

[Name of Document] SPECIFICATION

[Title of the Invention] SHEET SHUTTER

[Detailed Description of the Invention]

[Industrial Field of the Invention]

The present invention relates to a sheet shutter, and more particularly to a sheet shutter in which sheet ends are allowed to disengage from guide rails when a load over a predetermined magnitude acts upon a sheet.

[Description of the Related Art]

A sheet shutter is employed to open and close a building opening by using a sheet-like shutter curtain. If ends of the shutter curtain easily disengage from guide rails in a state of fully closing the opening, installation of the shutter would be meaningless. In some of sheet shutters, therefore, engaging portions are formed at both left and right side ends of a shutter curtain and are slidably engaged in guide rails so that both the ends of the shutter curtain will not disengage from the guide rails under an expected surface pressure.

However, because the strength of a sheet-like shutter curtain is weaker than that of a steel-made shutter curtain or the like, the following troubles may occur if forces in excess of the endurable wind pressure act upon the shutter curtain. The engaging portions formed at the side ends of the shutter curtain are forced to disengage from the guide rails, whereby the side ends of the shutter curtain are damaged. In another case, the shutter curtain is flexed to such an extent as damaging the guide rails.

[Problems to be Solved by the Invention]

The present invention has been accomplished with the view of solving the above-described problems, and its object is to provide a sheet shutter which can prevent damages of ends of a shutter curtain and damages of guide rails even when a load over a predetermined magnitude acts upon the shutter curtain.

Another object of the present invention is to provide a shutter curtain in which ends of the shutter curtain stand satisfactorily against a surface pressure acting upon the shutter curtain and is kept from dislodge from guide rails in use under a normal condition.

Still another object of the present invention is to provide a sheet shutter in which ends of a shutter curtain are allowed to disengage from guide rails when a load over a predetermined magnitude acts upon the shutter curtain (for example, when a strong impact is locally applied to the shutter curtain).

Still another object of the present invention is to provide a sheet shutter in which when ends of a shutter curtain have disengaged from guide rails with a load over a predetermined magnitude acting upon the shutter curtain, the disengaged ends can be easily restored into the guide rails.

[Means for Solving the Problems]

The technical means employed by the present invention to achieve the above objects resides in a sheet shutter comprising a sheet-like shutter curtain, a plurality of guide blocks provided at widthwise opposite left and right ends of the shutter curtain with intervals in the vertical direction, and guide rails vertically provided at the left and right sides of a building opening, wherein the guide blocks are vertically movable within the guide rails in a normal condition, the guide rails have an elasticity, and when a load over a predetermined magnitude acts upon the

shutter curtain, the guide rails are deformed to such an extent as allowing the guide blocks to disengage from the guide rails.

With the above construction, the ends of the shutter curtain can be avoided from being damaged, and the guide rails can also be avoided from being damaged.

Further, in the above sheet shutter of the present invention, the guide blocks may each have an abutment surface abutting against an inner wall of the guide rail such that a surface pressure acting upon the shutter curtain is resisted by the abutment between the abutment surface and the guide rail.

Still further, in the above sheet shutter, the abutment surface of each of the guide blocks may have curved sloped surfaces in upper and lower portions thereof such that when a load over a predetermined magnitude acts upon the shutter curtain, the guide blocks are more easily disengaged from the guide rails.

Still further, in the above sheet shutter, the surface of said each guide block opposite to said abutment surface is formed to be a rear portion vertically extending and having a tapered projecting cross-sectional shape such that the guide block having disengaged from the guide rail is pushed back into the guide rail from the rear portion thereof. With such a construction, the guide block having disengaged from the guide rail can be pushed back into the guide rail.

Still further, in the above sheet shutter, sloped guide surfaces may be formed at an opening of a guide groove of the guide rail such that the guide block having disengaged from the guide rail is pushed back into the guide rail while being guided by the sloped guide surfaces.

[Description of the Embodiment]

An embodiment of the present invention will be described with reference to the drawings. Fig. 1 is a schematic overall front view of a sheet shutter (showing a fully open state), and Fig. 2 is a view of the sheet shutter in an installed state, looking from a side. The sheet shutter comprises a pair of guide rail assemblies 1 vertically provided at both the left and right sides of a building opening, a shutter case 2 provided at an upper end of the opening, a take-up shaft 3 provided within the shutter case 2 and extended in the widthwise direction of the opening, and a shutter curtain 4 coupled to the take-up shaft 3.

Left and right ends of the shutter curtain 4 are received in guide grooves of the guide rail assemblies 1. When an opening/closing device is operated to open or close the shutter, the shutter curtain 4 is vertically moved while both the left and right ends thereof are guided by the guide grooves. With the vertical movement, the shutter curtain 4 is rolled round the take-up shaft 3 or unrolled from the take-up shaft 3. Such an overall construction of the sheet shutter is well known in the art.

The structure of the guide rail assembly will be described with reference to Figs. 3 to 9. The guide rail assembly 1 comprises a guide rail 5, a guide rail fixing member 6, a first rail cover 7, a second rail cover 8, and a rail sealing member 10.

The guide rail 5 is an elongate member extending in the vertical direction. As shown in Figs. 4 and 6(a), the guide rail 5 comprises side walls 5a, 5b opposing to each other, front walls 5d formed by extending one ends of the side walls 5a, 5b in opposite directions and having a slot 5c formed therein to extend vertically, a rear wall 5e connecting the other ends of the side walls 5a, 5b, and an engageable rib 5f projecting from the rear wall 5e. In the guide rail 5, a space surrounded by the walls 5a, 5b, 5d and 5e is substantially rectangular in cross-section. The guide rail 5 is made of a material having elasticity, e.g., a resin. When forces in

excess of a predetermined magnitude is applied, the guide rail 5 is deformed to such an extent as allowing the slot 5c to have an increased width. Further, the front walls 5d have a greater thickness than the side walls 5a, 5b.

The guide rail fixing member 6 is also an elongate member extending in the vertical direction. As shown in Figs. 4 and 6(b), the guide rail fixing member 6 comprises side walls 6a, 6b opposing to each other and a connecting wall 6c connecting intermediate portions of the side walls 6a, 6b. The guide rail fixing member 6 therefore has a substantially H-shape in cross-section. An engageable receptacle portion 6d is formed on one side of the connecting wall 6c to extend in the lengthwise direction, and a receptacle portion 6e for receiving a head at one end of a bolt, which is one component of a spring assembly, is formed on the other side of the connecting wall 6c to extend in the lengthwise direction. The engageable rib 5f of the guide rail 5 is received in the engageable receptacle portion 6d of the guide rail fixing member 6 to be slidable in the lengthwise direction. In this embodiment, the guide rail fixing member 6 is formed of a shaped aluminum bar.

The first rail cover 7 and the second rail cover 8 are each an elongate member extending in the vertical direction. The first rail cover 7 comprises a depthwise wall 7a extending in the depthwise direction, a widthwise wall 7b extending in the widthwise direction from one end of the depthwise wall 7a, and an end wall 7c formed at an extended end of the widthwise wall 7b and being L-shaped in cross-section. The second rail cover 8 comprises a depthwise wall 8a extending in the depthwise direction, a widthwise wall 8b extending in the widthwise direction from one end of the depthwise wall 8a, and an end wall 8c formed at an extended end of the widthwise wall 8b and being L-shaped in cross-

section. The end walls 7c, 8c are obliquely cut out in top portions of the first rail cover 7 and the second rail cover 8.

A plurality of rail fixtures 9 are fixed to a building body with intervals in the vertical direction. The first rail cover 7 and the second rail cover 8 are supported by the rail fixtures 9 into an integral structure. As shown in Fig. 7, the rail fixtures 9 each comprise a square depthwise wall 9a extending in the depthwise direction, widthwise walls 9b, 9c formed by bending both ends of the depthwise wall 9a in opposite directions, and two tongues 9d extending in oppositely spaced relation to the widthwise wall 9b. Wiring cables indicated by dotted lines in a plan view pass through a space surrounded by the second rail cover 8b and the tongues 9d. The wiring cables can be collected into a bundle by using a tying band in cooperation with the tongues 9d.

The depthwise wall 7a of the first rail cover 7 is fixed to the depthwise wall 9a of the rail fixture 9, and the widthwise wall 8b of the second rail cover 8 is fixed to the widthwise wall 9c of the rail fixture 9. The rail fixture 9 is a short member and is provided in plural number with intervals in the vertical direction. Further, a receptacle hole 9e is formed in the depthwise wall 9a of the rail fixture 9. A spring assembly 11 and the guide rail fixing member 6 are coupled to each other through the receptacle hole 9e.

The spring assembly 11 comprises a bolt 11a, a head 11b provided at one end of the bolt 11a, a nut 11c provided at the other end of the bolt 11a, and a spring 11d coiled over the bolt 11a. The rail fixture 9 and the first rail cover 7 have receptacle holes 7d, 9e formed therein for insertion of the bolt 11a through them. The head 11b of the bolt 11a penetrating both the rail fixture 9 and the first rail cover 7 is received in the receptacle portion 6e of the guide rail fixing member 6.

The bolt 11a is inserted through the first rail cover 7 while leaving a play between the bolt 11a and the receptacle hole 7d.

The diameter of the receptacle hole 7d is set greater than the outer diameter of the bolt 11a so as to provide a slight clearance between them, but smaller than the outer diameter of the spring 11d. The diameter of the receptacle hole 9e is set greater than the outer diameter of the nut 11c. Also, the spring 11d abuts against the depthwise wall 7a of the first rail cover 7, thereby bringing a guide rail (the guide rail fixing member 6 in the illustrated embodiment) into pressure contact with a rail cover (the first rail cover 7 in the illustrated embodiment). By loosening screws and removing the first rail cover 7, the spring assembly 11 can also be removed. In Fig. 4, numeral 20 denotes a building body, 21 denotes an anchor bolt, and 22 denotes a finished surface. Even in the case where the second rail cover 8 (described later) is embedded in the finished surface 22 shown by a two-dot-chain line in Fig. 4, it is possible to carry out maintenance or other required work.

The sealing member 10 is attached to a guide rail support member which is made up of the first rail cover 7, the second rail cover 8 and the rail fixtures 9 and which has a substantially C-shape or channel-like shape in cross-section. The sealing member 10 is a strip-like member extending in the vertical direction, and is held between the first rail cover 7 and the guide rail fixing member 6 in the illustrated embodiment. To describe in more detail, as shown in Fig. 5, a bushing nut 10a is fitted over the bolt 11a and is interposed between the sealing member 10 and the first rail cover 7. Concretely, the bushing nut 10a cooperates with a double-faced tape (not shown) so as to bring the sealing member 10 into contact with the back surface of the guide rail fixing member 6 for unitization. Left and

right ends of the sealing member 10 are held in abutment against or slide contact with an inner wall of the first rail cover 7 and an inner wall of the second rail cover 8 or the rail fixture 9. A double-faced tape (not shown) is interposed between the sealing member 10 and the guide rail fixing member 6. In the illustrated embodiment, since transverse edges of the sealing member 10 are positioned in surrounded relation by the end walls 7c, 8c, a satisfactory enclosed condition is obtained.

An upper guide 12 is coupled to an upper end of the guide rail 5. The upper guide 12 is a short member extending in the vertical direction. As shown in Fig. 8, the upper guide 12 comprises side walls 12a, 12b opposing to each other, front walls 12d formed by extending one ends of the side walls 12a, 12b in opposite directions and having a slot 12c formed therein to extend vertically, a rear wall 12e connecting the other ends of the side walls 12a, 12b, and an engageable rib 12f projecting from the rear wall 12e. The upper guide 12 is made of a material having elasticity, e.g., a resin. When forces in excess of a predetermined magnitude is applied, the upper guide 12 is deformed to such an extent as allowing the slot 12c to have an increased width. Additionally, using a resin to form the upper guide 12 can provide a sound arresting effect.

The upper guide 12 has a lower end portion having substantially the same cross-sectional shape as the guide rail 5, and is gradually flared while extending toward the upper end side. Concretely, the opposing front walls 12d of the left and right upper guides 12 are extended from the lower side toward the upper side so as to incline in the directions in which the front walls 12d gradually come closer to each other (i.e., inwardly in the widthwise direction of the building opening). With such a configuration, when the shutter curtain 4 is descended from the fully

open state, all other guide blocks 13 positioned above a lowermost one 13 can be guided into the upper guide in a satisfactory manner. The side walls 12a, 12b are extended from the lower side toward the upper side so as to flare gradually, and their outer wall surfaces define sloped surfaces. The rear wall 12e is vertically extended from the lower side toward the upper side, and has an upper portion obliquely projecting rearward. An upper end of the guide rail 5 is fitted to a lower end of the upper guide 12. Lower end portions of the side walls 12a, 12b of the upper guide 12 are inclined so that steps between the lower end portions of the side walls 12a, 12b and corresponding upper end wall surfaces of the guide rail 5 are minimized. In view of the fact that outer wall surfaces of the side walls 12a, 12b serve as guide surfaces for the guide blocks 13 having disengaged from the guide rail 5, the side walls 12a, 12b are designed to be free from any steps or projections on the outer wall surfaces at joint portions thereof for the purpose of smoothly guiding the guide blocks 13.

The upper guide 12 and the guide rail 5 are coupled to each other in accordance with the following ingenious design. First, when the upper end of the guide rail 5 is inserted into the upper guide 12, an inner wall surface of the guide rail 5 and an inner wall surface of the upper guide 12 are kept flush with each other. This arrangement enables the guide blocks 13 to move vertically in a satisfactory manner, and hence results in the smooth opening and closing operation. Then, fitting grooves 12g are formed at a lower end of the upper guide 12, while upper ends of the front walls 5d of the guide rail 5 are cut out. When the upper end of the guide rail 5 is coupled to the upper guide 12, upper ends of the side walls 5a, 5b of the guide rail 5 are fitted to the fitting grooves 12g. This arrangement enables the guide rail 5 to follow deformations of the upper guide 12 such that the

slot 5c also widens as the slot 12c widens. Further, the engageable rib 12f of the upper guide 12 is received in the engageable receptacle portion 6d of the guide rail fixing member 6. The upper guide 12, the guide rail 5 and the guide rail fixing member 6 are thus joined into an integral structure by fitting the lower end of the upper guide 12 to the upper end of the guide rail 5 and engaging the engageable ribs 12f, 5f slidably in the engageable receptacle portion 6d.

The structure of the shutter curtain will be described below. The shutter curtain 4 comprises a sheet body 4a and strip-like end sheets 4b extending in the vertical direction and welded to widthwise opposite edges of the sheet body 4a. The sheet body 4a and the end sheets 4b are each formed of a vinyl chloride resin as a main material and polyester as a core material. The core material is mixed in the end sheets 4b with a higher density than the sheet body 4a, and therefore the end sheets 4b have a higher strength than the sheet body 4a. In this embodiment, it was observed that the end sheets 4b were thinner and had lower firmness than the sheet body 4a, and that wrinkles were concentrated in the end sheets 4b and the sheet body 4a was less susceptible to wrinkles. Further, edges 4c of the end sheets 4b have a double structure and are subjected to welding to ensure positive fixing of the guide blocks 13 described below.

A plurality of guide blocks 13 are attached to the widthwise opposite ends of the shutter curtain 4 (i.e., the edges 4c having a double structure and being subjected to welding in this embodiment) with intervals in the vertical direction. The guide blocks 13 each have side walls 13a, 13b opposing to each other. The guide block 13 is opened at one end such that a slot 13c is formed between the opposing side walls 13a, 13b to receive an end of the shutter curtain 4. The opposing side walls 13a, 13b are joined into an integral structure through a rear

portion 13d at the other end, and the rear portion 13d has a curved outer peripheral surface. Further, the rear portion 13d is tapered upward and downward from the middle in the direction of height thereof. End surfaces of the side walls 13a, 13b on the one-end side are formed as flat surfaces 13e extending in the vertical direction. Curved surfaces 13f are formed to extend from upper and lower end portions of the flat surfaces 13e (which correspond to abutment surfaces in the present invention) to upper and lower end surfaces of the side walls 13a, 13b, and outer corners of the upper and lower end surfaces of the side walls 13a, 13b are formed as sloped surfaces 13g. Also, inner corners of the upper and lower end surfaces of the side walls 13a, 13b on the same side as the slot 13c are formed as sloped surfaces 13j. Such a configuration is effective to facilitate insertion of the sheet through the slot 13c and to prevent the sheet from being damaged.

A receptacle hole 13i for receiving a screw and a receptacle hole 13 for receiving a bit insert 13h are formed respectively in the side walls 13a, 13b in opposed relation. The end of the shutter curtain 4 (i.e., the edge of the end sheet 4b) is inserted between the side walls 13a and 13b, and is fastened in place by the screw. The guide block 13 is flat as a whole, but has a thickness greater than the width of the slot 5c of the guide rail 5.

The bit insert 13h is embedded to position slightly inward of an outer surface of the side wall 13b. When an end of the bit insert 13h is exposed to the outer surface of the side wall 13b, the end of the bit insert 13h indicates an extent of wear of the guide block 13 and hence serves as a guide for the timing at which the guide block 13 should be replaced (for example, based on the fact that the exposed bit insert 13h comes into slide contact with an inner wall of the guide rail 5

and generates an unusual sound). Likewise, the head of a screw tightened into the bit insert 13h is positioned slightly inward of an outer surface of the side wall 13a, and when the screw head is exposed to the outer surface of the side wall 13a, the user can know an extent of wear of the guide block 13. Additionally, the width of the slot 13c is a little greater at the entrance side than at the innermost side so that the sheet is more easily inserted through the slot and inner surfaces of the side walls 13a, 13b become parallel to the sheet when the sheet is fastened in place by a screw. The inner surfaces of the side walls 13a, 13b are thereby uniformly brought into pressure contact with the sheet. As a result, the sheet is less susceptible to tear.

The guide blocks 13 are attached to the widthwise opposite ends of the shutter curtain 4 with intervals in the vertical direction. At a lower end of the shutter curtain 4 on each side, two guide blocks 13 are provided in vertically adjacent relation. Because the lower end of the shutter curtain 4 is moved through the longest stroke and is worn with the heaviest duty, attaching two adjacent guide blocks 13 to such a portion is effective to lower a surface pressure acting upon each guide block 13 and reducing an amount of wear of the guide block.

In an upper portion of the shutter curtain 4, a sealing member 14 is provided to extend in the widthwise direction and to locate in corresponding relation to a lintel 19 of the building body when the shutter curtain 4 is in a fully closed state. The sealing member 14 is made of the same material as that of the end sheet 4b, and is bulged from the surface of the sheet body 4a to such an extent that the sealing member 14 contacts the lintel 19 to keep an enclosed condition. Conventionally, a sealing member is provided on the lintel side and is

held in contact with the shutter curtain 4 at all times when the shutter curtain 4 is opened and closed. In this embodiment, the sealing member is provided on the sheet side and is brought into contact with the lintel 19 only when the shutter curtain 4 is fully closed.

A lowermost edge of the shutter curtain 4 is folded back and welded together to form a bag-like portion 15 at the lower end of the shutter curtain 4. Bottom weights 16 are disposed at widthwise opposite ends of the bag-like portion 15. With the bottom weights 16 disposed at the left and right ends, the shutter curtain 4 can be evenly rolled up and the sheet is less susceptible to wrinkles. The bottom weights 16 are each constituted by filling a number of lead particles (small pieces having diameters on the order of 2 – 3 mm) 16b in a nylon-made bag 16a. By employing the bag 16a filled with the lead particles 16b, it is possible to provide a weight having flexibility as a whole and to absorb an impact caused upon colliding against an obstacle or the like.

An urethane pipe 17 is also disposed in the bag portion 15 to position between the left and right bottom weights 16. The urethane pipe 17 functions to make the lower end of the shutter curtain 4 maintain the form of a seating plate. Also, the urethane pipe 17 functions as a spacer to restrict the bottom weights 16 from displacing toward the middle in the widthwise direction. The urethane pipe 17 may be formed of a single member or formed by coupling a plurality of members successively in the lengthwise direction. Additionally, a bottom sheet 18 is welded to the lower end of the shutter curtain 4 such that the bag-like portion 15 is positioned within the bottom sheet 18 in surrounded relation.

In the sheet shutter having the above-described construction, when the shutter is opened and closed, the shutter curtain 4 is moved up and down while the

guide blocks 13 provided at both the left and right ends of the shutter curtain 4 are guided by the grooves of the guide rails 5. If a surface pressure acts upon the shutter curtain 4, for example, in a state of fully closing the building opening, the flat surfaces 13e of the guide blocks 13 provided at both the left and right ends of the shutter curtain 4 abut against the front walls 5d of the guide rails 5, thereby resisting the applied surface pressure.

The guide rails 5 are not only movable in the widthwise direction of the building opening, but also swingable in the back-and-forth direction with respect to the building opening through the spring assemblies 11. Accordingly, when the shutter curtain 4 is forced to flex upon being subjected to a wind or the like, the guide rails 5 are able to move following the motion of the shutter curtain 4. As a result, even when the shutter curtain 4 is forced to flex, the flat surfaces 13e of the guide blocks 13 abut against throughout the front walls 5d of the guide rails 5, whereby the shutter curtain 4 can be prevented from coming off from the guide rails 5 under evenly distributed resisting forces. Also, since a double-faced tape (not shown) is disposed between the sealing member 10 and the guide rail fixing member 6, the enclosed condition can be maintained in cooperation with the bushing nut 10a even when the guide rails 5 are moved following the motion of the shutter curtain 4.

For example, if any object hits against the shutter curtain 4, the slot 5c or 12c is forced to widen because the guide rail 5 and the upper guide 12 are made of a resin having elasticity, thereby allowing the guide block 13 at the end of the shutter curtain 4 to come off through the slot. Accordingly, the shutter curtain 4 or the guide rail 5 can be avoided from being damaged. Upon any object strongly striking against the shutter curtain 4, in particular, the sheet is subjected to a local

great force. In such an event, the upper and lower sloped surfaces 13g of the guide block 13 are brought into contact with inner wall surfaces of the front walls 5d of the guide rail 5, and therefore the guide block 13 is more easily disengaged from the guide rail 5. Because the rear surface 13d of the guide block 13 is in the form of a curved surface, the guide block 13 having disengaged from the guide rail 5 can be pushed back into the guide rail 5 by hands. Additionally, as shown in Fig. 4, a predetermined clearance is left between the rear surface 13d of the guide block 13 and the rear wall 5d of the guide rail 5. With the presence of the predetermined clearance, the guide block 13 is allowed to tilt in the groove of the guide rail 5 such that the sloped surfaces 13g are brought into contact with the inner wall surfaces of the front walls 5d. This enables the guide block 13 to more easily disengage from the guide rail 5.

Even when a plurality of guide blocks 13 are disengaged from the guide rail 5, all the guide blocks 13 can be descended in a condition where they are restored into the guide rail 5, by pushing only the lowermost guide block 13 into the guide rail 5, rolling up the shutter curtain 4, and then descending the shutter curtain 4 through the upper guide 12. On that occasion, the disengaged guide blocks 13 except for the lowermost guide block 13 are moved upward along the outer wall surfaces of the side walls 5a, 5b of the guide rail 5 and the outer wall surfaces of the side walls 12a, 12b of the upper guide 12. However, since those outer walls surfaces are formed as smoothly continuous surfaces, the guide blocks 13 are not caught by any steps or projections.

The above-mentioned feature will now be described with reference to Fig. 14. In a fully rolled-up state of the shutter curtain 4, the lowermost guide block 13 is positioned in the upper guide 12, and another one next to the lowermost guide

block 13 is positioned above the upper guide 12 in vertically spaced relation to the upper guide 12. By descending the shutter curtain 4 from such a state, therefore, all the guide blocks 13 are descended while being guided by the upper guide 12. In the illustrated embodiment, two guide blocks 13 are adjacently provided at the lower end of the shutter curtain 4. With this arrangement, when the lowermost guide block 13 having disengaged from the guide rail 5 is pushed back into the guide rail 5 by hands, the shutter curtain 4 tends to more easily stand vertically and can be more smoothly rolled up after that.

Fig. 15 shows another means which enables the guide block to be smoothly pushed into the guide rail. A guide block 130 and a guide rail 50 have the same basic constructions as those of the guide block 13 and the guide rail 5, respectively, except for that outer wall surfaces of front walls 50d of the guide rail 50 are formed as sloped guide surfaces gradually converging toward a groove of the guide rail 50. Note that the guide block 130 has a flat rear surface in Fig. 5, the rear surface of the guide block 130 may be curved like the rear surface of the guide block 13.

[Brief Description of the Drawings]

[Fig. 1]

Fig. 1 is a schematic front view of a sheet shutter, showing a fully open state.

[Fig. 2]

Fig. 2 is a view of the sheet shutter in an installed state.

[Fig. 3]

Fig. 3 is a sectional view of a guide rail assembly, showing an upper guide in particular.

[Fig. 4]

Fig. 4 is a sectional view of the guide rail assembly, showing a guide rail in particular.

[Fig. 5]

Fig. 5 is a sectional view, partly omitted, of the guide rail assembly, showing an arrangement of a sealing member and a bushing nut.

[Fig. 6]

Fig. 6(a) is a sectional view of a guide rail, and Fig. 6(b) is a sectional view of a guide rail fixing member.

[Fig. 7]

Fig. 7 shows a side view and a front view of a rail fixture.

[Fig. 8]

Fig. 8 shows the upper guide; Fig. 8(a) is a top plan view, Fig. 8(b) is a front view, Fig. 8(c) is a side view, and Fig. 8(d) is a bottom view.

[Fig. 9]

Fig. 9 shows the guide rail assembly; Fig. 9(a) is a front view and Fig. 9(b) is a side view.

[Fig. 10]

Fig. 10 is a front view of a shutter curtain.

[Fig. 11]

Fig. 11 shows a guide block; Fig. 11(a) is a side view, Fig. 11(b) is a rear view, Fig. 11(c) is a side view on the opposite side, Fig. 11(d) is a front view, Fig. 11(e) is a horizontal sectional view, Fig. 11(f) is a vertical sectional view, and Fig. 11(g) is a top plan view.

[Fig. 12]

Fig. 12 shows a lower end portion of the shutter curtain; Fig. 12(a) is a side view, Fig. 12(b) is a front view on the one-end side, and Fig. 12(c) is an overall front view of the lower end portion of the shutter curtain.

[Fig. 13]

Fig. 13 shows a bottom weight; Fig. 13(a) is a front view partly cut away and Fig. 13(b) is a top plan view.

[Fig. 14]

Fig. 14 is a partial front view of the sheet shutter showing positions of guide blocks in a fully rolled-up state of the shutter curtain.

[Fig. 15]

Fig. 15 shows another example of means for allowing the guide block to be pushed into the guide rail, in which the form of the guide rail has a different feature.

[Reference Numerals]

- 1 guide rail assembly
- 4 shutter curtain
- 5 guide rail
- 6 guide rail fixing member
- 11 spring assembly
- 12 upper guide
- 13 guide block
- 16 bottom weight
- 17 urethane pipe

**CLAIMS:**

1. A sheet shutter comprising a sheet-like shutter curtain (4), a plurality of guide blocks (13) provided at widthwise opposite left and right ends of said shutter curtain (4) with intervals in the vertical direction, and guide rails (5) vertically provided at the left and right sides of a building opening, wherein said guide blocks (13) are vertically movable within said guide rails (5) in a normal condition, said guide rails (5) have an elasticity, and when a load over a predetermined magnitude acts upon said shutter curtain (4), said guide rails (5) are deformed to such an extent as allowing the slot (5c) to have an increased width and allowing said guide blocks (13) to disengage from said guide rails (5), characterized in that said each guide block (13) comprises a rear portion (13d) vertically extending in the direction separating from the building opening and having a tapered projecting crosssectional shape and abutment surfaces (13e) opposing the building opening and extending in the vertical direction and perpendicular to the building opening, and is structured in such manner that the whole abutment surfaces (13e) abut against the inner surfaces of the front walls (5d) of the guide rails (5), thereby resisting a surface pressure acting on the shutter curtain and that said guide block (13) having disengaged from said guide rail (5) can be pushed back into said elastic guide rail from the rear portion (13d) thereof.

2. A sheet shutter according to Claim 1, characterized in that the rear portion (13d) of each of said guide blocks (13) has curved sloped surfaces in upper and lower portions thereof such that when a load over a predetermined magnitude acts upon said shutter curtain (4), said guide blocks (13) are more easily disengaged from said guide rails (5).

3. A sheet shutter according to Claim 1 or 2, characterized in that sloped guide surfaces (15d) are formed at an opening of a guide groove of said guide rail (50) such that said guide block (130) having disengaged from said guide rail (50) can be pushed back into said guide rail (50) while being guided by said sloped guide surfaces (50d).