

DESCRIPTION**Title of Invention****SHEET HOLDING DEVICE,
METHOD FOR HOLDING SHEET USING SAME, AND PANEL****Technical Field**

[0001] The present invention relates to a sheet holding device for holding an end portion of a sheet to be stretched over a predetermined place, a method for holding a sheet by using the sheet holding device, and a panel including the sheet holding device and a sheet.

Background Art

[0002] Generally, panels each having a stretched sheet are used for walls or ceilings in temporary booths including exhibition halls. Such a panel includes a sheet holding device for holding an end portion of a sheet to be stretched over a predetermined place.

[0003] As an exemplary conventional sheet holding device, Patent Literature 1 discloses a stretching device for stretching a sheet over a region defined by a frame.

[0004] The stretching device disclosed in Patent Literature 1 includes the frame, and a retaining plate for retaining the sheet in the frame.

[0005] The frame is formed with a retaining groove at its front side (a side on which the sheet is to be stretched) in a circumferential direction of the frame.

[0006] The retaining plate has such a rectangular cross section as to fit in the retaining groove of the frame. The retaining plate is made of an elastic material, and has a thickness equal to or slightly larger than a width of the retaining groove. The retaining plate is attached to a rear surface of the sheet at a peripheral edge portion thereof.

[0007] Ways of attaching the retaining plate to the sheet include fixation ways of sewing or stapling the sheet to the retaining plate, adhering, fusing or welding.

[0008] Moreover, the retaining plate is formed with a plurality of protrusions at constant intervals in a depth direction of the retaining groove on a surface thereof opposite to the surface attached to the sheet.

[0009] The stretching device can hold the sheet being stretched over the front side of the frame by pushing the retaining plate attached to the rear surface of the sheet into the retaining groove under a compression.

[0010] However, the stretching device disclosed in Patent Literature 1 has a drawback of poor sheet workability due to the necessary step of attaching the retaining plate to the sheet at the

peripheral edge portion thereof by, for example, sewing the sheet to the retaining plate in advance of the operation of holding an end portion of the sheet and stretching the sheet.

[0011] Moreover, the stretching device is configured to stretch the sheet over the front side of the frame by pushing the retaining plate attached to the rear surface of the sheet into the retaining groove. In this configuration, the retaining plate is restrained in the retaining groove, and hence it is difficult to adjust a tension of the sheet having been stretched. This causes another drawback of failure in a fine adjustment of the stretching of the sheet on site.

Citation List

Patent Literature

[0012] Patent Literature 1: Japanese Patent No. 5967740

Summary of Invention

[0013] The present invention has been accomplished in view of the aforementioned circumstances, and an object of the present invention is to provide a sheet holding device which can achieve a good sheet workability and execute a fine adjustment of a sheet stretching on site.

[0014] To achieve the object, a sheet holding device according to the present invention is a sheet holding device for holding an end portion of a sheet to be stretched over a predetermined place, the sheet holding device including: an inner rail having a changeable width; a frame including a rail retainer having a recess for accommodating the inner rail; and at least one width expander for expanding the width of the inner rail, wherein the inner rail defines gaps against inner walls defining the recess when being accommodated in the recess, the gaps allowing the end portion of the sheet to be disposed therein, and the sheet holding device is configured to allow the width of the inner rail to be expanded by the width expander so that the end portion of the sheet disposed in the gaps is sandwiched between the widthwise opposite side surfaces of the inner rail and the inner walls facing the opposite side surfaces, and held in the recess.

Brief Description of Drawings

[0015] Fig. 1 is a perspective view showing an overall configuration of a sheet wall assembled by three panels each including a sheet holding device according to an embodiment of the present invention.

Fig. 2 is an enlarged perspective view of corner portions of the panels shown in Fig. 1.

Fig. 3 is an explanatory perspective view showing a state of a frame of the sheet holding device shown in Fig. 2 to be coupled to a cover and a support member seen therearound.

Fig. 4 is an exploded perspective view of the sheet holding device shown in Fig. 1, the

perspective view illustrating an inner rail, an outer rail having a rail retainer in the frame, and a regulator having a threaded rod and a fixing piece.

Fig. 5 is a cross-sectional view of the outer rail having the rail retainer shown in Fig. 4.

Fig. 6 is an explanatory cross-sectional view showing a state of the sheet to be held for explaining a procedure of a method for holding the sheet by using the sheet holding device shown in Fig. 1.

Fig. 7 is another explanatory cross-sectional view showing a state of the sheet having been held for explaining the procedure of the method for holding the sheet by using the sheet holding device shown in Fig. 1.

Fig. 8 is an enlarged view of an engaging portion between a corner end of the inner rail and a protrusion of the outer rail shown in Fig. 7.

Fig. 9 shows an exemplary arrangement of the panels according to the present invention adopted as a facade border.

Fig. 10 shows another exemplary arrangement of the panel according to the present invention adopted as a backwall.

Fig. 11 shows further another exemplary arrangement of the panel according to the present invention adopted as a top of a suspended ceiling.

Description of Embodiments

[0016] Hereinafter, a preferable embodiment of a sheet holding device and a panel including the same will be described with reference to the accompanying drawings.

[0017] Figs. 1 to 2 illustrate a sheet wall 200 including three panels 100 as an exemplary arrangement of the panels 100 each having a sheet 50 having been stretched thereover in an embodiment of the present invention. The sheet 50 is made of a thin and light synthetic resin (e.g., polyester resin), and may be a plain sheet or a sheet provided with a preferable design such as a specific character or pattern. The sheet 50 may be illuminated from a rear surface thereof to make the design of the sheet outstanding for increasing an advertising effect.

[0018] Specifically, the sheet wall 200 includes the three panels 100 standing and sequentially connected at a right angle, a plurality of support members 101 each having a prismatic shape for respectively supporting the panels 100 from their rear side, and side plates (end plates) 102 for covering the rear side (particularly, the support members 101) of the panels 100 at ends thereof.

[0019] Each of the support members 101 may be made of a prismatic material which is light and has a specific rigidity. Adoptable for the support member 101 is a prismatic member (e.g., "MAXIMA light" that is the product name and produced by OCTANORM GmbH) made of aluminum or an aluminum alloy, or a prismatic wooden material and the like. In the

embodiment, the plurality of prismatic support members 101 are connected and combined at their respective ends to form a box, thereby supporting each of the panels 100 from the rear thereof. The panel 100 and the end of the corresponding support member 101 are removably coupled to each other by a coupling way using an already existing locking member 103 (see Fig. 3).

[0020] Each of the panels 100 includes a sheet holding device 1, and the sheet 50 having four sides each held by the sheet holding device 1.

[0021] The sheet holding device 1 can hold an end portion 51 of the sheet 50 to be stretched over a predetermined place. Specifically, as shown in Figs. 3 to 4, the sheet holding device 1 according to the embodiment includes a frame 2 having a rectangular shape, an inner rail 3 accommodated in a recess 9 on each of the four sides of the frame 2, a width expander 4 for expanding a width of the inner rail 3, and a decorative cover 5.

[0022] The frame 2 having the rectangular shape defines a rectangular space over which the sheet 50 is to be stretched. The size of the frame 2 is not particularly limited in the present invention. For instance, a large frame having the dimensions of approximately 3.6 m width $\times$ 6 m length may be adopted for stretching a sheet 50 having a larger area. The frame 2 may have a polygonal shape such as a triangular shape, a pentagonal shape, or other polygonal shape in place of the rectangular shape.

[0023] The frame 2 includes at least four outer rails 6 defining the four sides of the frame 2, and four corner members 7 constituting the corner parts of the frame 2. Each of the outer rails 6 and corner members 7 constituting the frame 2 is preferably made of a material which is light and has a specific rigidity, that is, preferably made of aluminum or an aluminum alloy. For instance, the outer rail 6 is made of a thin and long prismatic member having a square cross section with four sides each having the dimension of 5 cm. The corner member 7 at a lower position is provided with an adjuster 21 (see Fig. 3) for adjusting a height and an inclination of the frame 2.

[0024] As shown in Figs. 3 to 6, the outer rail 6 includes a rail retainer 8 having the recess 9 for retaining the inner rail 3. The recess 9 locates at the front side of the frame 2 (a side on which the sheet 50 is to be stretched). The frame 2 is therefore configured to include the rail retainer 8 having the recess 9 for accommodating the inner rail 3 on each of the four sides thereof.

[0025] Although the frame 2 in the embodiment has a structure including the four outer rails 6 and the four corner members 7 in combination, the present invention should not be limited thereto. These rails and members may integrally form the frame 2. Even in this case, the frame 2 may preferably include the rail retainer 8 having the recess 9 extending on the four sides

of the frame 2 at the front side thereof.

[0026] As shown in Fig. 5, the outer rail 6 has, around the recess 9, a plurality of joint member insertion holes 6a for receiving corresponding joint members 20 (see Figs. 3 to 4, and 6) inserted therein in a longitudinal direction of the outer rail 6 to be jointed to the corner members 7, a screw passing hole 6b for allowing a screw to pass therethrough and fasten the frame 2 to a target member such as a wall, and a cover engagement hole 6c to be engaged with a protrusion 5a (see Fig. 7) of the decorative cover 5. Each of the joint members 20 is fastened to the outer rail 6 with a fastening screw 22 when being inserted in the corresponding joint member insertion hole 6a.

[0027] In the embodiment, the rail retainer 8 in the outer rail 6 is formed with a protrusion 11 protruding inward at an opening of the recess 9 as shown in Figs. 5 and 7, the protrusion 11 being configured to engage with a corner end 3c of the inner rail 3 in an expanded state (see Fig. 8).

[0028] As shown in Figs. 4 and 6 to 7, the inner rail 3 is a long rail-shaped member having the opposite side surfaces in a direction of the width W, i.e., the widthwise opposite side surfaces 3a, 3a. The inner rail 3 has the changeable width W corresponding to the distance between the opposite side surfaces 3a, 3a.

[0029] The inner rail 3 in the embodiment has a pair of components 12, 13 which are connected by a hinge at a forward position in an insertion direction D1 of coming in the recess 9, and are capable of opening and closing in the direction of the width W.

[0030] A hinge connection part 14 is configured to allow the pair of components 12, 13 connected there by the hinge to be capable of opening and closing. For example, the hinge connection part 14 shown in Fig. 6 is provided at only one of the components 12, 13, and has a cylindrical protrusion 14a extending in a longitudinal direction of the component 12 (in a direction perpendicularly intersecting the paper of Fig. 6), and a receiver 14b rotatably receiving the cylindrical protrusion 14a. This configuration permits the pair of components 12, 13 to be capable of opening and closing while swinging about the cylindrical protrusion 14a.

[0031] Moreover, the pair of components 12, 13 in the embodiment respectively have a pair of opposite oblique surfaces 12a, 13a inclining in directions of separating from each other as advancing in the insertion direction D1.

[0032] A material for the inner rail 3 is not particularly limited in the present invention. However, the inner rail 3 may be preferably made of a soft resin so that a fine adjustment of the stretching of the end portion 51 of the sheet 50 is concentratively executable at a portion of the inner rail 3 near the width expander 4. The soft resin is selected from those allowing the portion that is near to a receiving point of an expansion force of expanding the width W of the

inner rail 3 to be expanded by the width expander 4, and having a property of partially expanding in the direction of the width W in an elastic deformation. For instance, a vinyl chloride resin is selected.

[0033] In the embodiment, a plurality of width expanders 4 are arranged at a distance therebetween in a longitudinal direction of the inner rail 3. For example, ten width expanders 4 may be arranged at every distance of 30 cm in the inner rail 3 having the total length of 3 m. Meanwhile, the holding device according to the present invention may include at least one width expander 4.

[0034] The width expander 4 can expand the width W of the inner rail 3 as shown in Figs. 4 and 6 to 7. The width expander 4 in the embodiment includes a fixing piece 15 which is movable in the insertion direction D1 and the opposite direction D2 thereto while coming into contact with the pair of opposite oblique surfaces 12a, 13a, and a fixing piece moving part 16.

[0035] The fixing piece 15 has side surfaces 15a in the opposite directions perpendicularly intersecting the insertion direction D1, the side surfaces 15a, 15a being curved in such a way as to separate from each other as advancing forward in the insertion direction D1. Therefore, the fixing piece 15 has a substantially semi-circular or semi-ellipsoid cross section with the curved opposite side surfaces 15a, 15a.

[0036] The fixing piece 15 has a threaded hole 15b extending in the insertion direction D1. Although the threaded hole 15b in the embodiment is a through hole, the threaded hole 15b may not penetrate through when having an enough depth for the fixing piece 15 to move between a position of the inner rail to be expanded (see Fig. 6) and a position of the inner rail having been expanded (see Fig. 7).

[0037] As shown in Figs. 4 and 6, the fixing piece 15 is supported by a member supporting protrusion 3e at a predetermined position in an inside space 3d of the inner rail 3. The member supporting protrusion 3e has a flat and tongue-like shape extending in the longitudinal direction of the inner rail 3, and has a cutout at a prospected arrangement position for the fixing piece 15. The fixing piece 15 is inserted in the cutout of the member supporting protrusion 3e, and supported at the predetermined position in the longitudinal direction of the inner rail 3.

[0038] Any structure may be adoptable so long as the fixing piece moving part 16 can move the fixing piece 15 in the insertion direction D1 and the opposite direction D2. The fixing piece moving part 16 in the embodiment comprises a threaded rod 17 extending in the insertion direction D1 to engage the threaded hole 15b, and a regulator 18 such as a washer for regulating a relative movement of the threaded rod 17 to the pair of components 12, 13 in the insertion direction D1. The threaded rod 17 passes across a slit 3b defined between the pair of components 12, 13 of the inner rail 3. The threaded rod 17 has a head 17a exposed to the

outside of the inner rail 3, and thus the threaded rod 17 is easily rotatable by a tool such as a screwdriver from the front side of the frame 2 (a side on which the sheet 50 is to be stretched).

[0039] The regulator 18 composed of the washer as shown in Figs. 6 to 7 is interposed between the inner rail 3 and the head 17a of the threaded rod 17 having been inserted to thereby regulate the movement of the threaded rod 17 in the insertion direction D1.

[0040] The regulator 18 may be composed of a member other than the washer. For instance, the head 17a of the threaded rod 17 may be set larger to serve as a regulator.

[0041] Gaps 19 are defined between inner walls 10 of the recess 9 and inner rail 3 when the inner rail 3 is accommodated in the recess 9, the gaps 19 allowing the end portion 51 of the sheet 50 to be disposed in the recess 9.

[0042] As described above, the sheet holding device 1 according to the embodiment includes the inner rail 3 capable of changing a width W of the inner rail 3, the frame 2 having the recess 9 into which the inner rail 3 is insertable, and the width expander 4 for expanding the width of the inner rail 3. As shown in Figs. 6 to 7, the sheet holding device 1 having this configuration allows the width W of the inner rail 3 to be expanded by the width expander 4 (specifically, the fixing piece 15), so that the end portion 51 of the sheet 50 in the gaps 19 is sandwiched between the opposite side surfaces 3a, 3a of the inner rail 3 and the inner walls 10 facing the opposite side surfaces 3a, 3a, and held in the recess 9.

[0043] A method for holding a sheet by using the sheet holding device 1 having the above-described configuration according to the embodiment is performed in accordance with a procedure described below.

[0044] First, as shown in Figs. 4 and 6, the inner rail 3 is inserted in the recess 9 of the rail retainer 8 while the end portion 51 of the sheet 50 sandwiched between the inner rail 3 and the rail retainer 8 of the frame 2 (specifically, the outer rail 6) is in contact with the opposite side surfaces 3a, 3a of the inner rail 3. In this way, the end portion 51 of the sheet 50 is disposed in the gaps 19 defined between the inner walls 10 defining the recess 9 and the inner rail 3 (an insertion step).

[0045] Subsequently, as shown in Fig. 7, the end portion 51 of the sheet 50 is held in the recess 9 with the end portion 51 of the sheet 50 being sandwiched between the opposite side surfaces 3a, 3a of the inner rail 3 and the inner walls 10 facing the opposite side surfaces 3a, 3a, by expanding the width W of the inner rail 3 from a width W1 to a width W2 by the width expander 4 while the sheet 50 is stretched (a holding step).

[0046] The holding step includes holding the end portion 51 of the sheet 50 in the recess 9 on each of the four sides of the frame 2. A sequential order of holding the end portion 51 of the sheet 50 from one after another of the four sides of the frame 2 is not particularly limited. For

instance, the end portion 51 of the sheet 50 may be temporarily held on the four sides of the frame 2 under a weak holding force, and then a fine adjustment of the stretching of the sheet 50 may be horizontally and vertically executed. Thereafter, the end portion 51 of the sheet 50 may be held on the four sides of the frame 2 under a stronger holding force. Alternatively, the end portion 51 may be held on the left and right two sides of the frame 2 when the sheet 50 is horizontally stretched, and thereafter may be held on the upper and lower two sides of the frame 2 when the sheet 50 is vertically stretched.

[0047] Instead, the end portion 51 may be held on only the left and right two sides of the frame 2 when the sheet 50 is horizontally stretched, or may be held on only the upper and lower two sides of the frame 2 when the sheet 50 is vertically stretched.

[0048] In the embodiment, the operation of expanding the width of the inner rail 3 by the width expander 4 is executed in the manner described below in detail. Specifically, as shown in Figs. 6 to 7, the threaded rod 17 is rotated to move the fixing piece 15 in the opposite direction D2 that is opposite to the insertion direction D1 of coming in the recess 9, thereby causing the fixing piece 15 to push the pair of components 12, 13 in the directions of separating from each other to open while pressing the pair of opposite oblique surfaces 12a, 13a of the pair of components 12, 13. In this manner, the width W of the inner rail 3 is easily expandable.

[0049] In the embodiment, as shown in Figs. 7 to 8, the rail retainer 8 in the outer rail 6 is formed with a protrusion 11 at an opening of the recess 9. Hence, when the corner end 3c defined by the side surface 3a of the inner rail 3 engages with the protrusion 11, the end portion 51 of the sheet 50 can be firmly held at the engaging portion. Furthermore, it is possible to avoid a risk that the inner rail 3 falls off from the recess 9 to the outside.

[0050] After the end portion 51 of the sheet 50 is held in the recess 9 on each of the four sides of the frame 2 in the holding step, an excess of the end portion 51 of the sheet 50 coming out of the recess 9 may be cut or folded into the recess 9 subsequently to the holding step.

[0051] Finally, the opening of the recess 9 is covered by the decorative cover 5. The decorative plate 5 is arranged to entirely cover the opening of the recess 9 at the front side of the frame 2 as shown in Figs. 1 to 2. A way of attaching the decorative cover 5 to the frame 2 is not particularly limited in the present invention. For instance, as shown in Fig. 7, the decorative cover 5 is formed with a protrusion 5a and a receiver 5b. The protrusion 5a is caused to engage the cover engagement hole 6c of the outer rail 6 in the frame 2, and the receiver 5b is caused to receive the cylindrical protrusion 3f provided on the surface of the inner rail 3. Therefore, the decorative cover 5 can be supported at the plurality of positions. The decorative cover 5 having this configuration consequently achieves a decrease in the risk of falling-off after its attachment while being removably attached.

[0052] Features of the embodiment

(1) A sheet holding device 1 configured in the above-described manner, and a panel 100 including the same facilitate an operation of stretching a sheet 50 by holding an end portion 51 of the sheet 50, and achieves a good sheet workability. Specifically, as shown in Figs. 6 to 7, the sheet holding device 1 is configured to allow a width W of an inner rail 3 to be expanded by a width expander 4 in a state where the end portion 51 of the sheet 50 is inserted in gaps 19 defined between the inner rail 3 and inner walls 10 defining a recess 9 of a rail retainer 8 on each of the four sides of a frame 2 while being pushed by the inner rail 3. This configuration permits the end portion 51 of the sheet 50 to be held in the stretched state in the recess 9 by sandwiching the end portion 51 of the sheet 50 between the opposite side surfaces 3a, 3a of the inner rail 3 and inner walls 10 facing the opposite side surfaces 3a, 3a. Further, the sheet 50 can be fixedly attached to the frame 2 in the stretched state. Therefore, it is possible to easily stretch the sheet 50 in the configuration in its own original state on site without the necessity of attaching a retaining plate to a sheet periphery by sewing the sheet to the retaining plate in advance of stretching the sheet unlike the stretching device disclosed in Patent Literature 1 (JPB5967740). The sheet 50 thus has an excellent workability.

[0053] Furthermore, the sheet holding device 1 according to the embodiment and the panel 100 including the same can facilitate the fine adjustment of the stretching of the sheet 50 on site. Specifically, for the fine adjustment of the stretching, a threaded rod 17 of the width expander 4 is rotated to narrow the width W of the inner rail 3 and reduce a force of sandwiching the end portion 51 of the sheet 50 held in the stretched state as shown in Fig. 7 between the inner rail 3 and the inner walls 10 defining the recess 9 in the rail retainer 8. More specifically, the threaded rod 17 is rotated to move a fixing piece 15 in an insertion direction D1 from its position shown in Fig. 7. At this time, a pair of components 12, 13 of the inner rail 3 receives a peripheral pressure from the end portion 51 of the sheet 50 under a reduced pressing force imposed onto the pair of opposite oblique surfaces 12a, 13a from the fixing piece 15 in an expansion direction, and hence the width W of the inner rail 3 is narrowed. As a result, the force of sandwiching the end portion of the sheet can be reduced. This contributes to the facilitated fine adjustment of the stretching, specifically, the tension, of the sheet 50. After the fine adjustment of the stretching, the threaded rod 17 is rotated to expand the width W of the inner rail 3 and increase the sandwiching force between the inner rail 3 and the inner walls 10 defining the recess 9. In this manner, the sheet 50 can be reliably held in the stretched state (as shown in Fig. 7).

[0054] (2) In the sheet holding device 1 according to the embodiment, a plurality of width expanders 4 are arranged in a longitudinal direction of the inner rail 3 as shown in Fig. 4. In

this configuration, expansion directional forces are distributed from the plurality of width expanders 4 to the inner rail 3. Accordingly, the end portion 51 of the sheet 50 can be reliably held in the entire longitudinal direction of the inner rail 3.

[0055] (3) In the sheet holding device 1 according to the embodiment, the inner rail 3 is made of a soft resin having a property of partially expanding in a width direction in an elastic deformation, the partially expanding occurring at only a portion which is near to a receiving point of an expansion force of expanding the width W of the inner rail 3 by the width expander 4. Thus, the width W of the inner rail 3 can be expanded and narrowed owing to the operation of the width expander 4 only at the portion near the location of the width expander 4. For the fine adjustment of the stretching of the end portion 51 of the sheet 50 partially at the portion near the width expander 4, the width expander 4 is operated to reduce the force from the width expander 4 to the inner rail 3 and narrow the width W of the inner rail 3 only at the portion near the width expander 4, and therefore the force of holding the end portion 51 of the sheet 50 can be reduced. This contributes to a partial fine adjustment of the stretching of the sheet 50. After the fine adjustment, the width of the inner rail 3 is expanded so that the sheet 50 can be reliably held in the stretched state.

[0056] In particular, the configuration including the plurality of width expanders 4 arranged in the longitudinal direction of the inner rail 3 like the embodiment permits only one of the width expanders 4 to operate to reduce the force of holding the end portion 51 of the sheet 50 and another expander 4 to maintain the force of holding the end portion 51 of the sheet 50. This configuration consequently contributes to an individual fine adjustment of the stretching of the sheet 50 by each of the width expanders 4 therearound.

[0057] Meanwhile, although the inner rail 3 is made of a soft resin in the embodiment, the present invention should not be limited thereto. The inner rail 3 may be made of a material other than the soft resin.

[0058] (4) In the sheet holding device 1 according to the embodiment, the inner rail 3 has a pair of components 12, 13 which are connected by a hinge in a hinge connection part 14 at a forward position in the insertion direction D1 of coming in the recess 9, and are capable of opening and closing in the direction of the width W as shown in Figs. 4 and 6. This configuration results in the inner rail 3 where the width W is reliably changeable with its simple structure. Consequently, the manufacturing of the inner rail 3 is facilitated with fewer troubles such as breakage.

[0059] (5) In the sheet holding device 1 according to the embodiment, the pair of components 12, 13 respectively have the pair of opposite oblique surfaces 12a, 13a inclining in directions of separating from each other as advancing in the insertion direction D1 as shown in Figs. 4 and 6.

The width expander 4 includes the fixing piece 15 which is movable in the insertion direction D1 and the opposite direction D2 while coming into contact with the pair of opposite oblique surfaces 12a, 13a, and a fixing piece moving part 16 for moving the fixing piece 15 in the insertion direction D1 and the opposite direction D2.

[0060] In this configuration, when being moved by the fixing piece moving part 16 in the opposite direction D2 that is opposite to the insertion direction D1 of coming in the recess 9, the fixing piece 15 pushes the pair of components 12, 13 in the directions of separating from each other to open while coming into contact with the pair of opposite oblique surfaces 12a, 13a of the pair of components 12, 13 of the inner rail 3. In this manner, the fixing piece 15 can easily expand the width W of the inner rail 3. In contrast, the fixing piece 15 can narrow the width W of the inner rail 3 when being moved in the insertion direction D1.

[0061] (6) In the sheet holding device 1 according to the embodiment, the fixing piece 15 has side surfaces 15a, 15a in the opposite directions perpendicularly intersecting the insertion direction D1, the side surfaces 15a, 15a being curved in such a way as to separate from each other as advancing forward in the insertion direction D1 as shown in Figs. 4 and 6. In this configuration, the fixing piece 15 has the opposite curved side surfaces 15a, 15a, and each of the opposite curved side surfaces 15a, 15a is always partly in contact with the corresponding one of the opposite oblique surfaces 12a, 13a of the pair of the components 12, 13. Thus, even if the fixing piece 15 tilts or loses its balance during the movement in the opposite direction D2 that is opposite to the insertion direction D1 of coming in the recess 9, no change is seen in the contact state between the fixing piece 15 and the opposite oblique surfaces 12a, 13a. Accordingly, it is possible to reliably expand the width W of the inner rail 3 by sufficiently pushing the pair of components 12, 13 of the inner rail 3 to open.

[0062] (7) In the sheet holding device 1 according to the embodiment, the fixing piece 15 has a threaded hole 15b extending in the insertion direction D1, and the fixing piece moving part 16 comprises a threaded rod 17 extending in the insertion direction D1 to engage the threaded hole 15b as shown in Figs. 4 and 6 to 7.

[0063] This configuration facilitates the movement of the fixing piece 15 engaged with the threaded rod 17 in the insertion direction D1 of coming in the recess 9 or the opposite direction D2 only by rotating the threaded rod 17, which leads to a good operability.

[0064] Moreover, the fixing piece moving part 16 in the embodiment further has a regulator 18 such as a washer for regulating a relative movement of the threaded rod 17 to the pair of components 12, 13 in the insertion direction D1. Thus, the threaded rod 17 whose relative movement to the pair of components 12, 13 in the insertion direction D1 is regulated by the regulator 18 such as the washer never moves in the insertion direction D1 by following the fixing

piece 15.

[0065] (8) In the sheet holding device 1 according to the embodiment, the rail retainer 8 in the outer rail 6 is formed with a protrusion 11 protruding inward at an opening of the recess 9 as shown in Figs. 5 and 7 to 8. This configuration eliminates the risk that the inner rail 3 having been expanded falls off from the recess 9, since the inner rail 3 in the expanded state is in contact with the protrusion 11 after being inserted in the recess 9. For the fine adjustment of the stretching of the sheet 50, the corner end 3c defined by the side surface 3a of the inner rail 3 is caused to engage with the protrusion 11. Owing to the engaging, the fine adjustment of the stretching of the sheet 50 is easily executable with increased accuracy while the end portion 51 of the sheet 50 is held under an appropriate holding force.

[0066] Even another configuration without the protrusion 11 at the opening of the recess 9 as described above can achieve the holding of the end portion 51 of the sheet 50 in the recess 9 by sandwiching the end portion 51 of the sheet 50 between the opposite side surfaces 3a, 3a of the inner rail 3 and the inner walls 10 defining the recess 9 and facing the opposite side surfaces 3a, 3a. However, the configuration including the protrusion 11 is preferable from the perspectives of the above-described advantageous operational effects, i.e., the prevention of the falling-off of the inner rail 3 from the recess 9, and the easier fine adjustment with the increased accuracy owing to the engaging between the corner end 3c of the inner rail 3 and the protrusion 11.

[0067] (9) The sheet holding device 1 according to the embodiment further includes a decorative cover 5 which covers the opening of the recess 9 as shown in Figs. 3 and 7. In this configuration, the decorative cover 5 can conceal the inner rail 3 inserted in the recess 9 from the outside by covering the opening in the recess 9 after the attachment of the sheet 50. Consequently, more beautiful appearance is attainable. Additionally, a process of, for example, making the surface of the decorative cover 5 shiny and smoothy in terms of beauty contributes to further improvement in the beautiful appearance of the sheet holding device 1.

[0068] The sheet holding device 1 may include no cover which covers the opening of the recess 9. Even the configuration without the cover can provide the above-described advantageous operational effects of the present invention, i.e., the increased sheet workability resulting from the expanded width of the inner rail 3 and achievement in the fine adjustment of the stretching.

[0069] (10) In a method for holding a sheet by using the sheet holding device 1 according to the embodiment, as shown in Figs. 6 and 7, the end portion 51 of the sheet 50 is sandwiched between the inner rail 3 and the rail retainer 8 of the frame 2 while being in contact with the opposite side surfaces 3a of the inner rail 3, and is disposed in this state in the gaps 19 defined between the inner walls 10 defining the recess 9 of the rail retainer 8 and the inner rail 3.

Thereafter, the width of the rail 3 is expanded by the width expander 4 to hold the end portion 51 of the sheet 50 in the stretched state in the recess 9, so that the end portion 51 of the sheet 50 is sandwiched between the opposite side surfaces 3a, 3a of the inner rail 3 and the inner walls 10 facing the opposite side surfaces 3a, 3a to hold the end portion 51 of the sheet 50 in the recess 9. In this way, the end portion 51 of the sheet 50 can be held in the stretched state over the frame 2. Therefore, it is possible to stretch the sheet 50 in its own original state without a preceding process of, for example, attaching a retaining plate or the like to the sheet 50, which leads to an excellent sheet workability. Furthermore, the fine adjustment of the stretching of the sheet 50 is easily executable by changing the width W of the inner rail 3 with use of the width expander 4.

[0070] (11) A panel 100 including the sheet holding device 1 configured in the above-described manner and a sheet 50 can be easily arranged in a desired place in the state where the sheet 50 even having the large area is stretched. Besides, the fine adjustment of the stretching is facilitated. Moreover, the panel 100 is light and has an extremely high permissibility of its locations regardless of the large area since the sheet 50 (e.g., a vinyl chloride sheet) which is thin and light constitutes a wall of the panel 100.

[0071] The panel 100 is accordingly adaptable to various purposes in addition to the sheet wall 200 assembled by the plurality of standing panels 100 as shown in Fig. 1.

[0072] For example, a unit of a plurality of laterally long panels 100 serves as a facade border decorating an upper part of an exhibition booth as shown in Fig. 9.

[0073] Furthermore, a panel 100 is also adoptable as a backwall arranged in parallel to a wall defining an installation space or arranged to hide a corner region of the installation space.

[0074] Additionally, a panel 100 may be adopted as a top of a suspended ceiling as shown in Fig. 11.

[0075] Modifications

(A) In the embodiment, the inner rail 3 has the pair of components 12, 13 which are connected by the hinge at the forward position in the insertion direction D1 of coming in the recess 9, and are capable of opening and closing in the direction of the width W. However, the present invention should not be limited thereto. In the present invention, the inner rail 3 may have any structure so long as the width W is changeable. For instance, the inner rail may have a pair of components which are linearly movable in directions of coming closer to each other and directions of separating from each other.

[0076] (B) Moreover, described as an exemplary width expander for expanding the width W of the inner rail 3 in the embodiment is the width expander 4 including the fixing piece 15 which is movable in the insertion direction D1 of the inner rail 3 and the opposite direction D2, and the fixing piece moving part 16 (having the threaded rod 17, and the regulator 18) for moving the

fixing piece 15 in these directions as shown in Fig. 4. However, the present invention should not be limited to this configuration.

[0077] In the present invention, any structure which can expand the width W of the inner rail 3 is adoptable as the width expander of the present invention. For instance, adoptable as a width expander for expanding a width of an inner rail whose pair of components are linearly movable in directions of coming closer to each other and directions of separating from each other like Modification (A) is a width expander having a mechanical structure or a mechanism such as a fluid-driven jack which can linearly move the pair of components in the directions of coming closer to each other and the directions of separating from each other.

[0078] (C) In the embodiment, as shown in Fig. 6, the pair of components 12, 13 of the inner rail 3 respectively have the pair of opposite oblique surfaces 12a, 12b. The fixing piece 15 having the semi-circular or semi-ellipsoid cross section presses the pair of opposite oblique surfaces 12a, 12b, thereby expanding the width of the inner rail 3. However, the present invention should not be limited thereto.

[0079] In another modification of the present invention, the fixing piece 15 may have a pair of oblique surfaces inclining with respect to the insertion direction D1 on the periphery thereof for pressing the corresponding portions of the pair of components 12, 13 in the directions of separating from each other to open.

[0080] (D) In the embodiment, the plurality of width expanders 4 are arranged at a distance therebetween in the longitudinal direction of the inner rail 3 as shown in Fig. 4. However, the present invention should not be limited thereto. For instance, in further another modification of the present invention where an inner rail 3 is made of a material having a specific rigidity, only a single width expander 4 provided at a middle position of the inner rail 3 can expand the width W of the inner rail 3 over its entire length. Alternatively, even in a case where the inner rail 3 is made of a soft resin, a width expander 4 which includes a single fixing piece 15 having almost the same length as the entire length of the inner rail 3 can expand the width W of the inner rail 3 over the entire length.

[0081] Each of these modifications includes the single width expander 4 at the corresponding position, and hence the operation (of, specifically, rotating the threaded rod 17) by the width expander 4 is required only once.

[0082] Hereinafter, the present invention will be briefly discussed in accordance with the above-described embodiments.

[0083] A sheet holding device according to an embodiment of the present invention is a sheet holding device for holding an end portion of a sheet to be stretched over a predetermined place, the sheet holding device including: an inner rail capable of changing a width of the inner rail; a

frame including a rail retainer having a recess for accommodating the inner rail; and at least one width expander for expanding the width of the inner rail, wherein gaps are defined between inner walls of the recess and the inner rail when the inner rail is accommodated in the recess, the gaps allowing the end portion of the sheet to be disposed in the gaps, and the sheet holding device has a function that the width expander expands the width of the inner rail to be expanded by the width expander so that the end portion of the sheet disposed in the gaps is sandwiched between the widthwise opposite side surfaces of the inner rail and the inner walls facing the opposite side surfaces, and held in the recess.

[0084] The sheet holding having this configuration according to the embodiment facilitates an operation of stretching the sheet by holding the end portion of the sheet, and achieves a good sheet workability. Specifically, the sheet holding device is configured to allow the width of the inner rail to be expanded by the width expander in a state where the end portion of the sheet is inserted in the gaps defined between the inner rail and the inner walls defining the recess of the rail retainer in the frame while being pushed by the inner rail. This configuration permits the end portion of the sheet to be held in the stretched state in the recess by sandwiching the end portion of the sheet between the opposite side surfaces of the inner rail and the inner walls facing the opposite side surfaces. Further, the sheet can be fixedly attached to the frame in the stretched state. Therefore, it is possible to easily stretch the sheet in the configuration in its own original state on site without the necessity of attaching a retaining plate to a sheet periphery by sewing the sheet to the retaining plate in advance of stretching the sheet unlike the stretching device disclosed in Patent Literature 1 (JPB5967740). The sheet thus has an excellent workability.

[0085] Moreover, this configuration can facilitate the fine adjustment of the stretching of the sheet on site. Specifically, for the fine adjustment of the stretching, the width expander is operated to narrow the width of the inner rail and reduce the force of sandwiching the end portion of the sheet held in the stretched state between the inner rail and the inner walls defining the recess of the rail retainer. This contributes to the facilitated fine adjustment of the stretching, specifically, the tension, of the sheet. After the fine adjustment of the stretching, the width expander is operated to expand the width of the inner rail and increase the sandwiching force between the inner rail and the inner walls defining the recess. In this manner, the sheet can be reliably held in the stretched state.

[0086] In the embodiment, a plurality of width expanders are arranged in a longitudinal direction of the inner rail. In this configuration, expansion directional forces are distributed from the plurality of width expanders to the inner rail. Accordingly, the end portion of the sheet can be reliably held in the entire longitudinal direction of the inner rail.

[0087] The inner rail is made of a soft resin having a property of partially expanding in a width direction in an elastic deformation, the partially expanding occurring at only a portion which is near to a receiving point of an expansion force of expanding the width of the inner rail by the width expander, and is made of a soft resin having a property of partially expanding by the width expander in a width direction in an elastic deformation. Since the inner rail is made of the soft resin having the aforementioned property, the width of the inner rail is expandable by the width expander concentratively at only the portion which is near to the receiving point of the expansion force of expanding the width of the inner rail in the elastic deformation. Thus, the width of the inner rail can be expanded and narrowed owing to the operation of the width expander only at the portion near the location of the width expander. For the fine adjustment of the stretching of the end portion of the sheet concentratively at the portion near the width expander, the width expander is operated to reduce the force from the width expander to the inner rail and narrow the width of the inner rail only at the portion near the width expander, and therefore the force of holding the end portion of the sheet can be reduced. This contributes to a concentrative fine adjustment of the stretching of the sheet. After the fine adjustment, the width of the inner rail is expanded so that the sheet can be reliably held in the stretched state.

[0088] In particular, the configuration including the plurality of width expanders arranged in the longitudinal direction of the inner rail permits only one of the width expanders to operate to reduce the force of holding the end portion of the sheet and another expander to maintain the force of holding the end portion of the sheet. This configuration consequently contributes to an individual fine adjustment of the stretching of the sheet by each of the width expanders therearound.

[0089] The inner rail has a pair of components which are connected by a hinge at a forward position in an insertion direction of coming in the recess, and are capable of opening and closing in the width direction. This configuration results in the inner rail where the width is reliably changeable with its simple structure. Consequently, the manufacturing of the inner rail is facilitated with fewer troubles such as breakage.

[0090] The pair of components respectively have a pair of opposite oblique surfaces inclining in directions of separating from each other as advancing in the insertion direction, and the width expander includes a fixing piece which is movable in the insertion direction and the opposite direction while coming into contact with the pair of opposite oblique surfaces, and a fixing piece moving part for moving the fixing piece in the insertion direction and the opposite direction. In this configuration, when being moved by the fixing piece moving part in the opposite direction that is opposite to the insertion direction of coming in the recess, the fixing piece pushes the pair of components in the directions of paring away from each other to open while coming into

contact with the pair of opposite oblique surfaces of the pair of components of the inner rail. In this manner, the fixing piece can easily expand the width of the inner rail. In contrast, the fixing piece can narrow the width of the inner rail when being moved in the insertion direction.

[0091] The fixing piece has side surfaces in the opposite directions perpendicularly intersecting the insertion direction, the side surfaces being curved in such a way as to separate from each other as advancing forward in the insertion direction. In this configuration, the fixing piece has the opposite curved side surfaces, and each of the opposite curved side surfaces is always partly in contact with the corresponding one of the opposite oblique surfaces of the pair of the components. Thus, even if the fixing piece tilts or loses its balance during the movement in the opposite direction that is opposite to the insertion direction of coming in the recess, no change is seen in the contact state between the fixing piece and the opposite oblique surfaces. Accordingly, it is possible to reliably expand the width of the inner rail by sufficiently pushing the pair of components of the inner rail to open.

[0092] The fixing piece has a threaded hole extending in the insertion direction, and the fixing piece moving part comprises a threaded rod extending in the insertion direction to engage the threaded hole. This configuration facilitates the movement of the fixing piece engaged with the threaded rod in the insertion direction of coming in the recess or the opposite direction only by rotating the threaded rod, which leads to a good operability.

[0093] The rail retainer is formed with a protrusion protruding inward at an opening of the recess. This configuration eliminates the risk that the inner rail having been expanded falls off from the recess, since the inner rail in the expanded state is in contact with the protrusion after being inserted in the recess. For the fine adjustment of the stretching of the sheet, the corner end defined by the side surface of the inner rail is caused to engage with the protrusion. Owing to the engaging, the fine adjustment of the stretching of the sheet is easily executable with increased accuracy while the end portion of the sheet is held under an appropriate holding force.

[0094] The sheet holding device further includes a cover which covers the opening of the recess. In this configuration, the cover can conceal the inner rail inserted in the recess from the outside by covering the opening of the recess after the attachment of the sheet. Consequently, more beautiful appearance is attainable. Additionally, a process of, for example, making the surface of the cover shiny and smoothy in terms of beauty contributes to further improvement in the beautiful appearance of the sheet holding device.

[0095] A method for holding a sheet according to another embodiment of the present invention is a method for holding a sheet by using the above-described sheet holding device, the method including: an insertion step of inserting the inner rail in the recess of the rail retainer while an end portion of the sheet is in contact with the opposite side surfaces of the inner rail,

thereby disposing the end portion of the sheet in the gap defined between the inner walls defining the recess and the inner rail; and a holding step of holding the end portion of the sheet in the recess with the end portion of the sheet being sandwiched between the opposite side surfaces of the inner rail and the inner walls facing the opposite side surfaces, by expanding the width of the inner rail by the width expander while the sheet is stretched.

[0096] As described above, for holding the end portion of the sheet by using the sheet holding device, the end portion of the sheet is disposed in the gaps defined between the inner walls defining the recess of the rail retainer and the inner rail while being in contact with the opposite side surfaces of the inner rail. Thereafter, the width of inner rail is expanded by the width expander to hold the end portion of the sheet in the stretched state in the recess, so that the end portion of the sheet is sandwiched between the opposite side surfaces of the inner rail and the inner walls facing the opposite side surfaces to hold the end portion of the sheet in the recess. In this way, the sheet can be held in the stretched state over the frame. Therefore, it is possible to stretch the sheet in its own original state without a preceding process of, for example, attaching a retaining plate or the like to the sheet, which leads to an excellent sheet workability. Furthermore, the fine adjustment of the stretching of the sheet is easily executable by changing the width of the inner rail with use of the width expander.

[0097] A panel according to further another embodiment of the present invention includes: the above-described sheet holding device; and a sheet having an end portion held by the sheet holding device.

[0098] The panel including the sheet holding device having this configuration facilitates the operation of stretching the sheet by holding the end portion of the sheet and achieves a good sheet workability, and further facilitates the fine adjustment of the stretching of the sheet on site.

CLAIMS

1. A sheet holding device for holding an end portion of a sheet to be stretched over a predetermined place, the sheet holding device comprising:
 - an inner rail capable of changing a width of the inner rail;
 - a frame including a rail retainer having a recess for accommodating the inner rail; and
 - at least one width expander for expanding the width of the inner rail, whereingaps are defined between inner walls of the recess and the inner rail when the inner rail is accommodated in the recess, the gaps allowing the end portion of the sheet to be disposed in the gaps, and
 - the sheet holding device has a function that the width expander expands the width of the inner rail, so that the end portion of the sheet disposed in the gaps is sandwiched between the widthwise opposite side surfaces of the inner rail and the inner walls facing the opposite side surfaces, and held in the recess.
2. The sheet holding device according to claim 1, wherein
 - a plurality of width expanders are arranged in a longitudinal direction of the inner rail.
3. The sheet holding device according to claim 1 or 2, wherein
 - the inner rail is made of a soft resin having a property of partially expanding in a width direction in an elastic deformation, the partially expanding occurring at only a portion which is near to a receiving point of an expansion force of expanding the width of the inner rail by the width expander.
4. The sheet holding device according to any one of claims 1 to 3, wherein
 - the inner rail has a pair of components which are connected by a hinge at a forward position in an insertion direction of coming in the recess, and are capable of opening and closing in the width direction.
5. The sheet holding device according to claim 4, wherein
 - the pair of components respectively have a pair of opposite oblique surfaces inclining in directions of separating from each other as advancing in the insertion direction, and
 - the width expander includes a fixing piece which is movable in the insertion direction and the opposite direction while coming into contact with the pair of opposite oblique surfaces, and a fixing piece moving part for moving the fixing piece in the insertion direction and the

opposite direction.

6. The sheet holding device according to claim 5, wherein
the fixing piece has side surfaces in the opposite directions perpendicularly intersecting the insertion direction, the side surfaces being curved in such a way as to separate from each other as advancing forward in the insertion direction.
7. The sheet holding device according to claim 5 or 6, wherein
the fixing piece has a threaded hole extending in the insertion direction, and
the fixing piece moving part comprises a threaded rod extending in the insertion direction to engage the threaded hole.
8. The sheet holding device according to any one of claims 1 to 7, wherein
the rail retainer has a protrusion protruding inward at an opening of the recess.
9. The sheet holding device according to any one of claims 1 to 8, further comprising
a cover which covers the opening of the recess.
10. A method for holding a sheet by using the sheet holding device according to claim 1,
the method comprising:
an insertion step of inserting the inner rail in the recess of the rail retainer while an end portion of the sheet is in contact with the opposite side surfaces of the inner rail, thereby disposing the end portion of the sheet in the gaps defined between the inner walls of the recess and the inner rail; and
a holding step of holding the end portion of the sheet in the recess with the end portion of the sheet being sandwiched between the opposite side surfaces of the inner rail and the inner walls facing the opposite side surfaces, by expanding the width of the inner rail by the width expander while the sheet is stretched.
11. A panel comprising:
the sheet holding device according to claim 1; and
a sheet having an end portion held by the sheet holding device.