

THERMALLY-INSULATED WINDOW ASSEMBLY

The present invention relates to windows, and more particularly to a thermally-insulated window assembly equipped with weathertightly sealing means.

Thermally-insulated window assemblies are known
5 in which a pair of spaced interior and exterior frame halves of a metallic outer frame is interconnected by means of thermally insulating connector bars. In order to make the window weathertight, it is known to provide an endless or encircling chamber between the outer frame
10 and a metallic inner frame by first and second sealing means spaced apart from one another and coextensive with the frames, the outer frame having an opening through which the chamber is open to the outside air. However, because the inner frame, which is exposed at its exterior
15 side to the air in the chamber, serves as a conductor for transferring heat, only inadequate thermal-insulation can be achieved. With this arrangement, the interior side of the inner frame tends to be wet with dew drops when the outside air and thus the air in the chamber is
20 cold, particularly in winter season.

According to the present invention, there is provided a thermally-insulated window assembly comprising: a rectangular outer frame of metal defining a window opening, said outer frame including a pair of
25 horizontal frame members and a pair of vertical frame members connected to said horizontal frame members

(13)

- 2 -

at their ends, each of such four frame members including a pair of spaced exterior and interior frame member halves interconnected by at least one thermally insulating connector bar; a window including a rectangular inner frame of metal mounted within said outer frame and a pane mounted within said inner frame; first sealing means of thermally insulating material coextensive with and supported on the four exterior frame member halves and weather-tightly engaging said inner frame on an exterior side thereof; and second sealing means of thermally insulating material coextensive with and supported on said inner frame and engaging said four exterior frame member halves, said first and second sealing means jointly defining an endless or encircling chamber between the exterior side of said inner frame and said four exterior frame member halves, one of said four exterior frame member halves having at least one opening through which said chamber is open to the outside air, said second sealing means covering substantially completely the whole surface of the exterior side of said inner frame to thereby prevent the latter from being exposed to the air in said chamber that is open to the outside air; said first sealing means being disposed in such a position as to prevent said connector bar from being exposed to the air in said chamber.

25 It is possible by means of the invention to provide an improved window assembly which enables not only adequate thermal-insulation but also satisfactory weatherproofing, thus preventing the interior side of an inner frame from

being wet with dew drops even when the outside air and thus the air in the chamber is cold.

The invention will be described by way of examples with reference to the accompanying drawings, wherein:-

5 Figure 1 is a front elevational view of a thermally-insulated window assembly embodying the present invention;

Figure 2 is an enlarged vertical cross-sectional view of the window assembly of Figure 1;

10 Figure 3 is an enlarged horizontal cross-sectional view of the window assembly of Figure 1; and

Figure 4 is a fragmentary, enlarged vertical cross-sectional view of a modified window assembly embodying the present invention.

15 In carrying the invention into effect according to one convenient mode by way of example, Figures 1 to 3 of the drawings show a thermally-insulated window assembly which generally comprises a rectangular outer frame 4 adapted to be mounted within an opening 3 (Figure 1) in a building wall, and a window 5 mounted within the outer
20 frame 4.

The outer frame 4 includes a pair of upper and lower horizontal frame members 6, 7 (Figures 1 and 2) and a pair of vertical frame members 8, 8 (Figures 1 and 3) connected to the horizontal frame members 6, 7 at their ends to
25 define a rectangular window opening. The upper and lower horizontal frame members 6, 7 are fixed to a pair of upper and lower horizontal support _____

(15)

- 4 -

bars 2, 2, respectively. The vertical frame members 8, 8 are fixed to a pair of vertical support bars 1, 1, respectively.

5 The window 5 includes a pair of closely spaced parallel panes of glass 12, and a rectangular inner frame (described below) of metal extending along and embracing the periphery of the panes 12. The inner frame is pivotally mounted within the outer frame 4 by means of a hinge 69 (Figure 2) so that the window
10 can be tilted to the interior side. The inner frame includes a pair of upper and lower horizontal frame members 9, 10 (Figures 1 and 2), and a pair of vertical frame members 11, 11 (Figures 1 and 3) connected to the horizontal frame members 9, 10 at their ends.

15 As shown in Figure 2, the upper horizontal frame member 6 of the outer frame 4 comprises a pair of spaced interior and exterior member halves 20, 21 made of metal such as aliminium and interconnected by a pair of thermally insulating connector bars 22, 22. Each of
20 the interior and exterior member halves 20, 21 has through its full length an elongate hollow defined by four walls 20a, 20b, 20c, 20d; 21a, 21b, 21c, 21d. The lower wall 21d of the exterior member half 21 has on its under side a longitudinal groove 23, for a
25 purpose described below. The interior and exterior member halves 20, 21 have a pair of upwardly directed parallel flanges 25, 26, respectively, which is weather-

tightly fixed to the upper horizontal support bar 2. The exterior member half 21 also has a downwardly directed flange 24 as an extension of the front wall 21b.

5 Likewise, the lower horizontal frame member 7 of the outer frame 4 comprises a pair of spaced interior and exterior member halves 30, 31 made of metal such as aluminium and interconnected by a pair of thermally insulating connector bars 32, 32. Each of the interior
10 and exterior member halves 30, 31 has through its full length an elongate hollow defined by four walls 30a, 30b, 30c, 30d; 31a, 31b, 31c, 31d. The upper wall 31d of the exterior member half 21 has on its upper side a longitudinal groove 33, for a purpose described below.
15 The interior and exterior member halves 30, 31 have a pair of downwardly directed parallel flanges 37, 38, respectively, which is weathertightly fixed to the lower horizontal support bar 2. The exterior member half 31 also has an upwardly directed flange 36 as an extension
20 of the front wall 31b.

As shown in Figure 3, each vertical frame member 8 of the outer frame 4 comprises a pair of spaced interior and exterior member halves 30', 31' made of metal such as aluminium and interconnected by a pair of
25 thermally insulating connector bars 32', 32'. Each of the interior and exterior member halves 30', 31' has through its full length an elongate hollow defined by

(17)

- 6 -

four walls 30'a, 30'b, 30'c, 30'd; 31'a, 31'b, 31'c,
31'd. The inner wall 31'd of each exterior member half 31'
has on its inner side a longitudinal groove 33', for
a purpose described below. Each exterior member half 31' also
5 has an inwardly directed flange 36' as an extension of
the front wall 31'd.

As shown in Figure 2, the upper horizontal frame
member 9 of the inner frame includes a pair of parallel
interior and exterior side walls 40, 41 and an inter-
10 mediate portion (described below) extending between the
lower edge of the interior side wall 40 and the upper
edge of the exterior side wall 41. The intermediate
portion has a pair of parallel horizontal walls 42, 42a
of different length and a vertical wall 42b extending
15 between the horizontal walls 42, 42a at their exterior
side; such three walls 42, 42a, 42b with a lower portion
of the interior wall 40 define an elongate hollow
through the full length of the upper horizontal frame
member 9. The lower horizontal wall 42a has on its
20 under side a longitudinal groove 43, for a purpose
described below. The exterior side wall 41 has on its
interior side a longitudinal groove 44, for a purpose
described below.

Likewise, the lower horizontal frame member 10
25 of the inner frame includes a pair of a pair of parallel
interior and exterior side walls 50, 51 and an inter-
mediate portion (described below) extending between the

upper edge of the interior side wall 50 and the lower edge of the exterior side wall 51. The intermediate portion has a pair of parallel horizontal walls 52, 52a of different length and a vertical wall 52b extending
5 between the horizontal walls 52, 52a at their exterior side; such three walls 52, 52a, 52b with an upper portion of the interior wall 50 define an elongate hollow through the full length of the lower horizontal frame member 10. The upper horizontal wall 52a has on its
10 upper side a longitudinal groove 53, for a purpose described below. The exterior side wall 51 has on its interior side a longitudinal groove 54, for a purpose described below.

As shown in Figure 3, each vertical frame member
15 11 of the inner frame includes a pair of parallel interior and exterior side walls 70, 71 and an intermediate portion (described below) extending between the inner edge of the interior side wall 70 and the outer edge of the exterior side wall 71. The intermediate
20 portion has a pair of parallel inner and outer walls 72, 72a of different length and a lower (as viewed in this Figure) wall 72b extending between the vertical walls 72, 72a at their exterior side; such three walls 72, 72a, 72b with an inner portion of the interior side
25 wall 70 define an elongate hollow through the full length of the respective vertical frame member 11. The inner wall 72a has on its inner side a longitudinal

groove 73, for a purpose described below. The exterior side wall 71 has on its interior side (upper side in this Figure) a longitudinal groove 74, for a purpose described below.

5 A pair of upper and lower weather strips (first sealing means) 60, 61 (Figure 2) is coextensive with and is supported by the upper and lower horizontal frame members 6, 7, respectively, of the outer frame 4. The upper weather strip 60 has a base 60a fixedly received
10 in the groove 23 of the exterior member half 21, and an interiorly inclined projection 60b extending from the base 60a and terminating in a tapering, outwardly (upwardly) bent end (as viewed in cross section) 60c which resiliently and weathertightly engages an extension 42'b of the vertical wall 42b of the inner frame.
15 The lower weather strip 61 has a base 61a fixedly received in the groove 33 of the exterior member half 31, and an interiorly inclined projection 61b extending from the base 61a and terminating in a tapering, outwardly (downwardly) bent end (as viewed in cross
20 section) 61c which resiliently and weathertightly engages an extension 52'b of the vertical wall 52b of the inner frame.

 Similarly, a pair of right and left vertical
25 weather strips (first sealing means) 61', 61' (Figure 3) is coextensive with and is supported by the right and left vertical frame members 8, 8, respectively, of

20

the outer frame 4. Each vertical weather strip 61' has a base 61'a fixedly received in the groove 33' of the exterior member half 31', and an interiorly inclined projection 61'b extending from the base 61'a and terminating in a tapering, outwardly (rightwardly or leftwardly) bent end (as viewed in cross section) 61'c which resiliently and weathertightly engages an extension 72'b of the lower (as viewed in Figure 3) wall 72b of the inner frame.

10 As shown in Figure 2, the upper periphery of the window pane 12 is pressed on opposite sides by a base portion 64a of an upper horizontal weather strip (second sealing means) 64 and an upper gasket 66. The base portion 64a of the weather strip 64 is fixedly received
15 in the groove 44 of the upper horizontal frame member 9 of the inner frame, and has a plurality of tongues resiliently engaging the window pane 12. The upper gasket 66 is carried by an upper batten 63, a base portion of which is fixedly received in the groove 43
20 of the upper horizontal frame member 9.

Similarly, the lower periphery of the window pane 12 is pressed on opposite sides by a base portion 65a of a lower horizontal weather strip 65 (second sealing means) and a lower gasket 66. The base portion 65a of
25 the weather strip 64 is fixedly received in the groove 54 of the lower horizontal frame member 10 of the inner frame, and has a plurality of tongues resiliently

engaging the window pane 12. The lower gasket 66 is carried by a lower batten 63, a base portion of which is fixedly received in the groove 53 of the lower horizontal frame member 10.

5 As shown in Figure 3, each side periphery of the window pane 12 is pressed on opposite sides by a base portion 67a of a vertical weather strip (second sealing means) 67 and a vertical gasket 66. The base portion 67a of the weather strip 67 is fixedly received in the
10 groove 74 of the respective vertical frame member 11 of the inner frame, and has a plurality of tongues resiliently engaging the window pane 12. The vertical gasket 66 is carried by a respective vertical batten 63, a base portion of which is fixedly received in the groove
15 73 of the respective vertical frame member 11 of the inner frame.

Each of the upper and lower horizontal weather strips 64, 65 (Figure 2) has a covering portion 64b, 65b extending from the base portion 64a, 65a and terminating in an
20 inwardly (downwardly or upwardly) bent end (as viewed in cross section) 64'b, 65'b fixedly received in a groove 45, 55. Thus the covering portion 64b, 65b of each weather strip 64, 65 substantially completely covers the whole surface of the respective exterior side
25 wall 41, 51. Each weather strip 64, 65 also has a tapering, outwardly (upwardly or downwardly)

bent projection 64c, 65c extending from the respective covering portion 64b, 65b and engaging an interiorly directed end (as viewed in cross section) 24a, 36a of the respective exterior flange 24,36 of the outer
5 frame 4.

Likewise, each vertical weather strip 67 (Figure 3) has a covering portion 67b extending from the base portion 65a and terminating in an inwardly bent end (as viewed in cross section) 67'b fixedly received in
10 a groove 75. Thus the covering portion 67b of each vertical weather strip 67 substantially completely covers the whole surface of the respective exterior side wall 71. Each weather strip 71 also has a tapering, outwardly bent projection 67c extending from the
15 respective covering portion 67b and engaging an interiorly directed end (as viewed in cross section) 36'a of the respective exterior flanges 36' of the outer frame 4.

Thus, the upper first weather strip 60 and the
20 upper second weather strip 64 define an upper horizontal chamber section A1 (Figure 2) between the upper frame member 9 of the inner frame and the upper exterior frame member half 21 of the outer frame 4. The lower first weather strip 61 and the lower second weather strip 65
25 define a lower horizontal chamber section A2 (Figure 2) between the lower frame member 10 of the inner frame and the lower exterior frame member half 31 of the outer frame 4. Each vertical first weather strip 61' and

each vertical second weather strip 67 define a vertical chamber section A3 (Figure 3) between the respective vertical frame member 11 of the inner frame and the respective vertical exterior frame member half 31' of the outer frame 4. The two horizontal chamber section A1, A2 and the two vertical chamber sections A3, A3 constitute an endless or encircling combined chamber.

As shown in Figure 2, the upper and lower walls 31d, 31e of the lower exterior member half 31 of the outer frame 4 have a pair of vertically aligned openings 34, 35, respectively, the lower first weather strip 61 having a cutout 62 vertically aligned with the openings 34, 35. Through the openings 34, 35 and the cutout 62, the combined chamber A1, A2, A3, A3 is open to the outside air so that the air pressure in the combined chamber is equalized with the air pressure outside, thus causing improved weatherproofing.

Since the whole surface of each exterior wall 41, 51, 71, 71 of the inner frame is completely covered by the respective second weather strip 64, 65, 67, 67 which is made of thermally insulating material, it is possible to prevent the inner frame from serving as a "bridge" or conductor for transferring heat between the interior and the exterior. The interior side of the inner frame is thereby prevented from being wet with dew drops even when the outside air is cold, particularly in winter season.

(24)

Further, the first weather strips 60, 61, 61' are disposed in such a position as to prevent the thermally insulating connector bars 22, 32, 32' from being exposed to the air introduced into the chamber from outside. With this arrangement, because there is no danger that the connector bars 22, 32, 32' are dewed or freezed, good thermal-insulation of the connector bars 22, 32, 32' is guaranteed.

Another advantage of the window assembly thus constructed is that the rain water introduced into the groove 33 (Figure 2) e.g. by capillarity is immediately and perfectly drained out, through the cutout 62 of the lower second weather strip 61 and then through the openings 34, 35, without being freezed in the groove 33.

Given that the outwardly bent projection 64c, 65c, 67c of each second weather strip 64, 65, 67 is only slightly resilient, this projection, when heavy wind hits the window 5, bends off the interiorly directed end 24a, 36a, 36'a of the respective exterior flange 24, 36, 36' so that the outside air flows into the chamber through such a gap. The air pressure in the chamber is thus equalized with the air pressure outside.

Further, since the projection 60b, 61b, 61'b of each first weather strip 60, 61, 61' is inclined interiorly, it is possible to have its tapering end 60c, 61c, 61'c brought in sure engagement with the extension 42'b, 52'b, 72'b of the wall 42b, 52b, 72b of the inner frame.



On and along its outer edge, each of the four interior side walls 40, 50, 70, 70 of the inner frame carries a weather strip 68 (Figures 2 and 3) of thermally insulating material weathertightly engaging the respective interior member half 20, 30, 30', 30' of the outer frame 4.

Figure 4 illustrates a modified form of window assembly having four modified first weather strip 60, 61, 61', 61' (only a lower horizontal weather strip 61 is shown for clarity) and four modified second weather strips 64, 65, 67, 67 (only a lower horizontal weather strip 65 is shown for clarity). The modified second weather strip 65 has the same construction as the second weather strips of Figures 2 and 3 except that its covering portion 65b extends further so as to also cover the whole exterior surface of the wall 52b and terminates in an inwardly bent end 65'b embracing the extension 52'b of the wall 52b. The modified first weather strip 61 is disposed on the inner connector bar 32 so as to completely cover the inner surface of the connector bar 32 by the base portion 61a, with the tapering bent end 61c of the interiorly inclined projection 61b weathertightly engaging the covering portion 65b of the modified second weather strip 65. The modified first weather strip 61 may be integrally formed at its base portion 61a with the connector bar 32.

In Figures 2 to 4, the weather strips 60, 61, 64,

26

- 15 -

65, 68 may be made of a thermally insulating synthetic resin such as soft polyvinyl chloride, chloroprene rubber, ethylene-propylene rubber. The connector bars 22, 32 may be made of a thermally insulating synthetic resin such as polyamid 6-6, hard foamed polyurethane, 5 hard polyvinyl chloride, ABS resin, polyacetal.

Alternatively, the base portion 64a, 65a of each second weather strip 64, 65 may be made of hard synthetic resin, with the remaining portions (projec- 10 tion and bent end) 64b, 64c; 65b, 65c made of soft synthetic resin.



* C L M S *

- 16 -

CLAIMS:

1. A thermally-insulated window assembly comprising: a rectangular outer frame of metal defining a window opening, said outer frame including a pair of horizontal frame members and a pair of vertical frame members connected to said horizontal frame members at their ends, each of such four frame members including a pair of spaced interior and exterior frame member halves interconnected by at least one thermally insulating connector bar; a window including a rectangular inner frame of metal mounted within said outer frame and a pane mounted within said inner frame; first sealing means of thermally insulating material coextensive with and supported on the four exterior frame member halves and weathertightly engaging said inner frame on an exterior side thereof; and second sealing means of thermally insulating material coextensive with and supported on said inner frame and engaging said four exterior frame member halves, said first and second sealing means jointly defining an endless or encircling chamber between the exterior side of said inner frame and said four exterior frame member halves, one of said four exterior frame member halves having at least one opening through which said chamber is open to the outside air, said second sealing means covering substantially completely the whole surface of the exterior side of said inner frame to thereby prevent



(28)

- 17 -

the latter from being exposed to the air in said chamber that is open to the outside air; said first sealing means being disposed in such a position as to prevent said connector bar from being exposed to the air in said
5 chamber.

2. A thermally-insulated window assembly according to claim 1, in which said opening is formed in the exterior frame member half of a lower one of said horizontal frame members.

10 3. A thermally-insulated window assembly according to claim 1, in which said second sealing means serves in part as a gasket held between said window pane and said inner frame.

15 4. A thermally-insulated window assembly according to claim 1, in which said first sealing means completely covers one surface of said connector bar and weathertightly engages said second sealing means.
