

CURTAIN WALLS COMPRISING APPARATUS FOR CONNECTING
CURTAIN WALL UNITS

The present invention relates to curtain walls comprising apparatus for connecting curtain wall units juxtaposed vertically and horizontally in a vertical plane.

In a conventional connecting apparatus as described in Japanese Patent Laid-open Publication No. 59-24052, a female member and a male member engaged with each other in a vertical plane are fixed to a lower end of an upper curtain wall unit and an upper end of a lower curtain wall unit each comprised in the unit type curtain wall, respectively, so as to connect the upper and lower curtain wall units with each other in such a manner as to permit relative displacement in the plane.

According to the aforementioned known connecting apparatus, in-plane displacement between the upper and lower adjacent curtain wall units is absorbed therebetween, and the outer surfaces of the curtain wall units are flush with each other. However, the outer surfaces of horizontally adjacent curtain wall units may not be flush. As a result, the entire outer surface of

in opposed relation with each other, said second coupling members each having an upwardly recessed portion; each projecting portion being engaged with a respective one of said recessed portions in such a manner that in-plane relative displacement of the curtain wall units in the vertical and horizontal direction in said vertical plane is permitted, while out-of-plane relative displacement thereof is restricted; a connecting plate provided either across said first coupling members or across said second coupling members; through-holes formed through either said first or said second coupling members, respectively; and bolts inserted through said through-holes for fixedly connecting said connecting plate and either said first or said second coupling members with the other pair of coupling members sandwiched between said connecting plate and said former pair of coupling members.

According to a second aspect of the present invention there is provided a curtain wall comprising curtain wall units, where are juxtaposed vertically and horizontally in a vertical plane, interconnected with each other at a portion of the wall where four corners of said curtain wall units are adjacent one another by connecting apparatus comprising a pair of first coupling members fixed to upper edge portions of a pair of horizontally

the unit type curtain wall may be out of alignment, resulting in poor appearance and there is a possibility of a reflective image on the entire outer surface being rendered out of order.

It is believed possible by means of the present invention to provide an apparatus for connecting curtain wall units juxtaposed vertically and horizontally in a vertical plane which permits the curtain wall units to be independently and correlatively moved in the plane, and may make the outer surfaces of the curtain wall units flash with each other.

According to a first aspect of the present invention there is provided a curtain wall comprising curtain wall units, which are juxtaposed vertically and horizontally in a vertical plane, interconnected with each other at a portion of the wall where four corners of said curtain wall units are adjacent one another by connecting apparatus comprising a pair of first coupling members fixed to upper edge portions of a pair of horizontally adjacent lower positioned curtain wall units, respectively, said first coupling members each having an upwardly projecting portion, a pair of second coupling members fixed to lower edge portions of a pair of horizontally adjacent upper positioned curtain wall units, respectively, in such a manner as to be arranged

adjacent lower positioned curtain wall units, respectively, said first coupling members each having an upwardly recessed portion, a pair of second coupling members fixed to lower edge portions of a pair of horizontally adjacent upper positioned curtain wall units, respectively, in such a manner as to be arranged in opposed relation with each other, said second coupling members each having the an upwardly projecting portion; each projecting portion being engaged with a respective one of said recessed portions in such a manner that in-plane relative displacement of the curtain wall units in the vertical and horizontal directions in said vertical plane is permitted, while out-of-plane relative displacement thereof is restricted; a connecting plate provided either across said first coupling members or across said second coupling members; through-holes formed through either said first or said second coupling members, respectively; and bolts inserted through said through-holes for fixedly connecting said connecting plate and either said first or said second coupling members with the other pair of coupling members sandwiched between said connecting plate and said former pair of coupling members.

The second aspect of the invention is merely a modification of the first aspect of the invention.

In a preferred embodiment, either pair of adjacent first or second coupling members are aligned in their respective out-of-plane positions by the connecting plate and the other pair of adjacent coupling members. Further, the recessed portions of either pair of adjacent first or second coupling members are respectively engaged with the projecting portions of the other pair of adjacent coupling members. Accordingly, the outer surfaces of the left lower, right lower, left upper and right upper curtain wall units are kept flush in a plane to improve appearance and make a reflective image on the entire outer surface in order. In addition, each of the curtain wall units can be restrained from out-of-plane movement.

Further, the bolts for connecting the connecting plate with the other pair of coupling members and operating to sandwich the former pair of coupling members therebetween are inserted through the through-holes of the former pair of coupling members, and each of the curtain wall

units may be independently moved in a plane, where the curtain wall units are juxtaposed vertically and horizontally, by the amount of play between the through-holes and the bolts, thereby absorbing in-plane correlative displacement created in the vertical and horizontal direction by thermal expansion and earthquake, etc. among the curtain wall units.

Furthermore, either pair of adjacent first or second coupling members having the projecting portion and the other pair of adjacent coupling members having the recessed portion are connected by the bolts with each other, so there is no possibility of both the pairs of adjacent first and second coupling members vertically disengaged from each other, thereby preventing the vertically adjacent curtain wall units from being disengaged from each other.

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

Fig. 1 is an exploded perspective view of a part designated by I in Fig. 5;

Fig. 2 is a vertical sectional view of a connecting portion of adjacent curtain wall units in accordance with the present invention;

Fig. 3 is an enlarged front view of a part as designated by reference I in Fig. 5;

Fig. 4 is a cross section taken along the line

IV-IV in Fig. 2; and

Fig. 5 is a schematic elevational view of a part of a unit type curtain wall.

Referring to Fig. 5 which shows a schematic elevational view of a part of a unit type curtain wall, a plurality of curtain wall units A are vertically and horizontally juxtaposed to each other in a vertical plane. Each of the curtain wall units A is constituted of a rectangular frame 4 and a panel member such as a glass 5 mounted in the frame 4. The rectangular frame 4 includes an upper frame member 1, lower frame member 2 and right and left vertical frame members such as square timbers 3.

Referring to Fig. 1 which shows an exploded perspective view of a portion indicated by I in Fig. 5, that is, a connecting portion at a portion where four corners of upper, lower, right and left curtain wall units meet with one another, each of first coupling members 10 is fixed to upper edge portions of a left lower curtain wall unit A₁ and a right lower curtain wall unit A₂, or upper end portions of the vertical frame members 3 adjacently arranged, for example. Further, each of second coupling members 20 is fixed to lower edge portions of a left upper curtain wall unit A₃ and a right upper curtain wall unit A₄, or lower end portions of the vertical frame members 3 adjacently arranged, for example.

Each of the first coupling members 10 is constituted

by a projecting portion 16 having a horizontally extending hollow portion 15 as defined by inside and outside vertical walls 11 and 12 and upper and lower horizontal walls 13 and 14, and of a mount wall or flange 17. The mount wall 17 is inserted into a hollow portion 3' of the vertical frame member 3, and is fixed by bolts 18 in such a manner that the projecting portion 16 is directed upwardly. The inside and outside vertical walls 11 and 12 are formed with horizontally elongated through-holes 19. Each of the through-holes 19 is formed with a circular large-diameter portion 19a at one end portion thereof to be engaged with a lifting hook when the curtain wall unit is lifted and mounted to a subject outer wall.

Each of the second coupling members 20 is formed with a recessed portion 24 as defined by inside and outside vertical walls 21 and 22 and an upper horizontal wall 23. The recessed portion 24 is opened downwardly and has such a shape and size as to mate with the projecting portion 16. The second coupling member 20 is inserted into a lower end portion of the hollow portion 3' of the vertical frame member 3, and is fixed by bolts 25.

As shown in Fig. 4, the vertical frame member 3 is an elongated material including the hollow portion 3' as defined by a thick-walled inside wall 3a, outside wall (not shown) and thin-walled side walls 3b. As shown in Figs. 2 and 3, a lower portion of the outside vertical wall 12 of the first coupling member 10 and the mount wall 17 are

engaged with the hollow portion 3'. The bolts 18 are inserted from holes 30 of the inside wall 3a, and are threadedly engaged with screw holes 17a of the mount wall 17. Bolts 31 are inserted through both the side walls 3b, and are thread-
5 edly engaged with screw holes 12a formed at the lower portion of the outside wall 12. Similarly, bolts 25 are inserted through both the side walls 3b, and are threadedly engaged with screw holes 21a and 22a formed through the inside and outside vertical walls 21 and 22 of the second coupling
10 member 20.

The upper frame member 1 and the lower frame member 2 are in a heat insulating construction such that inside frame portions 1a and 2a are connected through heat insulating materials 1c and 2c to outside frame portions 1b and 2b,
15 respectively.

Each of the projecting portions 16 of the first coupling members 10 is engaged with each of the recessed portions 24 of the second coupling members 20 to align the outer surfaces of the left upper, left lower, right upper
20 and right lower curtain wall units A_3 , A_1 , A_4 and A_2 .

A connecting plate 32 is inserted into both the hollow portions 15 of the first coupling members 10 in such a manner as to be laid thereacross. The connecting plate 32 is formed with screw holes 33 to be threadedly engaged
25 with the bolts 35 at both ends in the longitudinal direction thereof. The screw holes 33 are opened to the through-holes 19. As shown in Fig. 4, the bolts 35 are inserted from

through-holes 34 of the inside walls 3a of the vertical frame members 3 of the left and right upper curtain wall units A_3 and A_4 , and are threadedly engaged from holes 36 formed through the inside vertical walls 21 of the second coupling members 20 through the through-holes 19 into the screw holes 33. There are provided low-friction sheets 37 attached to the inside vertical walls 11 of the adjacent first coupling members 10, and the connecting plate 32 is brought into tight contact with the low-friction sheets 37 by the bolts 35, thus sandwiching the first coupling members 10 between the connecting plate 32 and the second coupling members 20. Similarly, there are provided low-friction sheets 38 attached to the inside and outside vertical walls 21 and 22 of the second coupling member 20. The low-friction sheets 38 are brought into contact with the inside and outside vertical walls 11 and 12 of the first coupling member 10.

The side walls 3b of the vertical frame member 3 of the left and right upper curtain wall units A_3 and A_4 are formed with recesses 39 to be engaged with the projecting portions 16 of the first coupling members 10.

Thus, the adjacent first coupling members 10 are connected with each other by the connecting plate 32 and the adjacent second coupling members 20, and the out-of-plane positions of the first and second coupling members 10 and 20 are aligned. Further, as the projecting portions 16 of the adjacent first coupling members 10 are engaged with the

recessed portions 24 of the adjacent second coupling members 20 to restrict the out-of-plane positions of the first and second coupling members 10 and 20, the outer surfaces of the left upper, left lower, right upper and right lower curtain wall units A_3 , A_1 , A_4 and A_2 are kept flush with each other to obtain a flush outer surface of the unit type curtain wall unit as a whole.

While the connecting plate 32 and the second coupling members 20 are fixed by the bolts 35 to the vertical frame members 3 of the left and right upper curtain wall units A_3 and A_4 , the bolts 35 are displaceable vertically and horizontally relative to the first coupling members 10 owing to the through-holes 19. As a result, each of the curtain wall units may be independently moved in their plane, and in-plane displacement created by thermal expansion and earthquake, etc. may be absorbed among the curtain wall units.

In the aforementioned preferred embodiment, the first coupling members 10 are provided at the upper edge portion of the left and right lower curtain wall units A_1 and A_2 , and the second coupling members 20 are provided at the lower edge portion of the left and right upper curtain wall units A_3 and A_4 . However, the first and second coupling members 10 and 20 may be provided in such a manner as to be reversed to the above.

Further, although the connecting plate 32 is inserted into the hollow portions 15 of the adjacent first coupling members 10 in such a manner as to be laid there-

across, the connecting plate 32 may be provided across depending portions integrally formed with the projecting portions 10 in a modified embodiment.

5 In other words, the connecting plate 32 is laid across the adjacent first coupling members 10, and is connected with the second coupling members 20 by the bolts 35 passing through the through-holes 19 of the first coupling members 10 with the first coupling members 10 sandwiched between the connecting plate 32 and the second coupling
10 members 20.



CLAIMS

1. A curtain wall comprising curtain wall units, which are juxtaposed vertically and horizontally in a vertical plane, interconnected with each other at a portion of the wall where four corners of said curtain wall units are adjacent one another by connecting apparatus comprising a pair of first coupling members fixed to upper edge portions of a pair of horizontally adjacent lower positioned curtain wall units, respectively, said first coupling members each having an upwardly projecting portion, a pair of second coupling members fixed to lower edge portions of a pair of horizontally adjacent upper positioned curtain wall units, respectively, in such a manner as to be arranged in opposed relation with each other, said second coupling members each having an upwardly recessed portion; each projecting portion being engaged with a respective one of said recessed portions in such a manner that in-plane relative displacement of the curtain wall units in the vertical and horizontal direction in said vertical plane is permitted, while out-of-plane relative displacement thereof is restricted; a connecting plate provided either across said first coupling members or across said second coupling members; through-holes formed through either said first or said second coupling members, respectively; and bolts inserted through said



through-holes for fixedly connecting said connecting plate and either said first or said second coupling members with the other pair of coupling members sandwiched between said connecting plate and said former pair of coupling members.

2. A curtain wall comprising curtain wall units, which are juxtaposed vertically and horizontally in a vertical plane, interconnected with each other at a portion of the wall where four corners of said curtain wall units are adjacent one another by connecting apparatus comprising a pair of first coupling members fixed to upper edge portions of a pair of horizontally adjacent lower positioned curtain wall units, respectively, said first coupling members each having an upwardly recessed portion, a pair of second coupling members fixed to lower edge portions of a pair of horizontally adjacent upper positioned curtain wall units, respectively, in such a manner as to be arranged in opposed relation with each other, said second coupling members each having an upwardly projecting portion; each projecting portion being engaged with a respective one of said recessed portions in such a manner that in-plane relative displacement of the curtain wall units in the vertical and horizontal directions in said vertical plane is permitted, while



out-of-plane relative displacement thereof is restricted; a connecting plate provided either across said first coupling members or across said second coupling members; through-holes formed through either said first or said second coupling members, respectively; and bolts inserted through said through-holes for fixedly connecting said connecting plate and either said first or said second coupling members with the other pair of coupling members sandwiched between said connecting plate and said former pair of coupling members.

3. An apparatus according to claims 1 or 2, wherein said projecting portion has a horizontally extending hollow portion.

4. An apparatus according to claim 3, wherein said connecting plate is inserted in both of said hollow portions of either said first or said second horizontally adjacent coupling members in such a manner as to be laid thereacross.

5. An apparatus according to any preceding claim wherein each of said first or said second adjacent coupling members has a mount wall inserted into a hollow portion formed in a vertical frame member of said lower curtain wall units and fixed by a bolt in such a manner



that said projecting or recessed portion is directed upwardly or downwardly.

6. An apparatus according to any preceding claim, wherein each of said through-holes has a size permitting vertical and horizontal, movement of said bolts relative to either said first or said second adjacent coupling members.

7. An apparatus to any preceding claim, wherein each of said through-holes is formed with a circular large-diameter portion to be engaged with a curtain wall lifting hook at one end portion thereof.

8. An apparatus according to any preceding claim, wherein each of the other pair of adjacent coupling members is inserted into a hollow portion formed in a vertical frame member of said upper curtain wall units, and is fixed by a bolt in such a manner that said recessed or projecting portion is directed downwardly or upwardly.

9. An apparatus according to any preceding claim, wherein said connecting plate is formed with screw holes threadedly engaged with said bolts at both ends in a longitudinal direction thereof, said screw holes opening to said through-holes.



10. An apparatus according to any preceding claim, further comprising a low-friction sheet attached to an interior-side wall of inside vertical walls of each of said coupling members which have said projecting portions, said connecting plate being a tight contact with said low-friction sheet.

11. An apparatus according to any preceding claim, further comprising low-friction sheets attached to interior-side and outdoor-side vertical walls of each of the other pair of adjacent coupling members which have said recessed portions, said low-friction sheets being in contact with interior-sides and outdoor-sides of outer vertical walls of each of said former pair of adjacent coupling members.

12. An apparatus substantially as described with reference to and as illustrated in the accompanying drawings.
