

MOVABLE LOUVER WINDOW

BACKGROUND OF THE INVENTIONField of the Invention

5 The present invention relates generally to a movable louver window, in which a plurality of double-vane assemblies are mounted within a frame body in vertically pivotable fashion.

Description of the Related Art

10 One example of the movable louver window has been disclosed in Japanese Examined Utility Model Publication (Kokoku) No. Hei 1-39288.

 In the disclosed construction, a square or rectangular frame body is formed with an upper frame, a lower frame and left and right vertical frames. A pair of louver vanes are coupled by a pair of clips each having a pivoting arm in such manner that the louver vanes are parallel to each other having a space therebetween and are positioned on different elevation from each other so as to form a double-vane assembly. The double-vane assembly is connected through the clips to left and right vertical frames in vertically pivotable fashion. Thus, a plurality of double-vane assemblies are mounted within the frame body in vertically pivotable fashion. An interior side upper horizontal seal member

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and an exterior side upper horizontal seal member are fixed to the upper frame for establishing sealing between the upper frame and relative one of interior side and exterior side louver vanes of the uppermost double-vane assembly, respectively. An interior side lower horizontal seal member and an exterior side lower horizontal seal member are fixed to the lower frame for establishing sealing between the lower frame and relative one of interior side and exterior side louver vanes of the lowermost double-vane assembly, respectively. Further, interior side vertical seal member and exterior side vertical seal member are fixed to each of the vertical frames for establish sealing between the vertical frame and double-vane assemblies.

15 In the movable louver window constructed as set forth above, when the movable louver window is closed, a plurality of interior side louver vanes form a continuous wall and a plurality of exterior side louver vanes form another continuous wall and an air layer is formed between those continuous walls. Therefore, the movable louver window constructed as set forth above has high heat insulation ability.

In such movable louver window, the interior side and exterior side upper horizontal seal members are directed toward the interior side, while the interior

side and the exterior side lower horizontal seal members are directed toward the exterior side. Further, when the movable louver window is closed, each of louver vanes is slightly oblique with respect to the vertical.

5 Therefore, the interior side and exterior side upper horizontal seal members and the interior side and exterior side lower horizontal seal members are different in position in the depth direction of the frame body.

Therefore, the interior side upper horizontal
10 seal member and the interior side lower horizontal seal member cannot be continuously connected through the interior side vertical seal members, and the exterior side upper horizontal seal member and the exterior side lower horizontal seal member cannot be continuously
15 connected through the exterior side vertical seal members. This results in degradation of watertightness between the frame body and the double-vane assemblies, and rain water may penetrate into the interior side across the double-vane assemblies.

20 There is also a drawback that once the rain water penetrates into the inside of the frame body, the rain water may accumulate on the lower frame and may flow toward the interior side in the case of rainstorm and so forth.

25 Further, in such movable louver window, the

frame body on which double-vane assemblies are to be mounted requires to have a depth dimension sufficient to ensure that each of pivoting arms for vertically pivoting double-vane assemblies does not interfere with a fitment
5 such as a net and so forth mounted on the interior side surface of the frame body even when the movable louver window is fully open and an interior side end portion of the pivoting arm projects toward the interior side maximally.. In case a pivoting center of each of the
10 double-vane assemblies is placed at a position between a pair of louver vanes, therefore in the exterior side portion of the pivoting arm as in the related art set forth above, a radius of an arc which an interior side end portion of the pivoting arm describes when the
15 movable louver window is opened and closed is relatively large, so that the pivoting arm projects toward the interior side deeply, and therefore the frame body requires to have a large depth dimension. If the pivoting center of the double-vane assembly can be placed
20 substantially at the center of the pivoting arm, a radius of an arc which the interior side end portion of the pivoting arm describes is reduced, so that the pivoting arm projects toward the interior side less deeply, and therefore the depth dimension of the frame body can be
25 reduced. However, in this case, at least a radius of an

arc which an upper end portion of an exterior side louver vane describes is enlarged, so that a lower end portion of an interior side louver vane of an upper double-vane assembly may interfere with an upper end portion of an exterior side louver vane of an vertically adjacent lower double-vane assembly so that pivoting movement is hindered.

SUMMARY OF THE INVENTION

Therefore, it is an object of the present invention to provide a movable louver window which can solve the above-mentioned problems.

More specific object of the invention is to provide a movable louver windows in which seal members are continuously connected to each other over the entire circumference of the frame body.

Another object of the present invention is to provide a drain mechanism for draining water such as rain water and so forth accumulating on a lower frame of a movable louver window.

A further object of the present invention is to provide a mouning structure for mounting double-vane assemblies capble of reducing the required depth dimension of the frame body.

According to the present invention, a movable louver windows comprises:

a quadrilateral frame body having an upper frame, a lower frame and left and right vertical frames ;

a plurality of double-vane assemblies each
5 comprising first and second louver vanes and a pair of
left and right coupling members each having a pivoting
arm, a pair of left and right coupling members coupling
first and second louver vanes in such manner that an
upper portion of a first louver vane extends upwardly
10 beyond an upper portion of a second louver vane and a
lower portion of a second louver vane extends downwardly
beyond a lower portion of a first louver vane and that
first and second louver vanes are parallel to each other
having a space therebetween, a plurality of double-vane
15 assemblies being mounted within the frame body in
vertically pivotable fashion and in such manner that when
the movable louver window is closed, a lower portion of
an upper one of each two vertically adjacent first louver
vanes overlaps an upper portion of an lower one of each
20 two vertically adjacent first louver vanes for forming a
first continuous wall of louver vanes and a lower portion
of an upper one of each two vertically adjacent second
louvers vanes overlaps an upper portion of a lower one of
each two vertically adjacent second louver vanes for
25 forming a second continuous wall of louver vanes and that

between the first and second continuous walls of louver vanes is defined a vertically continuous space for forming a heat insulating air layer therein;

sealing means for establishing sealing between
5 the frame body and the double-vane assemblies over the entire circumference of the frame body, the sealing means including an upper horizontal seal member mounted on the upper frame and directed toward the interior side and provided for being in contact with an uppermost one of
10 the double-vane assemblies, at least one lower horizontal seal member mounted on the lower frame and directed toward the exterior side and provided for being in contact with an interior side surface of a lower portion of a lowermost one of the double-vane assemblies,
15 vertical seal members mounted on the left and right vertical frames and directed towards the inside of the frame body and each provided for being in contact with side surfaces of the double-vane assemblies, each of the left and right vertical seal members being connected
20 continuously with the upper horizontal seal member and with the at least one lower horizontal seal member.

In the preferred construction, an uppermost one of the double-vane assemblies further comprises an upper cover engaged on and covering upper portions of first and
25 second louver vanes of the uppermost double-vane assembly

and closing an upper end of a space between the first and second louver vanes of the uppermost double-vane assembly. It can be so constructed that the upper horizontal seal member is in contact with an exterior side surface of the upper cover when the movable louver window is closed.

As for the provision of the lower horizontal seal member, a single horizontal seal member may be provided for being in contact with an interior side surface of a lower portion of either one of first and second louver vanes of the lowermost double-vane assembly. Alternatively, each one lower horizontal seal member may be provided for being in contact with an interior side surface of a lower portion of relative one of both the first and second louver vanes of the lowermost double-vane assembly.

The vertical seal member may consists of an upper wider vertical seal member forming an upper portion of the vertical seal member and provided for being in contact with a side surface of at least an upper portion of an uppermost one of the double-vane assemblies and having such width as overlapping side surfaces of both of first and second louver vanes, and first and second narrower vertical seal members forming a subsequent lower portion of the vertical seal member and

provided for being in contact with side surfaces of the double-vane assemblies subsequent to the side surface in contact with the upper wider vertical seal member and each having such width as continuously overlapping a side
5 surface of relative one of the first and second continuous walls of louver vanes, at least one of lower end portions of the first and second narrower vertical seal members being continuously connected with the at least one lower horizontal seal member. When each one
10 lower horizontal seal member is provided for being in contact with an interior side surface of a lower portion of relative one of both the first and second louver vanes of the lowermost double-vane assembly, respective lower end portions of the first and second narrower vertical
15 seal members are continuously connected with relative one of the lower horizontal seal members.

The vertical seal member may also consist of a wide vertical seal member having such width as continuously overlapping side surfaces of both of the
20 first and second continuous walls of louver vanes.

In order to comprise a drain mechanism, the movable louver window may be so constructed that the vertical frame comprises a vertical frame main body formed integrally with a plurality of vertical plates directed
25 towards the inside of the frame body and a mounting

vertical plate mounted on the vertical plates, and the vertical seal member is mounted on the mounting vertical plate and comprises first and second narrow vertical seal members having a vertical space between each other and each provided for continuously overlapping a side surface of relative one the first and second continuous walls of louver vanes, at least one of the first and second narrow vertical seal members being continuously connected with the at least one lower horizontal seal member, and the lower frame laterally extends beyond a lower end of the mounting vertical plate to be connected with the vertical frame main body so as to drain water along a surface of the lower frame. According to the provision of the lower horizontal seal member as set forth above, either one of the first and second narrow horizontal seal members may be continuously connected with a single lower horizontal seal member, or each of the first and second narrow horizontal seal member may be continuously connected with relative one of the lower horizontal members.

According to a preferred mounting structure, a movable louver windows comprises:

a quadrilateral frame body having an upper frame, a lower frame and left and right vertical frames ;

a plurality of double-vane assemblies each

comprising first and second louver vanes and a pair of
left and right coupling members each having a pivoting
arm, a pair of left and right coupling members coupling
first and second louver vanes in such manner that an
5 upper portion of a first louver vane extends upwardly
beyond an upper portion of a second louver vane and a
lower portion of a second louver vane extends downwardly
beyond a lower portion of a first louver vane and that
first and second louver vanes are parallel to each other
10 having a space therebetween, a plurality of double-vane
assemblies being mounted within the frame body in
vertically pivotable fashion and in such manner that when
the movable louver window is closed, a lower portion of
an upper one of each two vertically adjacent first louver
15 vanes overlaps an upper portion of an lower one of each
two vertically adjacent first louver vanes for forming a
first continuous wall of louver vanes and a lower portion
of an upper one of each two vertically adjacent second
louvers vanes overlaps an upper portion of a lower one of
20 each two vertically adjacent second louver vanes for
forming a second continuous wall of louver vanes and that
between the first and second continuous walls of louver
vanes is defined a vertically continuous space for
forming a heat insulating air layer therein;
25 wherein a pivoting center of each of the

double-vane assemblies is positioned on the interior side relative to a first louver vane, and positional relationship between vertically adjacent double-vane assemblies is determined to satisfy:

5
$$\ell_3 < \ell_2 + \ell_1 \text{ and } \theta_2 > \theta_1$$

wherein

ℓ_1 is a distance from a pivoting center of an upper double-vane assembly to a lowermost end edge on the interior side of a first louver vane of the upper double-vane assembly;

10 ℓ_2 is a distance from a pivoting center of a vertically adjacent lower double-vane assembly to an uppermost end edge on the exterior side of the second louver vane of the lower double-vane assembly;

15 ℓ_3 is a distance between the pivoting centers of the vertically adjacent upper and lower double-vane assemblies;

θ_1 is an angle defined by a line extending through an intersecting point of a circle c_1 centered at the pivoting center of the upper double-vane assembly and having a radius of ℓ_1 and a circle c_2 centered at the pivoting center of the lower double-vane assembly and having a radius of ℓ_2 and the pivoting center of the upper double-vane assembly and a line extending through the

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lowermost end edge on the interior side of the first louver vane of the upper double-vane assembly and the pivoting center of the upper double-vane assembly; and

θ_2 is an angle defined by a line extending
5 through the intersecting point of the circles c_1 and c_2 and the pivoting center of the lower double-vane assembly and a line extending through the uppermost end edge on the exterior side of the second louver vane of the lower double-vane assembly and the pivoting center of the lower
10 double-vane assembly.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be understood more fully from the detailed description given herebelow and from the accompanying drawings of the preferred
15 embodiment of the invention, which, however, should not be taken to be limitative to the present invention, but are for explanation and understanding only.

In the drawings:

Fig. 1 is a longitudinal section showing one
20 embodiment of a movable louver window according to the present invention;

Fig. 1A is an enlarged illustration showing a mounting portion of an uppermost double-vane assembly;

Fig. 1B is an enlarged illustration showing a
25 mounting portions of vertically adjacent double-vane

assemblies;

Fig. 2 is a transverse section of the movable louver window of Fig. 1;

Fig. 3 is a perspective view of a joint between
5 an upper frame and a vertical frame;

Fig. 4 is a perspective view showing a condition where a vertical seal member is mounted;

Fig. 5 is a exploded perspective view of a double-vane assembly;

10 Fig. 6 is an exploded perspective view of an uppermost double-vane assembly;

Fig. 7 is an exploded perspective view of a lower frame and the vertical frame; and

Fig. 8 is a perspective view of a joint between
15 the lower frame and the vertical frame.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The present invention will be described hereinafter in detail with reference to the accompanying drawings. In the following description, numerous
20 specific details are set forth in order to provide a thorough understanding of the present invention. It will be obvious, however, to those skilled in the art that the present invention may be practiced without these specific details. Well-known structures are not shown in detail
25 in order not to unnecessarily obscure the present

invention.

As shown in Figs. 1 and 2, a frame body A is formed in a square or rectangular configuration with an upper frame 1, a lower frame 2 and left and right vertical frames 3, 3. The upper frame 1 has an exterior side vertical plate 4 projecting downwardly from the inner surface 1a of the upper frame 1. On the exterior side vertical plate 4, an upper horizontal seal member 5 is mounted in an orientation directed to the interior side.

The inner surface 2a of the lower frame 2 is formed into stepwise configuration higher on the interior side and lower on the exterior side with an interior side upper lateral plane portion 6, an exterior side vertical plane portion 7 and an exterior side bottom plane portion 8. On the interior side upper lateral plane portion 6, a vertically extending plate portion 9 is formed integrally and an interior side lower horizontal seal member 10 is mounted on the vertically extending plate portion 9 in an orientation directed toward the exterior side. On the upper portion of the exterior side vertical plane portion 7, an exterior side lower horizontal seal member 11 is mounted in an orientation directed toward the exterior side.

The vertical frame 3 comprises a vertical frame

main body 12 and a mounting vertical plate 13. The vertical frame main body 12 is formed by forming an interior side vertical plate 15, an intermediate vertical plate 16 and an exterior side vertical plate 17 integrally on a vertical plate 14 in an orientation directed to the inside of the frame body A. On the projecting end portion of the exterior side vertical plate 17, an engaging recess 18 opening toward the exterior side is formed.

As also shown in Fig. 3, the mounting vertical plate 13 is formed into a crank-like configuration with an interior side portion 13a, an exterior side portion 13b and an intermediate portion 13c. On the exterior side portion 13b, first, second and third hooking pieces 19, 20 and 21 are formed integrally. The first, second and third hooking pieces 19, 20 and 21 are so arranged as having a space between each other in the depth direction of the frame body A and respectively extend in the longitudinal direction of the mounting vertical plate 13. An inwardly directed recess portion 13d is formed between the first hooking piece 19 and the second hooking piece 20. A first groove 23 is defined by a projecting piece 22 of the intermediate portion 13c and the first hooking piece 19, and a second groove 24 is defined by the second hooking piece 20 and the third hooking piece 21. The

mounting vertical plate 13 is coupled with the vertical frame main body 12 by engaging an engaging piece 25 formed integrally with the exterior side portion 13b in the engaging recess 18 and by connecting the interior side portion 13a to the intermediate vertical plate 16 by screws 26.

The upper end surface 13e of the mounting vertical plate 13 is in contact with the lower surface 4a of the exterior side vertical plate 4 as shown in Fig. 3, the lower end surface 13f of the mounting vertical plate 13 is in contact with the inner surface 2a of the lower frame 2 as shown in Fig. 1, and the longitudinal end face of the vertically extending plate portion 9 is in contact with interior side portion 13a of the mounting vertical plate 13.

As show in Fig. 3, the upper portions of the first and second hooking pieces 19 and 20 of the mounting vertical plate 13 are cut off and an upper wider groove 27 is defined by the third hooking piece 21 and the projecting piece 22. As shown in Fig. 4, an upper wider vertical seal member 28 is mounted within the upper wider groove 27, and first and second narrower vertical seal members 29₁ and 29₂ are mounted within the first and second grooves 23 and 24, The upper portions of the first and second narrower vertical seal members 29₁ and

29₂ are continuously connected to the upper wider vertical seal member 28.

As shown in Figs. 1 and 2, a double-vane assembly 30 comprises a first louver vane 31 and a second louver vane 32 respectively having light permeability such as a glass plate and so forth. The first louver vane 31 and the second louver vane 32 are coupled having a space between each other by left and right coupling members 33. The first louver vane 31 and the second louver vane 32 are positioned parallel to each other and on different elevation. The upper portion of the first louver vane 31 extends upwardly beyond the upper portion of the second louver vane 32, and the lower portion of the second louver vane 32 extends downwardly beyond the lower portion of the first louver vane 31.

As shown in Fig. 5, each of the left and right coupling members 33 comprises a louver vane holding member 34 and a louver vane mounting member 35. By the louver vane holding member 34, the first and second louver vanes 31 and 32 are coupled having a space between each other. The louver vane mounting member 35 is mounted on and engaged with the louver vane holding member 34. The louver vane mounting member 35 has a pivoting arm 36, and is connected to the interior side portion 13a of the mounting vertical plate 13 at the root

portion of the pivoting arm 36 by means of a pin 37 in
vertically pivotable fashion. The pivoting arm 36 is
also connected to a link lever 38 at the interior side
end portion by means of a pin 39. The link lever 38 is
5 shifted in the vertical and depth direction of the frame
body A by means of a handle 55 (Fig. 2) or so forth so
that the louver-vane assemblies 30 connected through the
pivoting arms 36 to the link lever 38 are vertically
pivoted and the movable louver window is opened and
10 closed.

As shown in Fig. 5, the louver vane holding
member 34 includes a vertical plate 40 of narrow and
elongated configuration with upper and lower ends shaped
into step-like configuration, a sideward holding vertical
15 plate 41 integrally formed at the upper portion of a side
edge of the vertical plate 40, an intermediate
partitioning vertical member 42 integrally formed at the
portion intermediate in the width and vertical direction
of the vertical plate 40, and a sideward holding vertical
20 plate 43 formed integrally at the lower portion of the
other side edge of the vertical plate 40. Between the
sideward holding vertical plate 41 and the intermediate
partitioning vertical plate 42, a first groove 44 is
defined. The upper portion of the first groove 44 is
25 opened on the side of the intermediate partitioning

vertical member 42 and the lower portion of the first groove 44 is opened on the side of the sideward holding vertical plate 41. The upper and lower ends of the first groove 44 are closed by a sideward upper holding piece 45
5 and an intermediate lower holding piece 46. The first groove 44 is designed for receiving the end of the first louver vane 31.

Between the intermediate partitioning vertical member 42 and the sideward holding vertical plate 43, a
10 second groove 47 is defined. The upper portion of the second groove 47 is opened on the side of the sideward holding vertical plate 43 and the lower portion of the second groove 47 is opened on the side of the intermediate partitioning vertical member 42. The upper
15 and lower ends of the second groove 47 are closed by an intermediate upper holding piece 48 and a sideward lower holding piece 49. The second groove 47 is designed for receiving the end of the second louver vane 32.

As shown in Fig. 5, the louver vane mounting
20 member 35 has a vertical plate 50 of substantially the same configuration as the vertical plate 40 of the louver vane holding member 34. A sideward holding plate 51 is integrally formed at an upper portion of a side edge of the vertical plate 50, and a sideward holding plate 52 is
25 integrally formed at a lower portion of the other side

edge of the vertical plate 50. An intermediate lower receiving piece 53 is formed integrally at a portion lower in the vertical direction and intermediate in the width direction of the vertical plate 50, and a sideward lower receiving piece 54 is formed at a position lower and near the side edge of the vertical plate 50. At the upper portion of the other side edge of the vertical plate 50, the pivoting arm 36 is formed integrally.

The louver vane holding member 34 is slid into the louver vane mounting member 35 from the upside and fitted therein. Then, the vertical plate 40 mates with the vertical plate 50, the sideward holding vertical plate 41 mates with the sideward holding vertical plate 51, the sideward holding vertical plate 43 mates with the sideward holding vertical plate 52, the intermediate lower holding piece 46 mates with the intermediate lower receiving piece 53, and the sideward lower holding piece 49 mates with the sideward lower receiving piece 54. The outer surface of the upper portion of the sideward holding vertical plate 41 of the louver vane holding member 34 is provided with an engaging piece 41a, and an engaging opening 51a is formed at the upper portion of the sideward holding vertical plate 51 of the louver vane mounting member 35. By engagement of the engaging piece 41a and the engaging opening 51a, disengagement of the

louver vane holding member 34 and the louver vane mounting member 35 in the longitudinal direction is prevented.

Among the double-vane assemblies 30, the
5 uppermost double-vane assembly 30 has an upper cover 60 mounted thereon as shown in Fig. 1. The upper cover 60 is formed into a step-like configuration with a sideward horizontal plate 61, an intermediate vertical plate 62, an intermediate oblique plate 63 and a sideward vertical
10 plate 64. A downward directed sideward piece 65 is formed integrally with the sideward horizontal plate 61 to define a first downward directed groove 66 together with the intermediate vertical plate 62. An downward directed intermediate piece 67 is formed integrally with the
15 intermediate oblique plate 63 to define a second downward directed groove 68 together with the sideward vertical plate 64.

The first downward directed groove 66 of the upper cover 60 is engaged with the upper end portion of
20 the first louver vane 31, and the second downward directed groove 68 of the upper cover 60 is engaged with the upper end of the second louver vane 32 to close a space between the first and second louver vanes 31 and 32.

25 As shown in Fig. 1, a coupling member 33 of the

uppermost double-vane assembly is designed to engage with the upper cover 60.

Namely, as shown in Fig. 6, in the louver vane holding member 34, the sideward holding vertical plate 43 and the side of the vertical plate 40 near the sideward holding vertical plate 43 are extended upwardly, and an oblique holding piece 43a is formed continuously from and integrally with the sideward holding vertical plate 43. Thus, the sideward holding vertical plate 43 and the oblique holding piece 43a mate with the sideward vertical plate 64 and the intermediate oblique plate 63 of the upper cover 60, respectively, and the vertical plate 40 serves to close an upper end of a space between the first louver vane 31 and the second louver vane 32. The vertical plate 50 and the sideward holding vertical plate 52 of the louver vane mounting member 35 are also extended upwardly.

It is to be noted that the configuration of the coupling member 33 of the uppermost double-vane assembly is not limited to the configuration shown in Fig. 6. The configuration shown in Fig 5 is also applicable to the uppermost double-vane assembly with a suitable modification of the upper cover 60.

Here, description will be given for the mounting structure for mounting the above-mentioned

double-vane assemblies 30 within the frame body A in vertically pivotable fashion.

Fig. 1A shows the mounting structure for the uppermost double-vane assembly 30. As shown in Fig. 1A, it is assumed that a distance from a pivoting center 37a of the louver vanes (center of the pin 37) to the exterior side end 3a of the vertical frame 3 is L_1 , a distance from the pivoting center 37a of the louver vanes to a pivoting center 39a of the pivoting arm 36 (center of the pin 39) is L_2 , a distance from the pivoting center 39a of the pivoting arm 36 to the interior side edge 38a of the link lever 38 is L_3 , a depth dimension of the frame body A is approximately L_4 , a distance from the pivoting center 37a of the louver vanes to the outer surface 32a of the second louver vane 32 is L_{10} , a distance in the vertical direction from the pivoting center 37a of the louver vanes to the lower end edge 4a of the exterior side vertical plate 4 of the upper frame 1 is L_{11} , a distance in the vertical direction from the pivoting center 37a of the louver vanes to the uppermost portion of the first louver vane 31 (the uppermost portion of the uppermost double-vane assembly 30) is L_{12} , a distance from the pivoting center 37a of the louver vanes to the lower end 4b on the interior side of the exterior side vertical plate 4 of the upper frame 1 is L_{13} and a distance from

the pivoting center 37a of the louver vanes to the uppermost portion on the exterior side of the second louver vane 32 (the uppermost portion on the exterior side of the uppermost double-vane assembly 30) is L_{14} .

5 In order to ensure that the pivoting arm 36 moves within the depth of the frame body A, the following relationship has to be satisfied:

$$L_4 > L_1 + L_2 + L_3 \quad \text{..... (1)}$$

10

In order to ensure that the uppermost double-vane assembly 30 pivots in vertical direction without interfering with the upper frame 1, the following dimensional relationship has to be satisfied.

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$$L_{10} < L_{11} < L_{12} \quad \text{..... (2)}$$

$$L_{13} > L_{14} \quad \text{..... (3)}$$

20 Since the distance L_3 is much smaller than L_4 and thus is ignorable, the foregoing relationship (1) may be approximated by:

$$L_4 > L_1 + L_2 \quad \text{..... (4)}$$

25

As set forth in the description of the related art, if a pivoting center of the louver vanes can be placed substantially at the center of an area regarded as substantially serving as a pivoting arm (Here, this corresponds to the area extending from the interior side end of the pivoting arm 36 to the exterior side end of the vertical plate 50, following the extending direction of the pivoting arm 36), a radius of an arc which the interior side end portion of the pivoting arm describes is reduced. Therefore, if distances L_1 and L_2 are set to be substantially equal to each other in the relationship (4),

$$L_1 < L_4/2 \quad \dots\dots (5)$$

$$L_2 < L_4/2 \quad \dots\dots (6)$$

When these relationships (5) and (6) are satisfied, it is ensured that the pivoting arm 36 does not project beyond the frame body A. And, in order to satisfy the relationships (5) and (6) to place the pivoting center of the louver vanes substantially at the center of the area regarded as substantially serving as a pivoting arm, the pivoting center 37a of the louver vanes is placed on the interior side relative to the interior side louver vane 31.

In mounting the second upper and subsequent double-vane assemblies 30, the pivoting center 37a of the louver vanes and the pivoting center 39a of the pivoting arm 36 are placed at the same positions in the depth direction as those of the uppermost double-vane assembly 30.

Here, it is assumed that the distance from the pivoting center 37a of an upper double-vane assembly to the lowermost end edge on the interior side of the first louver vane 31 of the upper double-vane assembly is ℓ_1 , a distance from the pivoting center 37a of a vertically adjacent lower double-vane assembly to the uppermost end edge on the exterior side of the second louver vane 32 of the lower double-vane assembly is ℓ_2 , the distance between the pivoting centers 37a of the vertically adjacent upper and lower double-vane assemblies is ℓ_3 , as shown in Fig. 1B.

The pivoting centers 37a of the vertically adjacent upper and lower double-vane assemblies are generally so determined that a circle c_1 having the radius ℓ_1 and a circle c_2 having radius ℓ_2 intersects with each other. However, when the pivoting centers 37a of the double-vane assemblies are placed on the interior side relative to the first louver vanes 31, it is feared that the lower end of the first louver vane 31 of the upper

double-vane assembly will interfere with the upper end of the second louver vane 32 of the vertically adjacent lower double-vane assembly so that the pivoting motion in the vertical direction of the double-vane assemblies is hindered.

As a solution for this, an angle θ_1 defined by a line extending through an intersecting point of the circles c_1 and c_2 and the pivoting center 37a of the upper double-vane assembly and a line extending through the lowermost end edge on the interior side of the first louver vane of the upper double-vane assembly and the pivoting center 37a of the upper double-vane assembly, and an angle θ_2 defined by a line extending through the intersecting point of the circles c_1 and c_2 and the pivoting center 37a of the vertically adjacent lower double-vane assembly and a line extending through the uppermost end edge on the exterior side of the second louver vane of the lower double-vane assembly and the pivoting center 37a of the lower double-vane assembly are determined to satisfy:

$$l_3 < l_1 + l_2 \text{ and } \theta_2 > \theta_1$$

By doing so, even when the pivoting centers 37a of the double-vane assemblies are placed on the interior side

relative to the first louver vanes 31, the lower end of the first louver vane 31 of the upper double-vane assembly does not interfere with the upper end of the second louver vane 32 of the vertically adjacent lower double-vane assembly so that the pivoting motion of the
5 double-vane assemblies is not hindered.

Returning to Fig. 1, with the shown construction, when a plurality of double-vane assemblies 30 are mounted within the frame body A and the movable
10 louver window is closed as shown in Fig. 1, a lower portion of an upper one of each two vertically adjacent first louver vanes 31 overlaps an upper portion of an lower one of each two vertically adjacent first louver vanes 31 for forming a first continuous wall of louver
15 vanes, and a lower portion of an upper one of each two vertically adjacent second louver vanes 32 overlaps an upper portion of a lower one of each two vertically adjacent second louver vanes 32 for forming a second continuous wall of louver vanes, and between the first
20 and second continuous walls of louver vanes is defined a vertically continuous space for forming a heat insulating air layer therein.

The upper horizontal seal member 5 is in contact with the intermediate vertical plate 62 of the
25 upper cover 60 of the uppermost double-vane assembly 30

and the upper wider vertical seal member 28 is in contact with the upper portion of the vertical plate 50 of the louver vane mounting member 35 in the entire width. Therefore, air-tight and water-tight sealing can be
5 certainly established between the upper portion of the uppermost double-vane assembly 30 and the upper portion of the frame body A.

The interior side surface of the lower portion of the first louver vane 31 of the lowermost double-vane
10 assembly 30 is in contact with the interior side lower horizontal seal member 10, and the interior side surface of the lower portion of the second louver vane 32 of the lowermost double-vane assembly 30 is in contact with the exterior side lower horizontal seal member 11. Thus,
15 air-tight and water-tight sealing can be certainly established between the lowermost double-vane assembly 30 and the lower frame 2.

The first and second narrower vertical seal members 29_1 and 29_2 are in contact with the vertical
20 plates 50 of the louver vane mounting members 35 (side surfaces of the double-vane assemblies 30). Each of the first and second narrower vertical seal members 29_1 and 29_2 has such width as continuously overlapping a side surface of relative one of the first and second
25 continuous walls of louver vanes. Therefore, air-tight

and water-tight sealing can be certainly established between the double-vane assemblies 30 and the vertical frames 3. Further, since the first and second narrower seal members 29₁ and 29₂ are continuously connected with
5 the interior side lower horizontal seal member 10 and the exterior side lower horizontal seal member 11 respectively, continuous air-tight and water-tight sealing can be certainly established over the entire circumference of the frame body A. Thus, the movable
10 louver window having excellent air-tight and water-tight sealing as well as excellent heat insulation can be obtained.

Since a vertically extending space is formed by the inwardly directed recess portion 13d between the
15 first and second narrower vertical seal members 29₁ and 29₂ and between the inner surface of the mounting vertical plate 13 and the side surfaces of the double-vane assemblies 30, rain water penetrating through the overlapping portion of the vertically adjacent second
20 louver vanes 32 flows through an intermediate clearance between the vertically adjacent coupling members 33, that is, through a clearance between the intermediate lower holding piece 46 and the intermediate upper holding piece
48 of the vertically adjacent louver vane holding members
25 34 into the vertically extending space formed by the

inwardly directed recess portion 13d, and then flows down through this vertically extending space onto the lower frame 2. Therefore, the rain water penetrating through the overlapping portion of vertically adjacent second
5 louver vanes 32 will never penetrate through the overlapping portion of the first louver vanes 31 into the interior side.

In the foregoing embodiment, the interior side and exterior side lower horizontal seal members 10 and 11
10 are provided for each being in contact with an interior side surface of a lower portion of relative one of both the first and second louver vanes 31 and 32 of the lowermost double-vane assembly 30. However, either one of the interior side and exterior side lower horizontal
15 seal members 10 and 11 can be omitted. That is, only the interior side lower horizontal seal member 10 may be provided for being in contact with an interior side surface of a lower portion of the first louver vane 31 of the lowermost double-vane assembly 30 and be continuously
20 connected with the first narrower vertical seal member 29₁, or otherwise, only the exterior side lower horizontal seal member 11 may be provided for being in contact with an interior side surface of a lower portion of the second louver vane 32 of the lowermost double-vane assembly 30
25 and be continuously connected with the second narrower

vertical seal member 29₂. Even in this case, improved air- and water-tightness as compared with the prior related art can be obtained.

5 The vertical seal member, which consists of the upper wider vertical seal member 28 and the first and second narrower vertical seal members 29₁ and 29₂ in the foregoing embodiment, may be formed by continuously extending the wider vertical seal member in the vertical direction.

10 Next, with reference to Figs. 7 and 8, a drain mechanism which can be incorporated into the shown embodiment of the movable louver window will be described. As seen in Fig. 7, lower end portions of the interior side vertical plate 15, the intermediate vertical plate 16 and the exterior side vertical plate 17 of the vertical frame 3 are respectively cut off. The lower end portion of the mounting vertical plate 13 is cut off according to the configuration of the inner surface 2a of the lower frame 2. Both of longitudinal end portions of the vertically extending plate portion 9 of the lower frame 2 are also cut off, and a drain opening 70 communicating with the inner surface 2a is formed in the vertically extending plate portion 9. Both of longitudinal end portions of the upper and lower
25 hooking pieces 72 and 73 which form a seal member

mounting groove 71 on the exterior side vertical plane portion 7 of the lower frame 2 are also cut off.

As shown in Fig. 8, the mounting vertical plate 13 is connected to the vertical frame main body 12 in such a manner that the interior side lower end edge 13g thereof is positioned at the equal elevation to the lower end edge 16a of the intermediate vertical plate 16 and the exterior side lower end edge 13h is positioned at the equal elevation to the lower end edge 17a of the exterior side vertical plate 17.

As shown in Fig. 8, the lower frame 2 and the vertical frame 3 are connected with screws by mating the longitudinal end face 2b of the lower frame 2 with the vertical plate 14 of the vertical frame main body 12, mating the longitudinal end edge 9a of the vertically extending plate portion 9 with the interior side portion 13a of the mounting vertical plate 13, mating the longitudinal end edges 72a and 73a of the upper and lower hooking pieces 72 and 73 with the second hooking piece 20 of the mounting vertical plate 13. The interior side upper plane portion 6 of the lower frame 2 mates with the lower end edge 16a of the intermediate vertical plate 16 and the interior side lower end edge 13g of the mounting vertical plate 13, the exterior side bottom plane portion 8 mates with the lower end edge 17a of the exterior side

vertical plate 17 and the exterior side lower end edge 13h of the mounting vertical plate 13, the interior side lower horizontal seal member 10 mates with the first narrower vertical seal member 29₁ and the exterior side
5 lower horizontal seal member 11 mate with the second narrower vertical seal member 29₂.

With the construction set forth above, the inner surface 2a of the lower frame 2 extends beyond the first and second narrower vertical seal members 29₁ and
10 29₂ continuously to the inner surface of the vertical plate 14 of the vertical frame main body 12. Therefore, water on the inner surface 2a of the lower frame 2 flows through the contact portion between the interior side lower end edge 13g of the mounting vertical plate 13 and
15 the inner surface 2a to the vertical plate 14 of the vertical frame main body 12, and then flows down along the exterior side vertical plane portion 7 to be drained through the contact portion between the exterior side bottom plane portion 8 and the lower end edge 17a of the
20 exterior side vertical plate 17.

Accordingly, rain water penetrating through the overlapping portion of vertically adjacent second louver vanes 32 accumulates on the exterior side area of the interior side upper plane portion 6 of the inner surface
25 2a of the lower frame 2 because the water-tight sealing

is established between the second louver vane 32 of the lowermost double-vane louver assembly 30 and the exterior side lower horizontal seal member 11, and then flows through between the first and second narrower vertical sel members 29₁ and 29₂ to the vertical plate 14 of the vertical frame main body 12, falls along the exterior side vertical plane portion 7, and is drained from the exterior side bottom plane portion 8.

Rain water penetrating through the overlapping portion of the vertically adjacent first louver vanes 31 accumulates on the interior side area behind the vertically extending plate portion 9 of the interior side upper plane portion 6 of the lower frame 2, and then flows through the drain opening 70, and is drained in the same manner as set forth above.

Thus, when the drain mechanism as set forth above is incorporated into the movable louver window, since the rain water penetrating through the overlapping portion of the vertically adjacent louver vanes and accumulating on the inner surface 2a of the lower frame 2 can be effectively drained through the drain mechanism, the rain water does not penetrate into the interior space beyond the frame body A even at a rainstorm.

It is to be noted that even when either one of the interior side and exterior side lower horizontal seal

members 10 and 11 is omitted, substantially the same effect can be expected.

As set forth above, the present invention achieves all of the objects set forth above.

5 Although the invention has been illustrated and described with respect to the exemplary embodiment thereof, it should be understood by those skilled in the art that the foregoing and various other changes, omissions and additions may be made therein and thereto,
10 without departing from the spirit and scope of the present invention. Therefore, the present invention should not be understood as limited to the specific embodiment set forth above.



WHAT IS CLAIMED IS:

1. A movable louver window comprising:

a quadrilateral frame body (A) having an upper frame(1), a lower frame (2) and left and right vertical frames (3);

a plurality of double-vane assemblies (30) each comprising first and second louver vanes (31, 32) and a pair of left and right coupling members (33) each having a pivoting arm (36), said pair of left and right coupling members (33) coupling said first and second louver vanes (31, 32) in such manner that an upper portion of said first louver vane (31) extends upwardly beyond an upper portion of said second louver vane (32) and a lower portion of said second louver vane (32) extends downwardly beyond a lower portion of said first louver vane (31) and that said first and second louver vanes (31, 32) are parallel to each other having a space therebetween, said plurality of double-vane assemblies (30) being mounted within said frame body (A) in vertically pivotable fashion and in such manner that when the movable louver window is closed, a lower portion of an upper one of each two vertically adjacent first louver vanes (31) overlaps an upper portion of an lower one of each two vertically adjacent first louver vanes (31) for forming a first continuous wall of louver vanes and a



lower portion of an upper one of each two vertically adjacent second louver vanes (32) overlaps an upper portion of a lower one of each two vertically adjacent second louver vanes (32) for forming a second continuous wall of louver vanes and that between said first and second continuous walls of louver vanes is defined a vertically continuous space for forming a heat insulating air layer therein;

sealing means for establishing sealing between said frame body (A) and said plurality of double-vane assemblies over the entire circumference of said frame body (A), said sealing means including an upper horizontal seal member (5) mounted on said upper frame (1) and directed toward the interior side and provided for being in contact with an uppermost one of said plurality of double-vane assemblies (30), at least one lower horizontal seal member mounted on said lower frame (2) and directed toward the exterior side and provided for being in contact with an interior side surface of a lower portion of a lowermost one of said plurality of double-vane assemblies (30), vertical seal members mounted on said left and right vertical frames (3) and directed towards the inside of said frame body (A) and each provided for being in contact with side surfaces of said plurality of double-vane assemblies (30), each of



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said left and right vertical seal members being connected continuously with said upper horizontal seal member (5) and with said at least one lower horizontal seal member.

5 2. A movable louver window as set forth in claim
1, wherein an uppermost one of said plurality of double-
vane assemblies (30) further comprises an upper cover
(60) engaged on and covering upper portions of first and
second louver vanes (31, 32) of said uppermost double-
10 vane assembly (30) and closing an upper end of a space
between said first and second louver vanes (31, 32) of
said uppermost double-cvane assembly (30).

3. A movable louver window as set forth in claim
15 2, wherein said upper horizontal seal member (5) is in
contact with an exterior side surface of said upper cover
(60) when the movable louver window is closed.

4. A movable louver window as set forth in claim
20 1, wherein said at least one lower horizontal seal member
is a lower horizontal seal member (10) provided for being
in contact with an interior side surface of a lower
portion of a first louver vane (31) of the lowermost
double-vane assembly (30).

25



5. A movable louver window as set forth in claim 1, wherein said at least one lower horizontal seal member is a lower horizontal seal member (11) provided for being in contact with an interior side surface of a lower portion of a second louver vane (32) of the lowermost double-vane assembly (30).

6. A movable louver window as set forth in claim 1, wherein said at least one lower horizontal member are lower horizontal members (10, 11) provided for each being in contact with an interior surface of a lower portion of relative one of both the first and second louver vanes (31, 32) of the lowermost double-vane assembly (30).

7. A movable louver window as set forth in claim 1, wherein each of said vertical seal member consists of an upper wider vertical seal member (28) forming an upper portion of said vertical seal member and provided for being in contact with a side surface of at least an upper portion of an uppermost one of said plurality of double-vain assemblies (30) and having such width as overlapping side surfaces of both of first and second louver vanes (31, 32), and first and second narrower vertical seal members (29₁, 29₂) forming a subsequent lower portion of said vertical seal member and provided for being in



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contact with side surfaces of said plurality of double-
vane assemblies subsequent to said side surface in
contact with said upper wider vertical seal member (28)
and each having such width as continuously overlapping a
5 side surface of relative one of said first and second
continuous walls of louver vanes, and at least one of
lower end portions of said first and second narrower
vertical seal members (29₁, 29₂) is continuously connected
with said at least one lower horizontal seal member.

10

8. A movable louver window as set forth in claim
6, wherein each of said vertical seal member consists of
an upper wider vertical seal member (28) forming an upper
portion of said vertical seal member and provided for
15 being in contact with a side surface of at least an upper
portion of an uppermost one of said plurality of double-
vane assemblies (30) and having such width as overlapping
side surfaces of both of first and second louver vanes
(31, 32), and first and second narrower vertical seal
20 members (29₁, 29₂) forming a subsequent lower portion of
said vertical seal member and provided for being in
contact with side surfaces of said plurality of double-
vane assemblies subsequent to said side surface in
contact with said upper wider vertical seal member (28)
25 and each having such width as continuously overlapping a



side surface of relative one of said first and second continuous walls of louver vanes, and lower end portions of said first and second narrower vertical seal members (29_1 , 29_2) are continuously connected with relative one of
5 said lower horizontal seal members (10, 11).

9. A movable louver window as set forth in claim 1, wherein each of said vertical seal member consists of a wide vertical seal member having such width as
10 continuously overlapping side surfaces of both of said first and second continuous walls of louver vanes.

10. A movable louver window as set forth in claim 4, wherein each of said vertical frame (3) comprises a
15 vertical frame main body (12) formed integrally with a plurality of vertical plates (15, 16, 17) directed towards the inside of said frame body (A) and a mounting vertical plate (13) mounted on said plurality of vertical plates (15, 16, 17), and each of said vertical seal
20 members is mounted on said mounting vertical plate (13) and comprises first and second narrow vertical seal members (29_1 , 29_2) having a space between each other and each provided for continuously overlapping a side surface of relative one of said first and second continuous walls
25 of louver vanes, and said first narrow vertical seal



member (29₁) is continuously connected with said lower horizontal seal member (10), and said lower frame (2) laterally extends beyond a lower end of said mounting vertical plate (13) to be connected with said vertical frame main body (12) so as to drain water along a surface of said lower frame (2).

11. A movable louver window as set forth in claim 5, wherein each of said vertical frame (3) comprises a vertical frame main body (12) formed integrally with a plurality of vertical plates (15, 16, 17) directed towards the inside of said frame body (A) and a mounting vertical plate (13) mounted on said plurality of vertical plates (15, 16, 17), and each of said vertical seal members is mounted on said mounting vertical plate (13) and comprises first and second narrow vertical seal members (29₁, 29₂) having a space between each other and each provided for continuously overlapping a side surface of relative one of said first and second continuous walls of louver vanes, and said second narrow vertical seal member (29₂) is continuously connected with said lower horizontal seal member (11), and said lower frame (2) laterally extends beyond a lower end of said mounting vertical plate (13) to be connected with said vertical frame main body (12) so as to drain water along a surface



of said lower frame (2).

12. A movable louver window as set forth in claim 6, wherein each of said vertical frame (3) comprises a vertical frame main body (12) formed integrally with a plurality of vertical plates (15, 16, 17) directed towards the inside of said frame body (A) and a mounting vertical plate (13) mounted on said plurality of vertical plates (15, 16, 17), and each of said vertical seal members is mounted on said mounting vertical plate (13) and comprises first and second narrow vertical seal members (29₁, 29₂) having a space between each other and each provided for continuously overlapping a side surface of relative one of said first and second continuous walls of louver vanes, and each of said first and second narrow vertical seal members (29₁, 29₂) is continuously connected with relative one of said lower horizontal seal members (10, 11), and said lower frame (2) laterally extends beyond a lower end of said mounting vertical plate (13) to be connected with said vertical frame main body (12) so as to drain water along a surface of said lower frame (2).

13. A movable louver window comprising:
a quadrilateral frame body (A) having an upper

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frame(1), a lower frame (2) and left and right vertical frames (3);

a plurality of double-vane assemblies (30) each comprising first and second louver vanes (31, 32) and a
5 pair of left and right coupling members (33) each having a pivoting arm (36), said pair of left and right coupling members (33) coupling said first and second louver vanes (31, 32) in such manner that an upper portion of said first louver vane (31) extends upwardly beyond an upper
10 portion of said second louver vane (32) and a lower portion of said second louver vane (32) extends downwardly beyond a lower portion of said first louver vane (31) and that said first and second louver vanes (31, 32) are parallel to each other having a space
15 therebetween, said plurality of double-vane assemblies (30) being mounted within said frame body (A) in vertically pivotable fashion and in such manner that when the movable louver window is closed, a lower portion of an upper one of each two vertically adjacent first louver
20 vanes (31) overlaps an upper portion of an lower one of each two vertically adjacent first louver vanes (31) for forming a first continuous wall of louver vanes and a lower portion of an upper one of each two vertically adjacent second louver vanes (32) overlaps an upper
25 portion of a lower one of each two vertically adjacent



second louver vanes (32) for forming a second continuous wall of louver vanes and that between said first and second continuous walls of louver vanes is defined a vertically continuous space for forming a heat insulating air layer therein;

wherein a pivoting center (37a) of each of said double-vane assemblies (30) is positioned on the interior side relative to a first louver vane (31), and positional relationship between vertically adjacent double-vane assemblies (30) is determined to satisfy:

$$\ell_3 < \ell_2 + \ell_1 \text{ and } \theta_2 > \theta_1$$

wherein

ℓ_1 is a distance from a pivoting center of an upper double-vane assembly to a lowermost end edge on the interior side of the first louver vane of the upper double-vane assembly;

ℓ_2 is a distance from a pivoting center of a vertically adjacent lower double-vane assembly to an uppermost end edge on the exterior side of the second louver vane of the lower double-vane assembly;

ℓ_3 is a distance between the pivoting centers of the vertically adjacent upper and lower double-vane assemblies;



θ_1 is an angle defined by a line extending through an intersecting point of a circle c_1 centered at the pivoting center of the upper double-vane assembly and having a radius of ℓ_1 and a circle c_2 centered at the
5 pivoting center of the lower double-vane assembly and having a radius of ℓ_2 and the pivoting center of the upper double-vane assembly and a line extending through the lowermost end edge on the interior side of the first louver vane of the upper double-vane assembly and the
10 pivoting center of the upper double-vane assembly; and

θ_2 is an angle defined by a line extending through the intersecting point of the circles c_1 and c_2 and the pivoting center of the lower double-vane assembly and a line extending through the uppermost end edge on
15 the exterior side of the second louver vane of the lower double-vane assembly and the pivoting center of the lower double-vane assembly.