet of 5mm thickness and the outer and inner sheets each of 3mm thickness are used, and (3) is the case where the intermediate sheet of 8mm thickness and the outer and inner sheets each of 5mm thickness are used.

In all cases, the three sheets of glass are spaced by 2.5cm, but this is not limitative. For example, they may be spaced by 3cm on the sound source side and by 2cm on the other side.

It is clear from the diagram that the cases (2) and (3) have advantages over the case (1) in absorbing or insulating sounds of low frequencies (noises caused by vehicles, for example) and sounds of high frequencies (noises caused by airplanes, for example).

WHAT WE CLAIM IS:—

1. A sound insulator structure adapted to be set in a window or door frame, comprising three sheets of transparent material arranged in a parallel-spaced relation to each other and at least one of which is of different thickness from the other sheets, and a sheet edge holding structure of elastic material provided with a plurality of hollow portions to house containers for desiccant material, and with grooves to hold the edges of said three sheets, one of said grooves being adapted to hold an intermediate sheet of said sheets freely supported whereas the remainder of said grooves are adapted to hold said two other sheets rigidly secured to said remainder of said grooves by adhesive, and sound-absorbing means provided on inner wall surfaces of said sheet edge holding structure.

2. A sound insulator structure as claimed in claim 1 set in a sash of aluminium material.

3. A sound insulator structure as claimed in claim 1 set in a window or door frame of wood material base covered with metallic material.

4. A sound insulator structure as claimed in claim 1 wherein said sound-absorbing means comprises provision of roughened surfaces on said inner wall surfaces.

5. A sound insulator structure as claimed in claim 1 wherein said sound-absorbing means comprises provision of mohair surfaces on said inner wall surfaces.

6. A sound insulator structure as claimed in claim 1 wherein said intermediate sheet is of substantially greater thickness than said two other sheets.

7. A sound insulator structure substantially as hereinbefore described with reference to the accompanying drawings.

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2. A sound insulator structure as claimed in claim 1 set in a sash of aluminium material.
3. A sound insulator structure as claimed in claim 1 set in a window or door frame of wood material base covered with metallic material.
4. A sound insulator structure as claimed in claim 1 wherein said sound-absorbing means comprises provision of roughened surfaces on said inner wall surfaces.
5. A sound insulator structure as claimed in claim 1 wherein said sound-absorbing means comprises provision of mohair surfaces on said inner wall surfaces.
6. A sound insulator structure as claimed in claim 1 wherein said intermediate sheet is of substantially greater thickness than said two other sheets.
7. A sound insulator structure substantially as hereinbefore described with reference to the accompanying drawings.

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