

TITLE

FOLDABLE CURTAIN-TYPE MESH WINDOW ASSEMBLY

5

BACKGROUND OF THE INVENTION

Field of the Invention

10 The present invention relates in general to mesh windows fitted to a sash window or a sash door. In particular, the present invention relates to a mesh window with a foldable mesh screen or curtain provided therewithin, such a mesh window can be fitted external to a sash window or a sash door for
15 adjusting natural light source and preventing entrance of insects indoors.

Technical Background

20 Mesh windows are frequently made as a panel-shaped plate (panel-style mesh window) and fitted external to glass sash windows or sash doors, for the purposes of ventilating air, adjusting environmental light entering into the house, as well as preventing annoying insects from entering into the house.
25 A panel-style mesh window is normally fitted within an outer frame of a glass sash window, and one pair of rails are provided in the outer frame to guide the panel-style mesh window to slide rightward or leftward thereon.

30 Some mesh windows are provided with foldable mesh screens and can be fitted to glass sash windows or doors in such a way that each of the two vertical edges of the mesh screens are secured to one movable edge rod. Each of the movable edge rods can be guided to slide horizontally within a plane defined by the upper and lower frames of the mesh window assembly. The
35 sliding movement of the movable edge rods allows the mesh screen to be extended or folded like the bellows of an accordion.

However, when such prior art mesh windows are fitted external to a glass sash window, since there is typically a limited space (or depth) left for the mesh window assembly, therefore, the mesh window is of , in most cases, relatively insufficient structural thickness. The result is that the rigidity of the mesh windows is always a problem. Distortions may easily result, and the mesh window assembly moves away from its normal position. In some occasions, complete fall off may even be the situation.

Furthermore, since these prior art mesh window assemblies are frequently fitted external to glass sash windows or door panels, they are inclined to be contaminated by outdoor dirt. A dirty mesh window obstructs the sight from indoors. Even worse is that these external mesh window assemblies are frequently difficult to be removed for cleaning, especially from inside the house.

It had therefore been proposed to provide a roller-type mesh window assembly that has its mesh screen rolled onto a shaft. The shaft was accommodated within a casing which is fitted to one side jamb of a sash window. The mesh screen can be pulled out of the casing to cover the opening of the sash window. When removal of the mesh screen is required, a torsion spring fitted to the shaft can pull back the mesh screen. However, this mesh window assembly has a severe problem. The upper and lower edges of the mesh screen can not fit the window opening in a tight way. In other words, clearances will occur therebetween, and insects will thus enter the house by way of the clearances. Moreover, the torsion spring is difficult to repair. Further to this, if the mesh screen is extended in horizontal direction, the weight of the mesh screen and the pulling force will result uneven elongations between the upper and lower edges of the mesh screen, and this will bring in sagging of the mesh screen.

Furthermore, for this roller-type of mesh window assembly, in order to keep the vertical edge of the mesh

screen in its vertical position when the mesh screen is being pulled out or retracted, a complex arrangement involving a flexible wire is required. One end of the wire has to be fixed to one side jamb of the assembly, and the other end must pass through the upper end of the movable edge rod to its lower end, and then fixed to the other opposing side jamb of the window assembly. The intention is to maintain the movable edge rod in its upright position during its movement. The wire is being stretched along a substantially Z-shaped route. However, when the wire becomes sagged by any chance, the movable edge rod will no longer be able to maintain its upright position during its movement. When the wire breaks, the replacement of the entire wire would be necessary. In other words, a joint section will block the smooth movement of the movable edge rod. Therefore, the replacement of a new wire is mandatory. Besides, the replacement of the wire in such an assembly requires trained personnel and is tedious and expensive to perform.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide a foldable curtain-type mesh window assembly that is suitable for installation to both interior and exterior to a glass sash window or a sash door.

It is another object of the present invention to provide a foldable curtain-type mesh window assembly that provides complete sealing to a sash window or door opening to prevent entrance of insects.

It is still another object of the present invention to provide a foldable curtain-type mesh window assembly that is easy to install as well as removal for cleaning and maintenance even when installed exterior to a glass sash window or door.

It is yet another object of the present invention to provide a foldable curtain-type mesh window assembly

that allows for great flexibility of use for controlling the environment lighting and room air ventilation.

BRIEF DESCRIPTION OF THE DRAWING

5 Other objects, features, and advantages of the present invention will become apparent by way of the following detailed description of the preferred but non-limiting embodiments. The description is made with reference to the accompanied drawings in which:

10 FIG. 1 is a cross-sectional view, taken along a selected horizontal plane, of a foldable curtain-type mesh window in accordance with a first preferred embodiment of the present invention;

15 FIG. 2 is a cross-sectional view, taken along a selected vertical plane of the foldable curtain-type mesh window shown in FIG.1;

20 FIG. 3 is a front view, with a selected cross section showing the middle portion, of the foldable curtain-type mesh window of the first embodiment of the present invention;

FIG. 4 is a side view of the foldable curtain-type mesh window shown in FIG. 3;

25 FIG. 5 is a perspective view showing a sliding element for the foldable curtain-type mesh window of the first embodiment of the present invention;

FIG. 6 is a front view of the sliding element shown in FIG. 5;

30 FIG. 7 is a front view, with a selected cross section showing the middle portion, of the foldable curtain-type mesh window in accordance with a second preferred embodiment of the present invention;

FIG. 8 is a side view of the foldable curtain-type mesh window shown in FIG. 7;

35 FIG. 9 is a schematic drawing showing the operation of the foldable curtain-type mesh window of second embodiment of the present invention;

FIG. 10 is a perspective view showing a modified sliding element on a rail for the foldable curtain-type mesh window in accordance with a third preferred embodiment of the present invention;

5 FIG. 11 is a perspective view showing a modified sliding element on a rail for the foldable curtain-type mesh window of the second embodiment of the present invention;

10 FIG. 12 is a front view showing a slide rail for the foldable curtain-type mesh window of the third embodiment of the present invention;

FIG. 13 is a side view of the slide rail shown in FIG. 12;

15 FIGS. 14 and 15 are schematic drawings showing the operation involving the slide rail of the foldable curtain-type mesh window of the third embodiment of the present invention;

20 FIG. 16 is a front view, with a selected cross section showing the middle portion, of a foldable curtain-type mesh window in accordance with a preferred embodiment of the present invention in its assembled status;

25 FIGS. 17, 18 and 19 are partial cross-sectional views showing schematically the operation of the foldable curtain-type mesh window in accordance with a fourth preferred embodiment of the present invention;

30 FIG. 20 is a cross-sectional view showing the longitudinal cross section of the latch device for the center rod of the fourth embodiment of the present invention;

FIG. 21 is a cross-sectional view showing a cross section of the latch device for the center rod of the fourth embodiment of the present invention; and

35 FIG. 22 is a cross-sectional view showing the latch device shown in FIG. 20 in its another latched status.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Reference is first directed to FIG. 1 which shows a cross-section taken along a selected horizontal plane, of a foldable curtain-type mesh window in accordance with a first preferred embodiment of the present invention. As can be seen in FIG. 1, a wooden frame 8 is disposed internal to the vertical outer frame sections 5 of a sash window frame assembly, and a pair of vertical side jambs 1 and 1' of the foldable curtain-type mesh window assembly of the present invention is secured to the wooden frame 8. The vertical side jambs 1 and 1' are respectively provided with storage spaces 1c and 1'c for accommodating a mesh screen 100 therein. As shown in FIG. 1, two movable edge rods 4 are detachably engaged with the side jambs 1 and 1'.

Reference is now switched to FIG. 2, in which the upper and lower ends of two movable edge rods 4 are respectively engaged with the upper and lower frame sections 2 and 3 of the mesh window assembly. As shown in FIG. 1, each of the movable edge rods 4 is provided with a channel which allows itself to form a virtually closed hollow space when the movable edge rods 4 are engaged with the side jambs 1 and 1' (see FIG. 1), and the mesh screen 100 can be accommodated therein. This allows the protection of the mesh screen 100 from being contaminated or damaged when not in use.

One vertical edge of the mesh screen 100 can be detachably fixed to the side jambs 1, or 1', and the other vertical edge to the movable edge rod 4 by any suitable and convenient means, for example, Velcro strips 31. Also is seen in FIGS. 1 and 2 are two glass sash window 200 and 300 that can be slide relatively toward or apart each other. Also, in FIGS. 1 and 2, numeral 400 stands for a conventional pane l-style mesh window.

Referring again to FIG. 2, the upper and lower frame sections 6 and 7 of the glass sash window have wooden frame 9 fixed thereto. The upper and lower frame sections 2 and 3 of the mesh window assembly of the first embodiment are in turn fixed to their corresponding sections of the

wooden frame 9 by the use of wood screws 10. As is seen in FIG. 2, each of the upper and lower frame sections 2 and 3 of the mesh window assembly has an L-shaped cross section, which allows the upper and lower edges of the mesh screen 100 to keep a close contact with the horizontal flanges 2a and 3a of the frame sections 2 and 3 respectively.

The upper and lower edges of the mesh screen 100 are maintained to be in contact with the horizontal flanges 2a and 3a respectively by suitable means as described below. That is, a number of wire holes 13 are formed at both the upper and lower edges of the mesh screen 100. These wire holes allow for the zig-zagged passing through of a wire 13 with proper diameter. Each end of the wire 13 passing through the upper and lower edges of the mesh screen 100 is fixed to the upper and lower ends of the side jambs 1 and 1' of the mesh window assembly. The wires 13 are tighten at both ends, so that the upper and lower edges of the mesh screen 100 can be maintained in a contact manner to the upper and lower horizontal flanges of the upper and lower frame sections 2 and 3 respectively.

The wires 13 passing through the upper and lower mesh screen edges can be hooked by ball-head hooks 12. The ball-head hooks 12 serve to reinforce the mesh screen 100 in its fully extended position. This prevents the upper and lower edges of the mesh screen 100 from falling apart from the horizontal flanges 2a and 3a when the mesh screen 100 is suddenly subjected to a strong wind.

The movable edge rods 4 are maintained at a vertical attitude while they are guided to move in the horizontal direction between the upper and lower frames 2 and 3 of the mesh window assembly. The vertical attitude of the movable edge rods 4 is maintained by employing, for example, sliding elements 14a. The sliding elements 14a are provided with side arms 14d extending into the upper and lower ends of the movable edge rods 4.

FIGS. 3 and 4 respectively show the front view and the side view of the foldable curtain-type mesh window

of the first embodiment described above. In FIGS. 3 and 4, cross sections of the movable edge rod 4 and the mesh screen are shown for better explanation. It can be seen that the side arms 14d of the sliding elements 14a are inserted into the upper and lower ends of the movable edge rod 4. However, the side arm 14d of the sliding element 14a at the lower end of the movable edge rod 4 is fixedly secured by wood screws 15. The side arm 14d of the sliding element 14a at the upper end of the movable edge rod 4 is loosely inserted into the upper end of the movable edge rod 4 only.

Due to the fact that the surfaces of the upper and lower frame sections 2 and 3 may never be perfectly parallel, the loose insertion of the upper sliding element 14a allows the variation of the distance between the upper and lower frame sections 2 and 3. By this arrangement, the movement of the movable edge rods 4 will not be blocked between the upper and lower frames sections 2 and 3 when they are pushed or pulled to move in horizontal direction. If the upper and lower sliding elements 14a are both fixedly secured to the movable edge rods 4, the movement of the movable edge rods 4 will be sticking and the distance between the surfaces of the upper and lower frames sections has to take a larger tolerance.

The sliding element 14a can be constrained to move in the desired horizontal direction and further prevented from deviating from the plane of the mesh screen by the use of a proper device. For example, an I-shaped rail 16 can be used to guide the movement of the sliding element 14a. FIG. 5 is the perspective view showing the relationships of various parts in such an arrangement. The arm 14d integrally formed with the body of the sliding element 14a is substantially orthogonal to the sliding element 14a. A rectangular groove 14c is formed in the sliding element 14a. Another sliding element 14b substantially identical to the sliding element 14a with a rectangular groove 14c is coupled with the sliding element

14a in such a manner that the I-shaped head of the rail 16 is sandwiched therebetween. Proper measure can be provided to reduce the friction induced between the sliding elements 14a, 14b and the rail 16. For example, the sliding elements 14a and 14b can be made of synthetic resin that has inherently small coefficient of friction when sliding on the surface of a rail made of typical material selected from metals such as aluminum alloy.

FIG. 6 is a front view of the sliding element 14a shown in FIG. 5. When the movable edge rod 4 is pushed or pulled to move horizontally on the rail 16 for extending or folding of the mesh screen, a horizontal force component P would exert on the extending side arm 14d of the sliding element 14a. As a result of the presence of the force P on the arm 14d, a pair of horizontal and vertical force components V_v and V_h can be derived from the resultant force V_p which is exerting on the surface of the sliding element 14a as a result of the presence of force P .

The horizontal force component V_h is the force to move the entire rod along by overcoming the frictional force that is inevitable induced between the surfaces of the sliding element 14a and the rail 16. It is obvious that the a larger relative magnitude ratio between the horizontal and vertical force components (that is, V_h/V_v) will make the movement of the movable edge rod 4 on the rail 16 easier and smoother. While it is obvious that the ratio V_h/V_v is also determined by the dimensional factors of the configuration of the sliding element 14a. It can be appreciated that the ratio V_h/V_v could be obtained by the ratio of the contact length L of the sliding element 14a on the rail 16, over the engaging height d . In other words, the larger the length L and the smaller the engaging height d , the smoother the movement of the movable edge rod 4 on the rail 16 will be.

The greater the ratio V_h/V_v or L/d , the swinging incline angle of the entire movable edge rod 4 would be smaller, and a smaller V_h component. In other words, the

larger L/d , the smoother the sliding movement of the movable edge rod 4 on the rail will be. The ratio V_h/V_v or L/d is preferably greater than 5.

FIG. 7 and FIG. 8 are respectively the front view and the side view, with a cross section, showing the middle portion of the foldable curtain-type mesh window in accordance with a second preferred embodiment of the present invention.

As is seen in the side view of this second embodiment of the mesh window assembly shown in FIG. 8, two guide slots 17a and 17b are respectively formed in the inner wall of the upper and the lower frame sections 17. A pair of sliding guide rails 18a and 18b are slidably inserted into the guide slots 17a and 17b. This allows for the desired smooth sliding movement of the movable edge rod 4 whose upper and lower ends are engaged with the side arms 19 fixed to the two sliding guide rails 18a and 18b.

Referring to FIG. 7, it can be seen that two movable edge rods 4a and 4b are installed in the second embodiment of the mesh window assembly of the present invention. The movable edge rods 4a and 4b are connected to the side arms 19 in a similar manner as that of the first embodiment described above. Specifically, the extending side arm 19 at the upper end of the movable edge rod 4a, or 4b, is loosely inserted into the movable edge rod 4a, or 4b, while the extending side arm 19 at the lower end of the movable edge rod 4a, or 4b, is secured to the lower end of the movable edge rod by, for example, wood screws 15. As already described in the case of the first embodiment, this allows the movable edge rods 4a and 4b to have an adjustable length that can accommodate the distance variation between the upper and lower frame sections 17 and 17' of the mesh window assembly as the movable edge rods are pushed or pulled to move.

FIG. 9 schematically shows the operation of the foldable curtain-type mesh window of the second embodiment of the present invention, the mesh screen may be extended

or floded by guiding the movable edge rods 4a and 4b to move in horizontal direction. The sliding guide rails 18a and 18b secured to the lower end of the movable edge rods 4a and 4b are respectively shown for the purpose of exhibiting the relative relationship of the sliding guide rails with the movable edge rods 4a and 4b.

Due to the arrangement, the mesh window assembly shown in FIG. 9 has only one of the sliding guide rails 18a and 18b installed for each of the two halves of the mesh screen, the movable edge rods 4a and 4b can be moved along the rail 16 to the center of the entire window. As is shown in FIG. 9, when the movable edge rods 4a and 4b are both pulled to the center of the window opening (shown in phantom lines), the sliding guide rails 18a and 18b of the two halves of the mesh screen can pass each other due to the fact that they are inserted into different sliding slots 17a and 17b (see FIGS. 7 and 8) respectively. When the two movable edge rods 4a and 4b of the two halves of the mesh screen are both pulled to the center of the window opening and contacting each other, the entire mesh screen then serves to enclose the window opening in a complete sealing manner.

Since the length of the sliding guide rails 18a and 18b in the second embodiment is noticeably longer than that of the sliding elements 14a in the first embodiment, the frictional force generated when the movable edge rods 4a and 4b are pulled or pushed along the rail in the second embodiment is much smaller than that in the first embodiment. The much larger L/d ratio in the second embodiment contributes to smoother movement. This also means that the tolerance of the engaging height d can be set to a larger range without introducing excessive frictional force that makes the movement of the movable edge rod sticking. This means the easier control over the manufacture of the upper and lower frame sections 17 and 17', since they are allowed with larger dimensional

tolerances while still maintaining reasonable sliding frictional force.

On the other hand, due to the greater length of the sliding guide rails 18a and 18b, the described second embodiment of the mesh window assembly of the present invention, has a limited application to sash windows with larger opening width. In other words, the sash window must have a width at least larger than twice the length of the sliding guide rails 18a or 18b.

FIGS. 12 and 13 are respectively the front view and side view showing a third embodiment of the foldable curtain-type mesh window assembly of the present invention. The third embodiment, when compared to that of the second embodiment described above, is specifically suitable for use in sash windows having relatively narrower opening width.

With simultaneous reference to FIGS. 12 and 13, it is observable that one pair of slide rails 21 made of, for example, synthetic resin, are allowed to smoothly slide along both surfaces of the upper and lower frame sections 20 and 20' of the mesh window assembly with proper arrangements to be described below. Each of the upper and lower frame sections 20 and 20' has a guide slot 20a formed therein. Each of the slide rails 21 for both the upper and lower ends of each of the two movable edge rods 4 has a guide slot 21c with C-shaped cross section as viewed in FIG. 13, and sliding guide elements 22 and 23 made of synthetic resin are inserted therein.

The sliding guide elements 22 and 23 are allowed to move along the surfaces of the upper and lower frame sections 20 and 20' respectively in horizontal direction. The extending side arms 22a and 23a formed integrally with the sliding guide elements 22 and 23 are respectively attached to the upper and lower ends of the movable edge rods 4 in the manner as described in the first and second embodiments of the present invention. Specifically, the sliding guide element 22 is loosely inserted into the upper

end of the movable edge rod 4 for free relative movement therebetween. On the other hand, the sliding guide element 23 is fixedly secured to the lower end of the movable edge rod by the use of screws 15. When viewed in FIG. 12, each of the extending side arms 22a and 23a form respectively with their corresponding sliding guide elements 22 and 23 a substantially T-shaped configuration at both the upper and lower ends of each of the two movable edge rods 4.

Refer to FIG. 12, on both the top and bottom surfaces of the sliding guide element 23 for the lower end of the movable edge rods 4, a number of bearing recesses in the form of half-cylinders cut along the longitudinal direction are formed therein. Each of these half-cylindrical recesses is used to accommodate one cylindrical bearing roller 24 for assisting the sliding movement of the sliding guide element 23 along the slide rail 21. At each end of the slide rail 21 of both the upper and lower frame sections 20 and 20', one stopper block 21a is provided for preventing the dis-engagement of the sliding guide element 23 with the slide rail 21.

FIGS. 14 and 15 together show schematically the operation involving the slide rail, as well as the movable edge rods 4a and 4b of the foldable curtain-type mesh window of the third embodiment of the present invention. In the mesh window assembly of FIG. 14, similar as was in the case of second embodiment of the present invention described above, the movable edge rods 4a and 4b for both halves of the mesh screen are disposed between the upper and lower frame sections 20 and 20'. The movable edge rods, as mentioned, can slide smoothly in horizontal direction while maintaining their upright position, and when the mesh screen is folded, the two movable edge rods 4a and 4b are pushed away from the center of the window opening and closely contact the vertical frame sections 5 of the mesh window assembly. On the other hand, if both halves of the mesh screen are pulled out of the folded condition by pulling both the movable edge rods 4a and 4b

toward the center of the enclosed window until the two movable edge rods meet each other, then the upper and lower sliding guide elements 22 and 23 would first be sliding relative to the slide rail 21 until they reached the extreme ends of the slide rail 21. When each of the sliding guide elements 22 and 23 reaches the stopping blocks 21a at the rail end, the slide rail 21 will also be pulled along as the movable edge rod is continuously pulled toward the center of the window opening.

If by any means the sliding guide element 22 or 23 pulls its corresponding slide rail 21 together to move along before the end of the sliding guide element 22 or 23 reaches the stopping block 21a, this is still a situation acceptable and would not affect the tight closure of the two movable edge rods 4a and 4b. This is because, when the two movable edge rods 4a and 4b are brought to meet each other at the center of the window opening, the front ends of the sliding guide elements 22 and 23 would also be contacting each other and forced to abut the end of the slide rail 21. The two halves of the mesh screen, at this instance, form one substantially perfect mesh screen that seals the entire window opening.

Then, refer to FIG. 15, in which the sash window to be covered by a mesh screen has a relatively narrower width. In such narrow windows, only one movable edge rod 4, that is, only one sheet of mesh screen is used. When the movable edge rod 4 is pulled from where the mesh screen is folded and stored toward the other side jamb of the sash window, the single set of sliding guide elements 22 and 23 along and close to the upper and lower frame sections of the window assembly would also be pulled along. When the movable edge rod 4 reaches and contacts the side jamb of the sash window, the entire single sheet mesh screen is then covering the sash window opening. Even if the slide rails does not has their stopping blocks abut by the end of the sliding guide elements 22 and 23 when the movable edge rod 4 is still pulled along the horizontal direction, the

smooth movement of the movable edge rod 4 trailing the mesh screen is not affected, as was in the case of the embodiment of FIG. 14 where two halves of the mesh screen are employed.

5 A comparison of the second and the third embodiments of the foldable curtain-type mesh window assembly of the present invention described above shows that the present invention is flexible to be suitable for both wide and narrow window openings to be covered by mesh
10 screens. For example, the second embodiments described herein is suitable for wide windows but not narrow ones. This is because that the long sliding element in the second embodiment, although helps with the smooth movements in the extending or folding of the mesh screen, does, however,
15 obstruct the full movement of the movable edge rod in a narrow window opening. In other words, the long sliding element prevents the movable edge rod to travel from the side jamb at one side of the window to the other.

 On the other hand, the foldable curtain-type mesh
20 window assembly of the third embodiment, shown in FIGS. 14 and 15, is suitable for narrow windows, however in the case of wide ones, it would be more preferable to employ the mesh window assemblies having the movement-smoothing mechanism as exhibited in the second embodiment. As
25 already indicated, second embodiment also enjoys a larger L/d ratio that allows for easy control of the manufacturing tolerance which will result a reducing of cost.

 The perspective views of FIGS. 10 and 11 show the sliding guide rails 18a and 18b and the slide rails 21
30 which are respectively for the third and the second embodiments of the foldable curtain-type mesh window of the present invention. The slide rail 21 and the sliding guide rails 18a and 18b for the third and the second embodiments are equipped with a number of free-running rollers 38 that
35 assist the sliding motion of the sliding guide rails and the slide rails. These configurations add costs to the mesh window assembly because of the use of the additional roller

wheels 38, however, these rollers 38 can greatly help in smoothing the sliding of the movable edge rods when they are pulled or pushed in the horizontal direction. These rollers 38 can, however, be removed if the movable edge rods attached to the mesh screen are light enough to cause neglectable frictional force, as well as frictional noise. If the cost effectiveness of the use of these rollers 38 are justifiable, they can be added to further smooth the sliding and reduce the noise level.

FIG. 16 is a front view, with a cross section showing a selected middle portion, of a foldable curtain-type mesh window, in accordance with the present invention in its assembled status. A selected number of wire holes 25 are formed along the upper edge of the mesh screen 100, this arrangement allows the zig-zag penetrating of a wire 13. Each of the ends of the wire 13 is fixedly secured to the upper ends of the side jambs 1 and 1'. With a similar arrangement, the other set of wire holes 25 are also formed along the lower edge of the mesh screen 100 for the zig-zag penetrating of another wire 13. Two ends of the second wire 13 for the lower edge of the mesh screen 100 is fixed to the lower ends of the 1 and 1'.

The attachment of the wires 13, either to the upper or lower ends of the side jambs 1 and 1', is tightened between the ends of the wires, so as to make the upper and lower edges of the mesh screen to closely contact with the surfaces of the upper and lower frame sections 2 and 3, each of them has an L-shaped cross section. In FIG. 16, the upper half of the view shows a two-half mesh screen arrangement that allows each half of the mesh screen to be stored within the two side jambs respectively. At about the center of the window opening, a coil spring 26 connects the two wires 13. This coil spring 26 serves to allow a flexibility while maintaining the tight tension of the wires 13 that suspend the mesh screen 100. The outside ends of the wires 13 are each secured to the side jambs 1 and 1' respectively by means of, for example, wire-holding

device 27 that allows for disengagement of the wire ends when required. The wire-holding device 27 passes through a hole 28 formed near the upper end of the side jambs 1 and 1', and its protruding portion abuts the rim of the hole 28. This arrangement allows for easy detachment of the wire end when required, while maintaining the necessary tightness of the wire 13 to suspend the mesh screen 100.

A number of ball-head hooks 12 are disposed in the upper and lower frame sections 2 and 3 respectively. The hooks 12 are spaced apart by a predetermined proper distance. These hooks 12 serve to assist the suspension of the wire 13 through its entire length in addition to the support at its both ends on the side jambs 1 and 1'. With the reinforcement of these hooks 12, improved resistance to strong wind, as well as other external forces to take the mesh screen 100 away from its proper position can be achieved.

Furthermore, the wire holes 25 for the edges of the mesh screen 100 can be formed by, for example, enlarging a selected mesh grid at the center of the wire hole 25 by means of pushing the mesh fibers apart. This allows for the mesh fibers to maintain the entire strength of the mesh screen 100. If, during the process of making wire holes 25, mesh fibers are cut, the wire holes 25 will then become weak spots of the mesh screen that will eventually ripped when it is pulled to move along the rail.

On the other hand, the lower half of FIG. 16 shows the extending status of the mesh window assembly. This lower half of view shows a slightly different arrangement of the mesh window compared with that of the upper half. This is a one movable edge rod embodiment suitable for sash windows or doors with relatively narrower opening. The wire 13 penetrating the wire holes 25 also has its one end attached to one end, that is, the lower end of a coil spring 26a. The other end of the wire 13 is attached to the side jamb by, for example, a wire-holding device 27 similar to the one used for embodiment described

in relation to the upper half of FIG. 16. Another end, the end remote from the wire 13 of the coil spring 26, is attached to a bracket 30. The bracket 30 is secured to the side jamb 1' and is allowed to slide relative to the side jamb 1' in vertical up and down directions so as to be detached therefrom. The extended portion 30' of the bracket 30 is the portion attached to the side jamb 1'. This arrangement allows the wire 13 to be tightened along the lower frame section 3. A number of ball-head hooks 12 arranged in the similar manner as that for the upper frame section 2 also serve to suspend and reinforce the mesh screen 100 when subjected to excessive force.

Thus, with the reinforced support of the tightened wires 13 at both the upper and lower edges of the mesh screen 100, the mesh screen may be extended in a tightened manner in the vertical direction, while allowing to be extended or folded in the horizontal direction. Since, the attachment of the mesh screen to both the side jamb and the movable edge rod can be done by means of, for example, Velcro stripes, therefore, the entire mesh screen can be easily removed from the mesh window assembly for cleaning. After cleaning, the installing of the mesh screen back into the assembly is also as easy. The screen may even be placed back into the assembly directly after being cleaned. This greatly simplifies the maintaining of the mesh window assembly.

FIGS. 17, 18 and 19 are partial cross-sectional views that together show schematically the operation of the foldable curtain-type mesh window in accordance with a fourth preferred embodiment of the present invention. In the exemplified embodiment, curtain cloth used for the control of environmental lighting can be added. A combined effectiveness of air ventilation, insect prevention, and lighting control can be achieved by such a mesh window assembly. As can be appreciated, large grid mesh screen is suitable for air ventilation, but is not suitable for lighting control. On the other hand, small grid mesh

5 screens are effective in blocking outdoor sunlight, but is not good for air ventilation. A combination of a mesh screen with suitable mesh grid size and a cloth curtain could meet the need. FIGS. 17, 18 and 19 depict such combinations.

10 In FIG. 17, mesh screen 100 is pulled and pushed along the rail to be extended and folded within the accommodation space 1c in the proximity of the side jamb 1 as required. A center rod 32 is also freely slidable along the rail and can be slid to approach the side jamb to form the accommodation space 1c. The movable edge rod 33, on the other hand, having its upper and lower ends smoothly sliding along the upper and lower frame sections of the assembly, can be pushed against and next to the center rod 15 32, with its lateral storage space 33c capable of accommodating the foldable curtain 100' therein.

Both the mesh screen 100 and the cloth curtain 100' have their one vertical edge secured to the inner vertical surface of the side jamb 1. The other vertical 20 edges of screen 100 and curtain 100' are secured to the movable edge rod 33 and the center rod 32 respectively. The attachment of the edges of the mesh screen 100 and curtain 100' to their respective locations is via convenient means such as, Velcro strips 31. The upper and 25 lower edges of both of the mesh screen 100 and the curtain 100' should be maintained at a close distance along the upper and lower frame sections of the sash window. The sliding engagement of these upper and lower edges can be implemented in the manner as described above, utilizing the 30 wire and hole arrangement.

Refer to FIG. 18. In the depicted situation, the curtain 100' is kept in the space 33c formed by the combination of the movable edge rod 33 and the center rod 32. The entire sheet of curtain 100' is folded and moved 35 on the horizontal rail along with the mesh screen 100. In the case of FIG. 18, the mesh screen 100 is fully extended, with the curtain 100' folded and stored. Contrary to the

situation of FIG. 18, FIG. 19 depicts a different situation of the assembly, wherein the mesh screen 100 is kept folded, while the curtain 100' is fully extended. Of course, a balance between the two situations is also possible. Both the mesh screen 100 and the curtain 100' may be partially extended, as the user desires.

FIG. 20 is a cross-sectional view showing the longitudinal cross section of a latch device for the center rod of the fourth embodiment of the present invention, and FIG. 21 is a cross-sectional view showing the traverse cross section of the latch device for the center rod of the fourth embodiment of the present invention. As is seen in FIG. 21, the center rod 32 is shown to include a flank portion 32a and an extended portion 32b forming a generally T-shaped cross section. Both of the side surfaces of the flank portion 32a are provided with attachment devices such as, for example, Velcro strips, which is suitable for attachment to the vertical edges of the mesh screen 100 and curtain 100' having its portion of the corresponding Velcro strips respectively.

The extended portion 32b of the center rod 32 has a groove 32c formed therein. A sliding switch 34 having an H-shaped cross section as seen in the traverse cross-sectional view of FIG. 20 is made of, for example, synthetic resin. The sliding switch 34 has its extension legs 34a allowed to slide along the groove 32c. Each of the remote ends of the four extension legs 34a of the sliding switch 34 is fitted with a magnet 35 that extends into the corresponding cut-away portion on the side wall of the groove 32c. A pair of contact pieces 36 made of magnet-attractable metal and placed at the locations corresponding to the magnets 35 are fitted to the movable edge rod 33. A pair of contact pieces 37 are also secured on the side jamb 1, at the locations corresponding to the magnets 35.

The pairs of contact pieces 36 and 37 are separated apart in the vertical direction as seen in the cross-sectional view of FIG. 20, and can be attracted by

the magnets 35 when the sliding switch 34 is moved to the very location that orients the contact pieces 36 or 37 to the magnets 35. The center rod 32 can thus be fixed to and stick together with the movable edge rod 33 as the magnets 35 firmly attract the contact pieces 36. This happens when the sliding switch 34 is pressed downward as viewed in FIG. 20, the movable edge rod 33 is then fixedly combined with the center rod 32, and the two can then be moved together, with the curtain 100' stored in the space 33c, while the mesh screen 100 is extendable.

On the other hand, the center rod 32 can be fixedly combined with the side jamb 1 of the assembly when the sliding switch 34 is pressed upward and the contact pieces 37 are attracted by the magnets 35 as is seen in FIG. 22, which schematically shows the latch device in its another latched status. In this situation, the mesh screen 100 is confined in its folded and stored status, allowing only the curtain 100' to be extendable.

A pair of spring plates 39 are further provided to abut the side wall of the groove 32c. This helps to prevent the sliding switch 34 from breaking away from the magnetic attraction due to its own weight.

Weight of the curtain 100' constitutes virtually no problem for the curtain-type mesh window assembly of the present invention. Thin and light weight cloth curtains coated with a thin film of, for example, aluminum may possess equivalent light shading effect as that of the thick cloth curtains. The use of either the mesh screen, or the cloth curtain, or both in the foldable curtain-type mesh window assembly, is simply a matter of selection. The entire assembly can be configured right to the requirement, with no presence of extra mesh screen or curtain when either of them is not required.

Thus, the foldable curtain-type mesh window assembly of the present invention is advantageous in several respects when compared to the prior art assemblies. Among the noticeable advantages, the present invention

provides an adjustable mesh window assembly that is easy to use and maintain, while requiring less cost to manufacture, and at the same time provides good effectiveness for the purposes of air ventilation, insect prevention, and environment light adjustment. The selection of the use of either the mesh screen or the cloth curtain provides even greater flexibility that is not comparable by any of the prior art devices.

CLAIMS

1. A foldable curtain-type mesh window assembly which is suitable for being fitted to a sash window having an outer frame, comprising:

a pair of side jambs secured to the outer frame of the sash window in a face to face manner;

a pair of guide rails secured to the outer frame of the sash window in a parallel manner and being substantially orthogonal to said pair of side jambs to surround the opening of the sash window;

a pair of sliding elements slidably secured to said pair of guide rails, the ratio " L/d " of the contact length " L " in the longitudinal direction of said pair of guide rails over the engaging height " d " in a direction perpendicular to the longitudinal direction of said pair of guide rails being greater than 5;

a movable edge rod having a first and a second ends, the first end being engaged with one of said sliding elements, the second end of said movable edge rod being fixed with the other sliding element so that said movable edge rod is capable of being urged to make shift movements along said pair of guide rails; and

a mesh screen being extendable and foldable in a predetermined direction transversing the opening of the sash window and having two end edges and two side edges, the two side edges being perpendicular to the predetermined direction, one side edge being secured to one side jamb, the other side edge being secured to said movable edge rod whose shift movement on said guide rails guides the extending and the folding of said mesh screen.

2. A foldable curtain-type mesh window assembly as claimed in Claim 1, wherein the first end of said movable edge is engaged with the sliding element in a manner that allows a



free movement in the longitudinal direction of said movable edge rod.

3. A foldable curtain-type mesh window assembly as claimed in Claim 1, wherein said pair of sliding elements are secured to said pair of guide rails in a manner that each sliding element is slidably secured to one slide rail capable of telescopically sliding on one of said pair of sliding elements in the longitudinal direction of the sliding elements.

4. A foldable curtain-type mesh window assembly as claimed in Claims 1 to 3, wherein each of the two end edges of said mesh screen is provided with a set of holes formed spaced apart and along each of the two end edges, each set of the holes being penetrated by one of two wires, each of which is extending along one end edge of said mesh screen, and each of the two wires being tightened at two ends, each end of the wires being secured to one of said side jambs so as to keep the two end edges of said mesh screen close to said pair of guide rails.

5. A foldable curtain-type mesh window assembly as claimed in Claim 4, further comprising:

two sets of hooks each of which has one hook end and one engaging end, each set of the engaging ends of the hooks being slidably secured on one guide rail, and each set of the hook ends of the hooks being hooked on the wire adjacent thereto.

6. A foldable curtain-type mesh window assembly which is suitable for being fitted to a sash window having an outer frame, comprising:

a pair of side jambs secured to the outer frame of the sash window in a face to face manner;

a pair of guide rails secured to the outer frame of the sash window in a parallel manner and being substantially orthogonal to said pair of side jambs to surround the opening of the sash window;



a first and second pairs of sliding elements slidably secured to said pair of guide rails respectively;

a movable edge rod having a first and a second ends, the first end being engaged with one of said first pair of sliding elements, the second end of said movable edge rod being fixed with the other sliding element of said first pair of sliding elements so that said movable edge rod is capable of being urged to make shift movements along said pair of guide rails;

a center rod being disposed in parallel with said movable edge, having a first and a second ends, the first end being engaged with one of said second pair of sliding elements, the second end of said movable edge rod being fixed with the other sliding element of said second pair of sliding elements so that said center rod is capable of being urged to make shift movements along said pair of guide rails;

a mesh screen being extendable and foldable in a predetermined direction transversing the opening of the sash window and having two end edges and two side edges, the two side edges being perpendicular to the predetermined direction, one side edge being secured to one side jamb, the other side edge being secured to said movable edge rod whose shift movement on said guide rails guides the extending and the folding of said mesh screen;

a curtain screen being extendable and foldable in the predetermined direction transversing the opening of the sash window and having two end edges and two side edges, the two side edges being perpendicular to the predetermined direction, one side edge being secured to said movable edge rod, the other side edge being secured to said center rod, the relative shift movement between said center rod and said movable edge rod on said guide rails guides the extending and the folding of said curtain screen; and

a switch device for selectively engaging said movable edge rod with said center rod or said side jamb engaging with said mesh screen.

