

CURTAIN WALL

BACKGROUND OF THE INVENTION5 Field of the Invention

[0001] The present invention relates to a curtain wall, and particularly to a curtain wall which does not need a caulking work for sealing a connection section in which upper, lower, left and right adjoining curtain wall units intersect one another and
10 provides a degree of freedom in the order of installing the curtain wall units.

Background Art

[0002] Curtain walls include knock-down type curtain walls which are formed by combining structural members at a construction site, and unit-type curtain walls which already
15 incorporate glass panels and are installed at a construction site. One of methods of installing unit-type curtain walls successively on a building wall is an interlocking type method which has been primarily used in countries other than Japan. The interlocking
20 type curtain wall is generally prepared by fitting a glass panel into each unit in a factory, then carried and installed in a construction site. With installation, upper, lower, left and right units are fitted in one another, thereby forming a surface of a building wall.

25 [0003] In Japanese Patent Laid-Open Publication 7-3923(1995-3927), a curtain wall is disclosed, which is a unit-type curtain wall configured to be formed by arranging curtain wall units successively, vertically and laterally, and in which one of opposing faces in an upper frame and a lower
30 frame of each of the vertically adjoining curtain wall units has a projection and another one has a recessed groove, successively along the longitudinal direction. Thus, each vertically adjoining pair of the curtain wall units are arranged such that the projection and the corresponding recessed groove are mated
35 with each other, thereby absorbing relative displacement between the curtain wall units, maintaining a closely adhered

state of sealing members upon the relative displacement, and ensuring water-tightness.

[0004] In Japanese Patent Laid-Open Publication 7-291821(1995-291821), a construction of a curtain wall is disclosed, in which a locking piece is formed on each rear face side of left and right vertical holding frames of a panel unit, each locking piece having an engaging groove facing in the same lateral direction and having a generally L-shaped cross section, while a mating locking piece configured to engage with the above locking piece and having a generally L-shaped cross section is integrally formed with each of the left and right vertical frames of a secondary frame; and in which an upper holding frame and a lower holding frame of the panel unit are first locked to the secondary frame, and the panel unit is moved laterally, then the light and left vertical holding frames of the panel unit are locked to the light and left vertical frames of the secondary frame, respectively, thus performing installation of the curtain wall.

[0005] However, when each panel unit is connected to another one both in the vertical and lateral directions in the interlocking method, the installation must be started at a predetermined end and performed successively, thereby limiting the degree of freedom of the working. Additionally, in the case of installing the last one unit of one row in the lateral direction, adjoining units installed just before the last one unit must be displaced once away from their installed positions in the left and right directions respectively, and then returned again to their originally installed positions after the last one unit is installed. Otherwise, a work must be required for removing engaging or fitting portions which perform the interlocking of units, and making a seal around a site to be in contact with another unit using a caulking agent or the like.

[0006] In a conventional method, when attempting to get complete air tightness or water-tightness, a work must be required for arranging a catch pan as a joint sleeve for connecting adjoining two units on a connection site of these two

units, and making a seal directly on or around the connected section using a sealing agent such as a caulking agent. Thus, such a work should be complicated and require significant time, thereby increasing the time for completion.

5 [0007] An object of the present invention is to provide a curtain wall which does not need a seal forming work based on a complicated wet sealing method, and enables to form a stable seal based on a dry sealing method as well as to reduce the time for completion.

10 [0008] Another object of the present invention is to provide a curtain wall which provides a degree of freedom in the order of installing the curtain wall units and realizes easy installation of the last one unit in the lateral direction.

15 SUMMARY OF THE INVENTION

[0009] To achieve the object above, one aspect of the present invention is a curtain wall (10) including curtain wall units (100, 200, 300, 400) each arranged vertically and laterally and connected with adjoining curtain wall units through
20 interlocking type connecting portions provided at its four sides, the curtain wall comprising: first sealing members (305) extending laterally along each connecting portion of vertically adjoining curtain wall units (100 and 200, or 300 and 400); second sealing members (507) extending vertically along each
25 connecting portion of laterally adjoining curtain wall units (200 and 400, or 100 and 300); and third sealing members (700) provided at both ends of an upper frame (401) of each curtain wall unit and adapted to serve as a mediating means for ensuring continuity of the seal between opposing ends of
30 adjoining first sealing members (305) as well as to serve as a mediating means for ensuring continuity of the seal between opposing ends of adjoining second sealing members (507) in each intersectional area of adjoining upper, lower, left and right curtain wall units.

35 [0010] Another aspect of the present invention is a curtain wall (10) including curtain wall units (100, 200, 300,

400) each arranged vertically and laterally and connected with adjoining curtain wall units through fitting portions provided at its four sides, the curtain wall comprising: first sealing members (305) extending laterally along each fitting portion of vertically adjoining curtain wall units (100 and 200, or 300 and 400); second sealing members (507) extending vertically along each fitting portion of laterally adjoining curtain wall units (200 and 400, or 100 and 300); third sealing members (700) adapted to cover both ends of an upper frame (401) of each curtain wall unit and further adapted to serve as mediating means for ensuring continuity of the seal between opposing ends of adjoining first sealing members (305); a fourth sealing member (800) provided at and abutting a top end of each second sealing member and adapted to abut bottom ends of the third sealing members for ensuring continuity of the seal between the second and third sealing members; and a fifth sealing member (900) provided at and abutting a bottom end of each second sealing member and adapted to abut top ends of the third sealing members provided in an adjoining unit located below and make a continuous seal between the second sealing member and third sealing members provided in the adjoining unit located below, each of the first to fifth sealing members being provided in advance in each unit; whereby a cut-off wall can be formed after assembly by these sealing members and vertical frames (510, 540) of each unit.

[0011] Still another aspect of the present invention is a curtain wall (10) including curtain wall units (100, 200, 300, 400) each arranged vertically, laterally and successively and connected with adjoining curtain wall units, the curtain wall (10) comprising: vertical fitting projections (303) each provided on a top face of an upper frame (301) of each unit, projecting along the face direction, and adapted to connect vertically adjoining units (100 and 200, or 300 and 400); lateral walls (405) each provided at and extending below a lower portion of each unit and adapted to abut the vertical fitting projection of the unit; lateral fitting projections (510) each provided at one lateral end

face of each unit in succession to one end of each lateral wall, extending over substantially the whole vertical length of the unit and adapted to connect laterally adjoining curtain wall units (200 and 400, or 100 and 300); vertical walls (540) each
5 provided at the other lateral end face of each unit in succession to the other end of each lateral wall, extending over substantially the whole vertical length of the unit, and adapted to abut the lateral fitting projection of the unit; lateral sealing members (305) for closely adhering the vertical fitting
10 projections to the lateral walls; vertical sealing members (507) for closely adhering the lateral fitting projections to the vertical walls; end sealing members (700) each adapted to cover an upper frame, the vertical fitting projection and both ends of the upper frame of each unit, connect with the lateral sealing
15 member and closely adhere to the lateral wall; an upper sealing member (800) provided at and abutting a top end of each vertical sealing member and adapted to close a gap to be formed between the upper sealing member and the end sealing members; and a lower sealing member (900) provided at and
20 abutting a bottom end of each vertical sealing member and adapted to close a gap to be formed between the lower sealing member and the end sealing members provided in an adjoining unit located below.

[0012] Another aspect of the present invention is a
25 curtain wall (10) including curtain wall units (100, 200, 300, 400) each arranged vertically and laterally and connected with adjoining curtain wall units, the curtain wall (10) comprising: connecting portions (302, 303, 404, 405) each provided at upper and lower ends of each unit and adapted to connect
30 vertically adjoining units (100 and 200, or 300 and 400); and elastic air-tight sealing members (Ls, Rs) provided at both lateral ends of each unit and extending over substantially the whole height of the unit.

[0013] Still another aspect of the present invention is a
35 curtain wall (10) including curtain wall units (100, 200, 300, 400) each arranged vertically and laterally and connected with

adjoining curtain wall units, in which an air-tight sealing member exhibiting elasticity along the whole height of each unit is provided to at least one of the lateral ends of at least one of a group of units to be laterally arranged.

5 [0014] According to the present invention, when assembling is carried out, on a construction site, of a curtain wall including curtain wall units which are fitted together through the interlocking type concavo-convex connecting portions, there is no need of the seal forming work based on the
10 wet sealing method using a caulking agent or the like. In addition, providing predetermined elastic sealing materials to each unit in advance in a factory or the like enables to create a continuous seal at each intersectional area of the adjoining units based on a completely dry sealing method.

15 [0015] Additionally, providing a structure, in which a reinforcing plate is embedded in and integrally molded with a sealing material such as foamed silicones, to the third sealing members adapted to serve as mediating means for ensuring continuity of the seals between opposing ends of adjoining first
20 and second sealing members can eliminate possibility of reducing the sealing ability, and maintain stable sealing properties for a long period of time at each intersectional area of adjoining upper, lower, right, and left units.

[0016] According to the present invention, vertically
25 adjoining units are connected together by the interlocking method for example, while the laterally adjoining units are joined together, without being connected, only by proving an elastic air-tight sealing member at both lateral ends of each unit for creating an air-tight seal between the units. Thus, the
30 assembly is not restricted by the order of installation of units in the lateral direction, thereby enhancing the degree of freedom in the installation work.

[0017] Moreover, according to the present invention, since
35 an air-tight sealing member exhibiting elasticity along the whole height of each unit is provided at least one of the lateral ends of at least one of a group of units to be laterally arranged, if using

this unit as the last one to be installed in a lateral row of units, it is not necessary to move the laterally adjoining units aside upon the installation of the last one unit. Also, it is not necessary to remove engaging portions, which perform the interlocking type connection, at both ends of each unit and make a seal around the removed portions.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] Fig. 1 is a diagram showing an appearance of a curtain wall.

Fig. 2 is an enlarged view of a part of the curtain wall of Fig. 1.

Fig. 3 is a diagram showing a single unit of the curtain wall.

Fig. 4 is a perspective view of a portion where upper, lower, left and right units intersect one another.

Fig. 5 is a vertical cross section showing a portion where upper, lower, left and right units intersect one another.

Fig. 6 is a horizontal cross section taken along line V-V of Fig. 5.

Fig. 7 is a horizontal cross section taken along line VI-VI of Fig. 5.

Fig. 8 is a diagram showing a right lower unit.

Fig. 9 is a diagram showing a right upper unit.

Fig. 10 is a diagram showing a left lower unit.

Fig. 11 is a diagram showing a left upper unit.

Fig. 12 is a plan view showing an end sealing member attached to an end of an upper frame.

Fig. 13 is a cross section showing a connected section of a lateral elastic sealing member and the end sealing member.

Fig. 14 is a plan view showing a reinforcing plate embedded in the end sealing member.

Fig. 15 is a side view of an intersectional area of each unit of a first embodiment.

Fig. 16 is a diagram showing a left upper unit according to a second embodiment of the present invention.

Fig. 17 is a vertical cross section showing a portion where upper, lower, left and right units of Fig. 10 intersect one another.

Fig. 18 is a horizontal cross section taken along line V-V
5 of Fig. 17.

Fig. 19 is a horizontal cross section taken along line Vi-Vi
of Fig. 17.

Fig. 20 is a diagram showing a right lower unit.

Fig. 21 is a diagram showing a right upper unit.

10 Fig. 22 is a diagram showing a left lower unit.

Fig. 23 is a diagram showing a left upper unit.

Fig. 24 is a side view of an intersectional area of each unit of the second embodiment.

15 DETAILED DESCRIPTION OF THE INVENTION

[0019] The present invention will be described with reference to embodiments illustrated in the drawings.

[0020] (General construction)

Fig. 1 is a diagram showing an appearance of a curtain
20 wall, in which (a) is a front view seen from the outside of a building, (b) is a vertical cross section of a unit installing portion, and (c) is a horizontal cross section of a unit installing portion. The positional relation of curtain wall units is described based on the arrangement shown in Fig. 1(a). It is noted that in the
25 drawings seen from the inside of a room, the positional relation of left and right will be reverse.

[0021] A curtain wall 10 shown in Fig. 1 is so constructed as to cover a frontage of a building with curtain wall units, ..., 11 to 15, ..., 21 to 25, ..., 31 to 35, ..., which are connected
30 vertically and laterally with one another. These units, ..., 11 to 15, ..., 21 to 25, ..., 31 to 35, ..., are fixed to a building wall by suspending upper portions of these units from installing members 61, 62, 63, ... which are attached to cross members 51, 52, 53, ... of frames of a building, respectively (see Fig.
35 1(b)). The circumference consisting of four sides of each unit is joined to adjoining upper, lower, left and right units,

respectively. This connection will be described in detail below.

[0022] Fig. 2 is an enlarged view of a part of the curtain wall of Fig. 1. In Fig. 2(a), four units are shown to be arranged around an intersectional area A. In the description below, based on the arrangement of this drawing as a front view seen from the outside of a building, each unit is assigned anew with a corresponding reference numeral and will be referred to as right lower unit 100, right upper unit 200, left lower unit 300, and left upper unit 400. Moreover, in the same member, for discrimination of the upper, lower, left and right positions, a subscript a (meaning right lower), b (meaning right upper), c (meaning left lower), and d (meaning left upper) will be optionally added following each corresponding reference numeral.

[0023] (Construction of each unit)

Fig. 3 is a diagram showing a single unit of the curtain wall 10, in which (a) is a front view seen from the outside of a room, (b) is a side view, and (c) is a front view seen from the inside of the room. As shown in the drawings, the single curtain wall unit includes a frame body 39 consisting of an upper frame 301, a lower frame 352, a left vertical frame 353 and a right vertical frame 354, a transom 355 vertically dividing the frame body 39, a single plate glass panel SG fitted in an upper portion of the frame body 39 divided by the transom 355, and a multi-layered glass plate PG fitted in a lower portion of the frame body 39. On a top face of the upper frame 301 is formed a convex portion(s) to be fitted in a concave portion(s) formed on a bottom face of a unit to be positioned on the frame 301. Similarly, on a bottom face of the lower frame 352 is formed a concave portion(s) to receive therein a convex portion(s) formed on a top face of a unit to be positioned under the frame 301. Additionally, on a left end face of the left vertical frame 353 is formed a convex portion(s) to be fitted in a concave portion(s) formed on a right end face of the right vertical frame of a unit to be positioned on the right side of the frame 353. Similarly, on a right end face of the right vertical

frame 354 is formed a concave portion(s) to receive therein a convex portion(s) formed on a left end face of the left vertical frame of a unit to be positioned on the left side of the frame 354.

5 Connections of the upper, lower, left and right units are achieved respectively by engagement or fitting of each corresponding pair of the concave and convex portions. Such connections will be described further in detail below.

[0024] First, the connecting structure and sealing
10 structure of each unit 100 to 400 constituting the curtain wall 10 will be described with reference to the drawings.

[0025] 1. Connecting structure and sealing structure between the upper and lower units

 The connecting structure between the upper and lower
15 units is described with reference to Figs. 4 and 5. Fig. 4 shows a portion where upper, lower, left and right units intersect one another. Fig. 5 is a vertical cross section taken along line V-V of a joined section of the upper and lower units of Fig. 4. In Fig. 5 is shown an interlocking type connecting structure for
20 connecting a lower frame of the right upper unit 400 and an upper frame of the left lower unit 300.

[0026] On a top face of an upper frame of each unit (upper frame 301 of the left lower unit 300 in Fig. 5), two projections 302, 303 extend in parallel with each other and are
25 formed over the whole lateral length of the unit. These projections 302, 303 constitutes a concave-shaped connecting portion, and each upper portion of the projections 302, 303 is provided with a seal loading portion 302a, 303a extending over the whole longitudinal length of the unit. In each of the seal
30 loading portions 302a, 303a, an elongated elastic sealing member 304, 305 is provided.

[0027] On a bottom face of a lower frame of each unit (lower frame 401 of the left upper unit 400 in Fig. 5), two walls 404, 405 extend downwardly in the longitudinal direction of the
35 lower frame, running in the lateral direction over substantially the whole length of the unit except both end portions. The

walls 404, 405 constitute a convex-shaped connecting portion which is fitted in the concave-shaped connecting portion composed of the projections 302, 303.

[0028] In a connected state of the upper and lower units,
5 the elastic sealing member 304 of the projection 302 is adapted to closely adhere to an exterior side face of the exterior side wall 404 over substantially the whole lateral length of the unit 400. On the other hand, the elastic sealing member 305 of the projection 303 is adapted to closely adhere to an interior side
10 face of the interior side wall 405 over substantially the whole lateral length of the unit 400.

[0029] Thus, in the vertically adjoining units 400, 300, fitting the convex-shaped connecting portion composed of the walls 404, 405 provided in the lower frame of the unit 400 into
15 the concave-shaped connecting portion composed of the projections 302, 303 provided in the upper frame of the unit 300 limits movement in the direction from the interior to the exterior or in the reverse direction of the upper and lower units 400, 300, fixes the positional relation of the both, as well as
20 provides a tight seal due to close adhesion of the elastic sealing members 304, 305 to the walls 404, 405.

[0030] In the two elastic sealing members 304, 305, the exterior side elastic sealing member 304 is used for ensuring water tightness to prevent infiltration of water. On the other
25 hand, the interior side elastic sealing member 305 is used for ensuring air tightness, and comprises a sealing material having a higher sealing ability as compared to the exterior side elastic sealing material 304.

[0031] From a bottom face of the lower frame 401 of each
30 unit vertical fins 406, 407 extend downwardly. In a connecting work, when the convex connecting portion of the upper unit 400 is pushed down into the concave connecting portion, an upper end of the projection 302 of the unit 300 connected below that unit 400 will abut a lower end of the exterior side fin 406. At
35 that time, an upper end of the projection 303 of the unit 300 will abut a lower end of the interior side fin 407, thus limiting

further vertical movement between the upper unit 400 and the lower unit 300.

[0032] In this way, the positional relations in the direction from the interior to the exterior or in the reverse direction and in the vertical direction of the upper and lower units are limited by such a connection as mentioned above. In this state, though the relative positional relation in the lateral direction is still changeable, each unit will be finally fixed by each of cross members of frames of a building as described above, thereby fixing the connected positional relation between the upper and lower units.

[0033] 2. Sealing between the left and right units

The sealing between the left and right units will be described with reference to Figs. 4, 6 and 7.

[0034] In Fig. 6, vertical frames 353, 354 of left and right units 200, 400 include primary end vertical members 501b, 501d which extend in the vertical direction, respectively. Further, on the exterior side of the primary end vertical members 501b, 501d, first glass panel fixing portions 502b, 502d extend, respectively. From the first glass panel fixing portions 502b, 502d, panel fixing portion connecting members 503b, 503d extend perpendicularly toward the exterior, respectively. To the panel fixing portion connecting members 503b, 503d are attached second glass panel fixing walls 504b, 504d respectively facing the first glass panel fixing walls 502b, 502d, and as such a glass panel attaching portion 500A is formed by these components.

[0035] In this embodiment, an interlocking type connecting structure is employed as a means for connecting the vertical frames 353, 354 of the left and right units 200, 400.

In the right upper unit 200, an interior side distal end of the panel fixing portion connecting member 503 extends toward the interior beyond a point of intersecting the first glass panel fixing portion 502b, and its distal end bends perpendicularly to form a fitting wall 505 extending toward the left upper unit 400. From the primary end vertical member 501b, a first vertical wall

510 and a second vertical wall 520 extend perpendicularly in parallel with each other toward the left upper unit 400. At one end of the first vertical wall 510 is further provided a fitting wall 508 in parallel with the fitting wall 505. These fitting walls 505, 508 constitute a convex-shaped connecting portion for connecting the vertical frames of the left and right units 200, 400.

[0036] In the left upper unit 400, a third vertical wall 530, a fourth vertical wall 540 and a fifth vertical wall 550 extend perpendicularly in parallel from the primary end vertical member 501d of the vertical frame 353 toward the right upper unit 200. The first glass panel fixing wall 502d and the fourth vertical wall 540 constitute a concave-shaped connecting portion in which is fitted the convex-shaped connecting portion constituted by the fitting walls 505, 508.

[0037] In such a state that the vertical frames 353, 354 of the left and right units 200, 400 are fitted together through the interlocking type concavo-convex connecting portions, an exterior isobaric chamber 500B is composed of the first glass panel fixing walls 502b, 502d, approximately two-thirds, on the exterior side, of the primary end vertical members 501b, 501d, the first vertical wall 510 and the fourth vertical wall 540. Simultaneously, an interior isobaric chamber 500C is composed of the first vertical wall 510, the fourth vertical wall 540, approximately one-third, on the interior side, of the primary end vertical members 501b, 501d, the second vertical wall 520 and the fifth vertical wall 550. Each vertical member constituting the glass panel attaching portion 500A, exterior isobaric chamber 500B and interior isobaric chamber 500C is formed over the whole length of each unit along the vertical direction except for each connection section.

[0038] As the sealing member for the interlocking type connection for connecting the vertical frames 353, 354 of the left and right units 200, 400, elastic sealing members 506, 507 are used. In this case, on the exterior side of the fitting wall 505 is provided an elastic sealing member 506 for ensuring

water tightness, this elastic sealing member 506 extending over the whole height of the vertical frames and adapted to closely adhere to the interior side face of the first glass panel fixing portion 502d. Similarly, on the interior side of the fitting wall 508 is provided an elastic sealing member 507 for ensuring air tightness. The elastic sealing member 507 extends over the whole length of the vertical frames and is adapted to closely adhere to the fourth vertical wall 540 of the left upper unit 400. In addition, an interior side face of a distal portion of the second vertical wall 520 abuts an exterior side face of a distal portion of the fifth vertical wall 550.

[0039] In such a way, the connection of the left and right units 200, 400 by fitting the interlocking type concavo-convex connecting portions can provide secure air tightness and water tightness due to the effect of the elastic sealing members 506, 507.

[0040] Fig. 6 shows a connected section of the left and right frames 353, 354 of upper portions of the respective units, Fig. 7 shows a connected section of the left and light frames 353, 354 at a position under the upper frame 301 of each unit. Accordingly, in Fig. 6, a multi-layered glass plate PG is fitted directly in the glass panel attaching portion 500A by means of a bead, while in Fig. 7, a single plate glass panel SG is attached to the glass panel attaching portion 500A via gap securing members 600a, 600c.

[0041] 3. Sealing structure in an intersectional area of upper, lower, left and right units

Next, a sealing structure in an intersectional area of upper, lower, left and right units will be described with reference to Figs. 8 to 11, in which upper, lower, left and right units 100 to 400 are illustrated suitably and individually. These drawings illustrate a state where a left end portion of the right lower unit 100 and a right end portion of the left lower unit 300 are connected with each other. Fig. 8 is a diagram showing a left upper portion of the right lower unit 100, in which (a) is a left side view, (b) is a side front view seen from the exterior, (c) is a

right side view, and (d) is a horizontal cross section taken based on the line VI-VI of Fig. 2(a) and viewed from above. Fig. 9 is a diagram showing a left lower portion of the right upper unit 200, in which (a) is a plan view, (b) is a left side view, (c) is a front view seen from the exterior, and (d) is a right side view. Fig. 10 is a diagram showing a right upper portion of the left lower unit 300, in which (a) is a left side view, (b) is a front view seen from the exterior, (c) is a right side view, and (d) is a horizontal cross section taken based on the line VI-VI of Fig. 2(a) and viewed from above. Fig. 11 is a diagram showing a right lower portion of the left upper unit 400, in which (a) is a plan view, (b) is a left side view, (c) is a front view seen from the exterior, and (d) is a right side view.

[0042] Referring to Fig. 6, in the curtain wall 10 is provided an opening 512 on the exterior side of the glass panel attaching portion 500A. In the exterior isobaric chamber 500B located on the interior side of the glass attaching portion 500A, a sealing line is formed over the substantially the whole length in the vertical direction of the units by abutment of the elastic sealing member 506 of the fitting wall 505 to a first glass panel fixing portion 502c.

[0043] Since the sealing line does not exist in the intersectional area A (see Fig. 2) of the upper, lower, left and right units 100 to 400, the pressure in the exterior isobaric chamber 500B is the same as the open air. Accordingly, rainwater can infiltrate up to the interior of the exterior isobaric chamber 500B.

[0044] In the curtain wall 10, what prevents the infiltration of the open air or rainwater into the interior of a room mainly includes the vertical frame elastic sealing member 507 for water-tightly sealing the connected section (the section sealed by the sealing member 507 will be referred to hereinafter as vertical sealed section) formed by fitting of the interlocking type connecting portions of the vertical frames 353, 354 between the left and right units, and the lateral frame elastic sealing member 305 for water-tightly sealing the fitted section

(the section sealed by the sealing member 305 will be referred to hereinafter as lateral sealed section) formed by engagement of the inter-locking fitting portions of the lower and upper frames between the upper and lower units. However, only with
5 these sealing means, similar to the exterior side walls (502a, 505, 502c) of the exterior isobaric chamber 500B, the continuity of the seal is not sufficient in the intersectional area A of the upper, lower, left and right units 100 to 400.

[0045] The reason is that as shown in Fig. 15, in the right
10 upper unit 200 and the left upper unit 400, the vertical frame elastic sealing member 507 has a sealing effect only on the section where the laterally adjoining vertical frames 353, 354 are fitted together. However, since the bottom ends of the vertical frames 353, 354 of the right upper unit 200 and left
15 upper unit 400 are also associated with the upper frames 401 of the right lower unit 100 and left lower unit 300, the vertical elastic sealing member 507 can not have a sealing effect on the section where the bottom ends of the right upper unit 200 and left upper unit 400 are associated with the upper frames 401.
20 Similarly, the lateral frame elastic sealing member 305 has a sealing effect on the fitted section of the vertically fitting lower frame 301 and upper frame 401, but does not provide a seal to the respective end portions of the laterally adjoining vertical frames 353, 354.

25 [0046] To address these problems, in the prior art, the wet sealing method was selected, in which a catch pan is arranged over a top face of a connected section between the left and right units in a construction site, making a seal around the section using a caulking agent or the like, and further forming a
30 seal to ensure the continuity to the elastic sealing member.

[0047] Contrary, in the curtain wall 10 of the present invention, a completely air-tight and water-tight structure in each intersectional area A is realized using a complete dry
35 sealing method, in which predetermined elastic sealing materials are provided to each unit in advance in a factory or the like without the need of seal forming works according to the

wet sealing method using a catch pan and a caulking agent or the like. The details of this invention are as follows.

[0048] In the upper frames 401 of the left and right units 100, 300, concave shaped fitting portions constituting the interlocking connecting portion are formed by the projections 302, 303. To both ends of the projections 302, 304 are attached generally U-shaped end elastic sealing members 700a, 700c, respectively. When the left and right units 100, 300 are connected with each other, these elastic sealing members 700a, 700c will closely adhere together.

[0049] As shown in Figs. 4 and 12, each of the end elastic sealing members 700 is a U-shaped sealing member formed of an elastic material, such as foamed silicones, foamed resins or synthetic rubbers. As a material for making these sealing members, foamed silicones are preferred because there is little or no tendency of remaining permanent distortion in the materials when compressed. In each end elastic sealing member 700, a metallic reinforcing plate 710 is embedded integrally. The reinforcing plate 710, as shown in Fig. 14, is a metallic plate having a generally U-shaped flat shape which is substantially the same as the U-shaped cross section of each end elastic sealing member 700. In this case, each end elastic sealing member 700 is molded integrally with the reinforcing plate 710 by filling a sealing material upon molding into a mold with the reinforcing plate 710 placed therein. While it is preferred that the reinforcing plate 710 is embedded in the sealing material such that the whole body of the plate 710 is covered with the foamed silicone as in the case of this embodiment, the plate 710 may be exposed partly from the foamed silicone.

[0050] In the reinforcing plate 710 of this embodiment, folding-back portions 711a to 711d are formed by a folding process at edges of required positions. Each of the folding-back portions serves to enhance the strength of the foamed silicones at its located position and prevent deformation of the edge of the sealing material. Also, in order to prevent

the foamed silicone from peeling off from the surface of the reinforcing plate 710, a predetermined number of holes 712 are punched in the reinforcing plate 710. In this way, the foamed silicone on the front and rear sides of the reinforcing plate 720 can be connected together through the holes 712, thereby making the foamed silicone difficult to peel off.

[0051] In Fig. 12, an end face designated by reference numeral 734 is a sealing face of the end elastic sealing member 700. In the end elastic sealing member 700, the interior side half thickness of the member 700 is slightly larger than the exterior side half thickness thereof so that the difference in the thickness is defined to be δ as shown in the drawing. This is intended to provide a difference in the sealing ability such that the exterior half thickness portion serves as a rein barrier while the interior half thickness as a window barrier. That is, the increased thickness in the exterior side half of the sealing member 700 allows for a larger compressibility of the seal on the rainwater barrier side, thereby enhancing the sealing ability.

[0052] In Fig. 4 and Fig. 12, each end elastic sealing member 700 includes a concave portion 720 having a largely depressed central portion and convex portions 730a, 730b disposed at both ends of the concave portion 720. The width of the concave portion 720 is set such that the entire concavo-convex connecting portions in the interlocking connection portion can have a space suitable for enabling the fitting in the upper frame, lower frame, and vertical frames of each unit. In addition, as shown in Fig. 12, each end elastic sealing member 700 is attached to an end face of the upper frame 301 using screws or the like through the reinforcing plate 710 as an attaching base. The seal end, extending up to an end of the frame 301, of the upper frame lateral elastic sealing member 305 reaches a connecting hole 732 formed in the convex portion 730a of the end elastic sealing member 700 such that the sealing member 305 is fitted in the connecting hole 732. Thus, in the lower frame 301 of each unit (see Fig. 10), the end elastic sealing member 700 is provided such that it covers both

ends of the respective projections 302, 303 constituting the concave shaped interlocking type connecting portion.

[0053] In the intersectional area A (see Fig. 2) of the upper, lower, left and right units, the end elastic sealing member 700a of the right lower unit 100 (see Fig. 8) and the end elastic sealing member 700c of the left lower unit 300 (see Fig. 10) are faced together, and the respective sealing faces 734 adhere to each other, thus forming a U-shaped sealing face (hereafter, referred to as end sealing face) (see Figs. 11 and 12).

10 [0054] In the curtain wall 10 according to the present invention, as a sealing member to be used in combination with the end elastic sealing members 700, a bottom gap closing piece 900 (see Fig. 15) provided at a bottom portion of the vertical frames and a top gap closing piece 800 (see Fig. 14) provided in a top portion of the vertical frames are arranged to ensure the continuity of the seal.

[0055] The top gap closing piece 800 serves as a part of the convex shaped interlocking connecting portion of the vertical frame 354 and is attached to the top end of the interior side face of the first vertical wall 510 to which the vertical frame elastic sealing member 507 is provided. Namely, the bottom end of the top gap closing piece 800 adheres to the top end of the vertical frame elastic sealing member 507. In addition, the top end of the top gap closing piece 800 adheres to the bottom face of the end elastic sealing members 700 (see Fig. 15). In respect of the positional relation to the vertical frame 353 of the right adjoining unit, the top gap closing piece 800 is adapted to closely adhere to the fourth vertical wall 540, which serves as a part of the concave shaped interlocking connecting portion of the vertical frame 353, along with the vertical elastic sealing member 507 (see Fig. 12).

[0056] Similarly, the bottom gap closing piece 900 is attached to the bottom end of the interior side face of the first vertical wall 510 of the vertical frame 354. The top end of the piece 900 adheres to the bottom end of the elastic sealing member 507. This bottom gap closing piece 900 is adapted to

provide a seal between the vertical frames 353, 354 along with the vertical elastic sealing member 507, and adhere to a face designated by reference character P in Fig. 15(a) and a face designated by reference character Q in Fig. 16(c) of the end elastic sealing members 700a, 700b, respectively.

5 [0057] According to each unit of the curtain wall of the present invention, continuous seal portions can be formed between the adjoining upper, lower, left and right units as mentioned below by using the dry sealing method which
10 requires only fitting together the interlocking type concavo-convex fitting sections.

[0058] In Fig. 6 and Fig. 15, connection of the left lower unit 300 and the right lower unit 100 is first described.

[0059] When the interlocking type concavo-convex
15 connecting portions in the vertical frames 353, 354 of the left lower unit 300 and the right lower unit 100 are fitted together, a vertical sealing portion due to the vertical frame elastic sealing member 507 is formed over the whole height of the vertical frames. At the same time, the sealing faces 734 of the end
20 elastic sealing members 700 of the upper frames 401 abut and closely adhere together.

[0060] Next, the upper frame 401 of the right upper unit 200 is fitted in the lower frame 301 of the right lower unit 100, followed by fitting the lower frame 301 of the left upper unit
25 400 in the upper frame 401 of the left lower unit 300, then fitting together the vertical frames 353, 354 of the right upper unit 200 and the left upper unit 400, successively. As a result, the lateral sealing portions formed by the lateral elastic sealing members 305 are connected together between the adjoining left
30 and right units through the respective end elastic sealing members 700 positioned at the intersectional area.

[0061] At that time, the vertical sealing portions formed by the vertical elastic sealing members 507 are also connected together between the adjoining upper and lower units through
35 the respective end sealing members 700 positioned at the intersectional area. In this case, at the top ends of the vertical

frames 353, 354 of the right lower unit 100 and the left lower unit 300 is provided a sealing effect due to the top gap closing piece 800. In addition, the top end of the top gap closing piece 800 adheres in advance to the end elastic sealing members 700, thus in the whole body to be composed of the left lower unit 300 and the right lower unit 100 is formed a continuous vertical sealing portion which extends from the vertical elastic sealing member 507 through the bottom gap closing piece 900 up to the end elastic sealing members 700. Similarly, at the bottom ends of the right upper unit 200 and the left upper unit 400 is given the sealing effect due to the bottom gap closing piece 900. Additionally, the bottom end of the bottom gap closing piece 900 is closed by the end elastic sealing members 700, thus in the whole body to be composed of the left upper unit 400 and the right upper unit 200 is formed a continuous vertical sealing portion extending from the vertical elastic sealing member 507 through the bottom gap closing piece 900 to the end elastic sealing members 700.

[0062] As clearly seen from Fig. 6, the walls 405, first vertical wall 510 and fourth vertical wall 540 are formed in the same laterally extending plane across the primary end vertical members 501. Accordingly, in the sealing portions formed by the elastic sealing members 305 and the walls 405 at the central portion of the units, the continuity of the seal is maintained, even in the interior isobaric chamber 500C, through a sealing portion S1 formed by the elastic sealing member 305 and the first vertical wall 510 and a sealing portion S2 formed by the elastic sealing member 305 and the fourth vertical wall 540. Furthermore, the continuity of the seal between the sealing portions S1 and S2 is maintained by the bottom gap closing piece 900. Thus, the sealing of the interior isobaric chamber 500C is provided completely, thereby preventing rainwater or the like infiltrating up to the exterior isobaric chamber 500B from further entering the interior isobaric chamber 500C.

[0063] In this embodiment, each end elastic sealing

member 700 has a structure in which the reinforcing plate 710 is embedded and molded integrally with a sealing material such as foamed silicones. Having such a structure allows for a stable sealing ability as described below due to the dry sealing method.

[0064] In Fig. 12, in the end elastic sealing members 700 abutting each other, while the position that requires a stable sealing is of course the sealing face 734 for providing a close seal between the end elastic sealing members 700, but also includes a place between the face opposite to the sealing face 734 and a corresponding end portion of each upper frame 301.

[0065] In this respect, since the reinforcing plate 710 is embedded in each end elastic sealing member 700, a stable sealing ability can be obtained between the sealing faces 734 due to compression of the material of the sealing member 700 positioned between the sealing face 734 and the reinforcing plate 710. In addition, another stable sealing ability can be provided between the face opposite to the sealing face 734 and the corresponding end portion of the upper frame 301 by compression of the material residing between the reinforcing plate 710 and the upper frame 301 due to attachment of the plate 710 using screws.

[0066] Moreover, as mentioned above, the structure of the reinforcing plate 710 is devised such that the folding-back portions 711a to 711d and holes 712 are provided in the reinforcing plate 710 to prevent peeling off and deformation of the sealing material. Accordingly, there is substantially no potential of experiencing degradation of the sealing ability, thus maintaining a stable sealing ability for a long period of time in each intersectional area of the upper, lower, left and right units.

[0067] As stated above, according to the curtain wall 10 of the present invention, the dry sealing method can be realized only by assembling the units to each of which has been provided sealing members in advance in a factory or the like. Accordingly, there is no need of the seal forming works according to the wet sealing method on a construction site, thus

significantly lessening the time for completion, and greatly reducing the working cost. Because of being already produced in a factory, each unit can be provided with a sealing material having uniform properties and condition, thus not being affected
5 by differences in skill of the sealing workers, and facilitating to provide a curtain wall with an ever-high-quality. Moreover, the need for arranging a catch pan on the upper frames and making a seal around it as in the prior art can be eliminated.

[0068] Second embodiment

10 Next, an embodiment suitable for use in a curtain wall including an interlocking type connecting structure between upper and lower units and a gasket type connecting structure between left and right units will be described.

[0069] 1. Connection between upper and lower units

15 In this second embodiment, the connecting structure of upper and lower units is of an interlocking type, and essentially the same as the structure described in the first embodiment. Fig. 16 is a perspective view showing an intersectional area of upper, lower, left and right units, and Fig. 17 is a vertical cross
20 section of a connected section of the left and right units, showing a lower portion of the left upper unit 400 and an upper portion of the left lower unit 300. In the second embodiment, the top gap closing piece 800 and the bottom gap closing piece 900 shown in Fig. 5 are made unnecessary by employing a
25 gasket type connecting structure for connecting the left and right units. The components other than the gasket type connecting structure are the same as those in the first embodiment shown in Fig. 5, thus such components being designated by the same reference numeral with its description
30 omitted.

[0070] 2. Connection between the left and right units

For the connection between the left and right units, description will be provided below referring in particular to Figs. 18 and 20. Fig. 18 is a horizontal cross section taken along
35 line V-V in Fig. 17. In this drawing, a left end portion of the right upper unit 200 is connected with a right end portion of the

left upper unit 400. Fig. 19 is a horizontal cross section taken along line VI-VI in Fig. 17. In this drawing, a left end portion of the right lower unit 100 is connected with a right end portion of the left lower unit 300.

5 [0071] In the second embodiment, a first vertical wall 510 extends laterally toward the left upper unit 400 at an approximately central portion of a primary end vertical member 501b which constitutes a vertical frame 354 of the right upper unit 200. In addition, a second vertical wall 511 positioned
10 nearer the interior of a room and an interior side vertical wall 520 positioned at an interior side distal end of the primary end vertical member 501b also extend laterally. On the other hand, a third vertical wall 530 extends laterally toward the right upper unit 200 at an approximately central portion of another primary
15 end vertical member 501b constituting a vertical frame 353 of the left upper unit 400. Additionally, a fourth vertical wall 540 located at a position corresponding to the first vertical wall 510 of the right upper unit 200 and an interior side vertical wall 550 positioned at an interior side distal end of the primary end
20 vertical member 501d also extend laterally.

[0072] LS, RS designate sealing members used for the gasket-type connecting structure, respectively. In the right upper unit 200, the elastic sealing member LS is attached to distal ends of the first vertical wall 510 and second vertical wall
25 511 such that the sealing member LS extends over the whole length of the unit along the vertical direction. Also in the left upper unit 400, the elastic sealing member RS is attached to distal ends of the third vertical wall 530 and fourth vertical wall 540 such that the sealing member RS extends over the whole
30 length of the unit along the vertical direction (see also Figs. 20 to 23).

[0073] In a state where the vertical frames 353, 354 of the left and right units 200, 400 are connected together through the gasket-type connecting portion, an exterior isobaric
35 chamber 500B is composed of first glass panel fixing walls 502b, 502d, approximately a half, on the exterior side, of the primary

end vertical members 501b, 501d, the first vertical wall 510 and the fourth vertical wall 540. Simultaneously, a sealing portion 500C is composed of the first vertical wall 510, the second vertical wall 511, the third vertical wall 530, the fourth vertical wall 540 as well as the elastic sealing members LS, RS. In addition, an interior isobaric chamber 500D is composed of approximately one-thirds, on the interior side, of the primary end vertical members 501b, 501d, the second vertical wall 511, the interior side vertical wall 520, the fourth vertical wall 540 and the exterior side vertical wall 550. Each vertical member constituting the glass panel attaching portion 500A, exterior isobaric chamber 500B, sealing portion 500C and interior isobaric chamber 500D is provided over the whole length of each unit along the vertical direction except for each connecting portion.

[0074] A gap formed between a distal end of the interior side vertical wall 520 and a distal end of the interior side vertical wall 550 is closed by an elastic piece 560 attached to a distal portion of the interior side vertical wall 520. Similar to the first embodiment, at the upper frame 301 and both lateral ends of the projections 302, 303 of each of the left and right lower units 100, 300 in Fig. 6 is attached end elastic sealing members 700a, 700c having a substantially U-like shape (see also Figs. 20 and 22).

[0075] The end elastic sealing members 700a, 700c are the same as those in the first embodiment in that they are formed of a foamed urethane, in which a U-shaped metallic reinforcing member is embedded and molded integrally.

[0076] With each unit of the curtain wall according to the second embodiment as described above, a continuous seal portion can be formed between the upper, lower, left and right units as described below by the dry sealing method in which the upper and lower units are connected with each other by fitting together their inter-locking type concavo-convex connecting portions, while the left and right units are connected with each other only by contacting together their gasket type connecting

portions.

[0077] First, in Fig. 18 and Fig. 24, a case where the left lower unit 300 and the right lower unit 100 are connected with each other will be described.

5 [0078] Since the connection between the vertical frames 353, 354 of the left lower unit 300 and the right lower unit 100 is carried out based on the gasket type connecting method, a vertical sealing portion is formed by closely adhering the elastic sealing materials RS, LS each extending over the whole height
10 of these units. At the same time, sealing faces 734 of the sealing members 700 in the upper frames 401 abut together to provide close adhesion.

[0079] Next, the upper frame 401 of the right upper unit 200 is fitted in the lower frame 301 of the right lower unit 100,
15 followed by fitting the lower frame 301 of the left upper unit 400 in the upper frame 401 of the left lower unit 300, then fitting together the vertical frames 353, 354 of the right upper unit 200 and the left upper unit 400, successively. As a result, the lateral sealing portion formed by the lateral elastic sealing
20 members 305 are connected together between the adjoining left and right units through the respective end elastic sealing members 700 positioned at the intersectional area.

[0080] At that time, the vertical sealing portion formed by the elastic sealing members RS, LS extending over the whole
25 length of the units is also connected between the vertically adjoining units through the end sealing members 700 positioned at the intersectional area.

[0081] In the second embodiment, unlike the first embodiment in which the connection between the left and right
30 units is based on the interlocking method, the top ends of the elastic sealing members RS, LS are connected with the end elastic sealing members 700, respectively. Therefore, in the whole body to be composed of the left lower unit 300 and the right lower unit 100 is formed a vertical sealing portion which
35 extends continuously up to the end elastic sealing members 700. Similarly, at the bottom ends of the vertical frames 353, 354 of

the right upper unit 200 and the left upper unit 400, the bottom ends of the elastic sealing members RS, LS are connected to the end elastic sealing members 700, respectively. Thus, in the whole body to be composed of the left upper unit 400 and the right upper unit 200 is formed a vertical sealing portion which continues up to the end elastic sealing members 700.

[0082] In such a manner, a continuous sealing structure including no discontinuation both in the vertical sealing portions and lateral sealing portions can be formed with ease utilizing the end elastic sealing members 700 as a seal mediating means in each unit intersectional area of the upper, lower, left and right units.

[0083] As stated above, according to the curtain wall of the second embodiment, since each unit does not have concavo-convex fitting portions for connecting the left and right units, there is no need to install the units in order in a specific direction on a building wall, thus enhancing the degree of freedom in the installation work.

[0084] In the above description, while both left and right end portions of each unit are provided with the elastic sealing members, in one aspect of the present invention, only one of units to be arranged in a lateral row may have the elastic sealing member only its one end. In such a construction, when such a unit is installed as the last one unit in a lateral row of units, it is not necessary to move aside the adjoining units installed just before the last one unit as in the prior art. In addition, additional works for removing engaging portions which perform the interlocking connection of each unit and for making a seal around a site to be in contact with another unit as in the prior art are not required in this type of units. Namely, with this type of unit, the assembly or installation of the units can be carried out by first connecting one of left and right units with adjoining units according to the conventional interlocking method and then with the other left or right one using the connected section as a fulcrum in such a manner as if closing a door.

CLAIMS

1. A curtain wall including curtain wall units each arranged vertically and laterally and connected with adjoining curtain wall units, the curtain wall comprising:

connecting portions each provided at upper and lower ends of each unit and adapted to connect vertically adjoining units; and

elastic air-tight sealing members provided at both lateral ends of each unit and extending over substantially the whole height of the unit.

2. A curtain wall including curtain wall units each arranged vertically and laterally and connected with adjoining curtain wall units, wherein

an air-tight sealing member exhibiting elasticity along the whole height of each unit is provided to at least one of the lateral ends of at least one of a group of units to be laterally arranged.