April 2, 1968 C. H. HURKAMP 3,375,619

PNEUMATIC APPARATUS FOR ERECTING STRUCTURAL BUILDING COMPONENTS

Filed Nov. 21, 1966 2 Sheets-Sheet 1

Fig. 1.

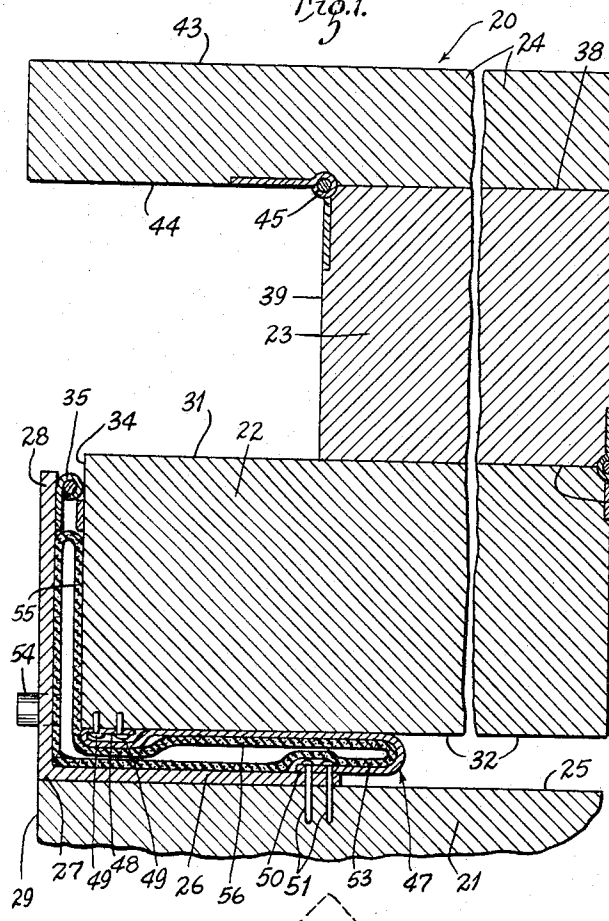


Fig. 4.

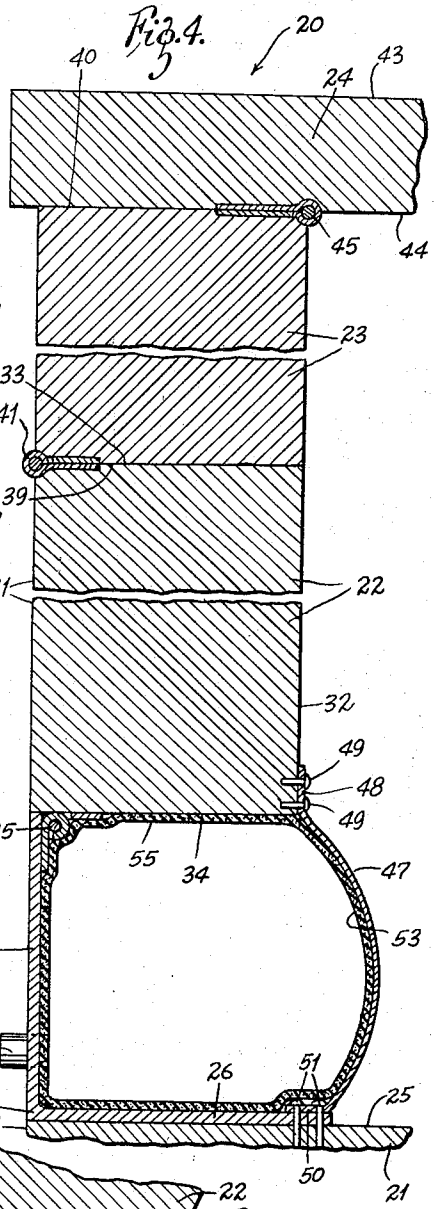


Fig. 2.

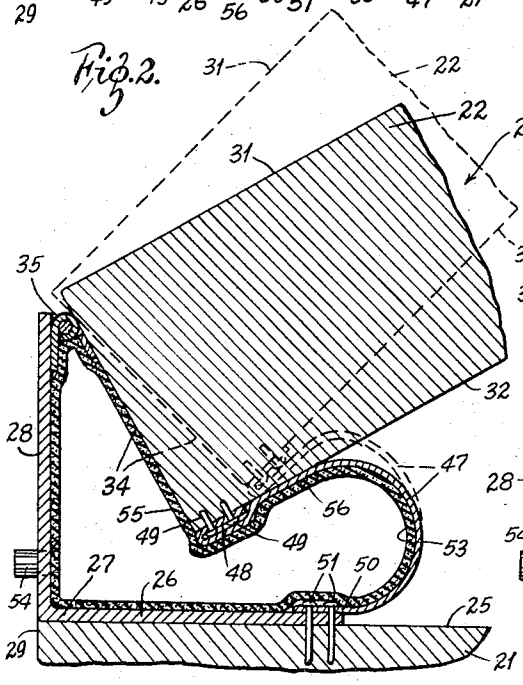
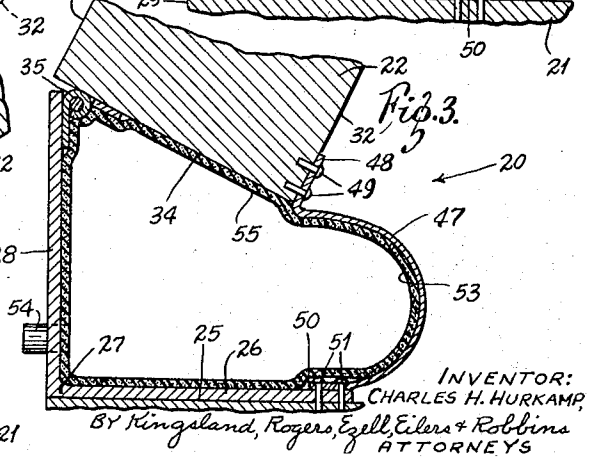


Fig. 3.



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Fig. 5.

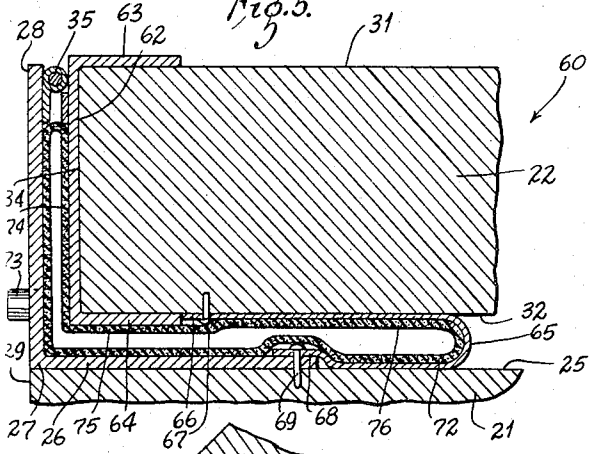


Fig. 6.

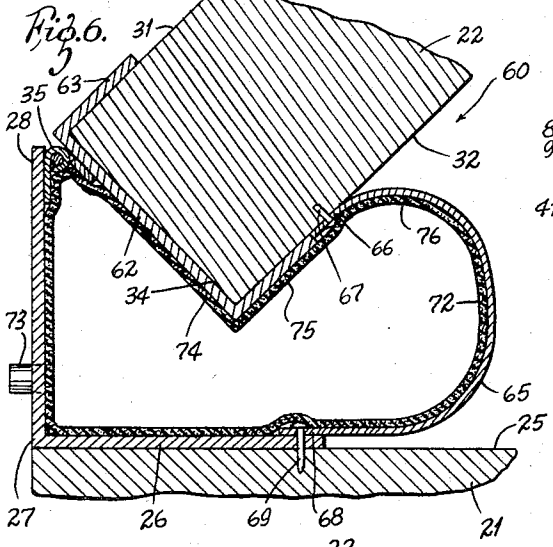


Fig. 7.

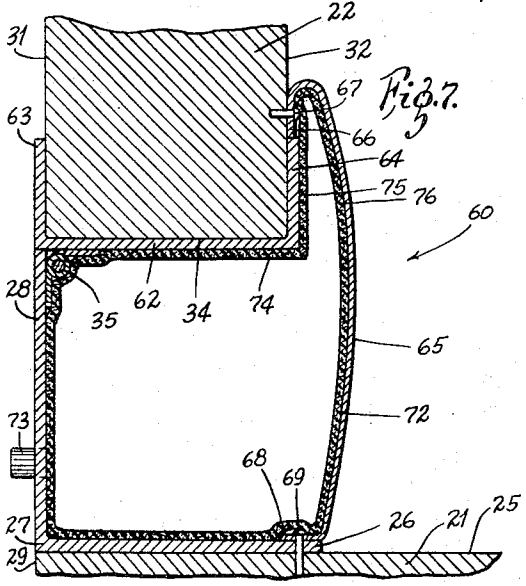
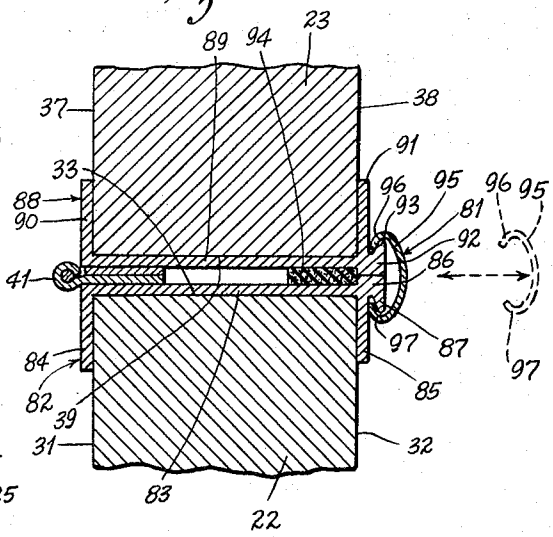


Fig. 8.



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3,375,619

PNEUMATIC APPARATUS FOR ERECTING STRUCTURAL BUILDING COMPONENTS

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Filed Nov. 21, 1966, Ser. No. 595,775
6 Claims. (Cl. 52—2)

This invention relates to apparatus for erecting structural building components and is an improvement upon my prior Patent No. 3,189,949, dated June 22, 1965.

The invention is directed to a means for positively, quickly, inexpensively, and yet automatically erecting building components. The building components include a floor panel, upper and lower side wall panels, and a top panel. This arrangement of panels may be duplicated for a plurality of sides as may be required to form a completed building or enclosure. The floor panel is hinged to the lower end of the lower side panel. The two side panels are hinged end to end, while the upper side panel is hinged to the top panel. The structure is stored and transported in a collapsed condtion with the various panels folded against one another. Erection of the structure to an expanded condtion is accomplished by inflating a pneumatic tube which, when deflated, is flattened between the floor panel and the lower side panel, and which, when inflated, forces the lower side panel to pivot about its hinge connection to the floor panel to an upright unfolded position. The hinge connections between the other panels cause the other panels to automatically follow unfolding of the lower side panel to erect the entire building structure when the tube is inflated.

A particular feature of this improvement is in the provision of a flexible means for confining and locating the inflatable tube to cause the inflatable tube to exert erecting forces against both the lower edge and a portion of the lower side of the lower side wall during initial erecting when the exertion of such forces will aid pivotal movement of the lower side wall panel, and to cause the pneumatic tube to exert erecting forces against the lower edge only of the lower side panel as the lower side panel approaches its fully erected position. The principal object of this invention is to provide such an improvement.

Another feature of the invention is that it is readily adaptable to modular buildings wherein separate building modules are erected according to the invention and are then assembled to form different sizes of buildings of different floor plans.

Another object of the invention is to provide a modification of the foregoing improvement, wherein the initial forces supplied by the inflatable tube are exerted against the lower edge and a portion of a side of the lower side panel during initial erection, with the area of the side of the lower side panel against which such forces are applied being gradually reduced as the lower side panel approaches its final erected position, but with some area of the side of the lower side panel being exposed to the forces applied by the pneumatic tube even upon complete erection of the building structure. This modification is particularly important for the erection of heavier building structures.

Another object of the invention is to provide a quickly attachable and releasable locking device for locking the structure in the erected condition.

Other objects and advantages will be apparent to those skilled in the art.

In the drawings:

FIGURE 1 is a fragmentary view in vertical section showing the floor panel, the lower side panel, the upper side panel, the top panel, and their hinged connections, and showing the pneumatic tube and the flexible confining and positioning member;

FIGURE 2 is a fragmentary view in section of the lower portion of the structure of FIGURE 1, and showing the lower side panel in a typical initial partially erected position, with dotted lines showing a further erected position, but omitting the inflatable tube;

FIGURE 3 is a sectional view similar to that of FIGURE 2, but showing the lower side panel in still further erected position;

FIGURE 4 is a sectional view similar to that of FIGURE 1, but showing the panels in fully erected positions;

FIGURE 5 is a fragmentary view in vertical section showing a modification of the invention, illustrating a floor panel, a lower side panel, an inflating tube, and a flexible confining and positioning member for this modification;

FIGURE 6 is a sectional view similar to that of FIGURE 5, but showing the lower side panel in partially erected position;

FIGURE 7 is a sectional view similar to FIGURE 6, but showing the lower side panel in fully erected position; and

FIGURE 8 is a fragmentary view in vertical section showing a locking device, illustrated in this figure as being applied to lock an upper side panel and a lower side panel in erected positions.

Referring to the drawings, while parts of a building are generally schematically illustrated, it should be understood that this invention may be used to erect any parts of buildings or other enclosures, such as containers, doll houses, and the like.

FIGURES 1–4 show a portion of a building structure **20** that comprises a floor panel **21**, a lower side panel **22**, an upper side panel **23**, and a top or roof panel **24**. The floor panel **21** has an upper surface **25** to which one leg **26** of an angle member **27** is permanently fastened by screws, nails or other suitable fastening devices (not shown). The other leg **28** of the angle member **27** extends vertically upwardly in continuation of the plane of the side edge **29** of the floor panel **21**, although that specific location for the leg **28** is not critical.

The lower side panel **22** has an outer surface **31**, an inner surface **32**, a top edge **33**, and a bottom edge **34**. The lower side panel **22** is fastened to the vertical leg **28** of the angle member **27** by a hinge **35** which permits the panel **22** to swing between the horizontal position illustrated in FIGURE 1 and the vertical position illustrated in FIGURE 4.

The upper side panel **23** has an exterior wall **37**, an interior wall **38**, a top edge **39**, and a bottom edge **40**. A hinge **41** joins the top edge **33** of the lower side panel **22** to the bottom edge **40** of the upper side panel **23**.

The top panel **24** has an upper surface **43** and a lower surface **44**. A hinge **45** joins the lower surface **44** to the upper edge **39** of the upper side panel **23**. The hinges **41** and **45** permit the upper side panel **23** to swing between the horizontal position illustrated in FIGURE 1 and the vertical position illustrated in FIGURE 4 as the lower side panel **22** swings between the positions illustrated in FIGURES 1 and 4.

A flexible retaining and positioning element **47** extends along the full width of the lower side panel **22** and the floor panel **21**. The upper edge **48** of the element **47** is fastened by screws or nails **49** to the inner surface **32** of the lower side panel **22** adjacent the lower edge thereof. The other edge or margin **50** of the element **47** is fastened by nails or screws **51** to the leg **26** of the angle member **27** at a position generally directly below the plane of the inner surface **32**, as viewed in FIGURE 4.

An inflatable tube **53** is confined within the area defined by the legs **26** and **28** of the angle member **27**, the lower edge **34** of the lower side panel **22**, and the flexible retaining and positioning member **47**. The tube extends

the full width of the lower side panel 22 and the floor panel 21, and may or may not continue to other structural panels of the building or enclosure 20, as is illustrated in my prior Patent No. 3,189,949. A filler post 54 extends through the leg 28 of the angle member 27 and is adapted to be connected to a source of compressed air (not shown) for inflating the tube 53. The filler post 54 can also be actuated to deflate the tube 53.

As can be seen in FIGURE 1, with the various panels collapsed, and the tube 53 collapsed, a portion 55 of the tube 53 bears against the lower edge 34 of the lower side panel 22, and another portion 56 bears against part of the inner surface 32 of the lower side panel 22. This is permitted by the retaining and positioning member 47 which folds over as illustrated in FIGURE 1. Upon initial introduction of air or other fluid from a suitable source (not shown) through the filling post 54, the tube 53 begins to expand, and the portions 55 and 56 of the tube 53 exert forces against the lower edge 34 and the lower portion of the inner surface 32 of the lower side panel 22. The forces exerted against the lower edge 34 apply their moment about the hinge 35, and the forces applied against the surface 32 apply a moment about the hinge 35, both moments tending to pivot the lower side panel 22 about the hinge 35.

As the lower side panel 22 begins to pivot upwardly in a counterclockwise direction, as viewed in FIGURE 2, the portion 55 of the tube 53 continues to exert forces against the entire lower edge 34 of the lower side panel 22, but the member 47 begins to peel away from the surface 32 of the lower side panel 22, and less area of the portion 56 of the tube 53 applies pressure against the surface 32. However, the member 47 causes the portion of the tube 53 between the portion 56 and the nail 51 to be formed in a loop with pressure being exerted against the loop tending to pull the lower corner at the intersection between the surface 32 and the edge 34 outwardly. This aids in forcing the lower side panel 22 to continue its pivotal movement. When the panel 22 continues to swing and reaches the fully erected position illustrated in FIGURE 4, the guiding and positioning member is fully extended and the portion 56 of the tube 53 is completely free of contact with the surface 32.

Upon deflation of the tube 53, the tube 53 and member 47 reassume the folded conditions illustrated in FIGURE 1, being guided into that fold by the corner at the intersection between the surface 32 and the edge 34 of the panel 22.

FIGURES 5–7 illustrate a modified building structure 60. In this modified building structure, the various panels may be identical to the panels described in connection with FIGURES 1–4, so like reference characters for the panels, and for the angle member 27 and the hinge 35 are used. A metal or plastic butt plate 62 is permanently affixed to the lower side panel 22 against the lower edge 34 thereof. The butt plate 62 has side flanges 63 and 64 extending upwardly a short distance against the outer and inner surfaces 31 and 32, respectively, of the panel 22. A flexible retainer and positioning member 65 has one edge 66 fastened by nails or screws 67 to the panel 22 against the surface 32 adjacent the flange 64. The other edge 68 is fastened by nails or screws 69 to the leg 26 of the angle member 27, as illustrated in FIGURE 5.

A pneumatic tube 72 is fitted within the area defined by the legs 26 and 28 of the angle member 27, the butt plate 62, the flange 64, and the flexible member 65. There is a filler post 73 connected to a source of compressed air or other insulating fluid (not shown) to inflate the tube 72.

The principal difference between the arrangement of the tube 72 and the flexible retaining and positioning member 65 compared to their comparable parts in the embodiment shown in FIGURES 1–4 is that the tube 72 has a portion 74 that is always in contact with the butt plate 62 and the portion 75 that is always in contact with the flange 64. There is another portion 76 that initially bears against the member 65 and against the portion of the face 32 of the lower side panel 22 beyond the flange 64 when the building structure is collapsed as shown in FIGURE 5.

Upon initial inflation of the tube 72, the portions 74, 75, and 76 apply moments about the hinge 35 tending to pivot the lower side panel 22 toward an upright position. As the tube 72 is further inflated, and the panel 22 further pivoted, the portion 76 of the tube 72 begins to peel away as the retaining and positioning member 65 begins to be stretched. However, since the member 65 is fastened to the panel member 22 beyond the flange 64, the portion 75 of the tube 72 remains in contact with the flange 64 and continues to apply a moment about the hinge 35 in aid of the moment applied by the portion 74 of the tube 72. This additional moment applied by the portion 75 continues during the complete erection of the building structure until the panel member is in the position illustrated in FIGURE 7, and the moment remains to hold the panel member in the erected position. Thus, the sizing and positioning of the flexible retaining and positioning member 65 determines the locations of applied moments to the pivoting movement of the panel 22. The arrangement shown in FIGURES 5–7 is particularly suitable for heavier building structures.

Because of the locations of the hinges 35, 41, and 45, as shown in FIGURE 4, the building structures 20 and 60 tend to remain erected simply by virtue of the weights of the various panels. However, in some instances, it may be desirable to lock the structures in erected positions.

FIGURE 8 shows a simple and inexpensive locking device for that purpose. By way of example, the locking device of FIGURE 8 is shown locking the upper side panel 23 to the lower side panel 22. It may also be used for locking together adjacent building modules.

For this locking device 81, a metal or plastic channel member 82 is formed of the same width as the lower side panel 22 with a base 83 positioned against the edge 33, a flange 84 positioned against the external surface 31, and a flange 85 positioned against the internal surface 32. The channel member 82 is permanently affixed in place by nails, screws or other suitable fastening devices. From the intersection of the base 83 and the flange 85, there is an upwardly and outwardly extending shoulder 86, and below the shoulder 86, there is an outwardly and downwardly extending tapered rib 87.

A similar channel member 88 is affixed to the upper side panel 23 with its base 89 bearing against the lower edge 39, a flange 90 bearing against the surface 37, and another flange 91 bearing against the surface 38. The channel member 88 also has a downwardly and outwardly extending shoulder 92 and an upwardly and outwardly tapered rib 93.

The hinge 41 is affixed to the base portions 83 and 89 of the channel members 82 and 88, and an insulating strip 94 is positionable between the bases 83 and 89, as shown in FIGURE 8.

An elongated clip 95 is of generally C shape in cross-section with inturned flanges 96 and 97 adapted to fit between the ribs 93 and 87 and their opposing flanges 91 and 85, respectively. The clip 95 is flexible and resilient and can be snapped into the solid line position illustrated in FIGURE 8 or pried loose to the dotted line position. In this way, any panels, such as the panels 22 and 23, can be releasably locked in erected position.

Various changes and modifications may be made within the purview of this invention as will be readily apparent to those skilled in the art. Such changes and modifications are within the scope and teaching of this invention as define by the claims appended hereto.

What is claimed is:

1. An automatically erectable building structure comprising a rigid floor panel having an upper surface, a side panel hinged to the floor panel, the side panel having

upper and lower edges and first and second side surfaces, the floor panel including means defining a generally vertical surface above the upper surface and adjacent to which the lower edge of the side panel is positioned when the side panel is pivoted to a generally horizontal position, the hinge between the side panel and the floor panel being so located that the first side surface of the side panel when the side panel is in the generally horizontal position is adjacent the upper surface of the floor panel, a pneumatic tube positioned with portions lying against the said generally vertical surface, the upper surface of the floor panel, the lower edge of the side panel, and a portion of the aforesaid first side surface of the side panel, and a flexible retaining and positioning member having a first edge affixed to the side panel and a second edge affixed to the upper surface of the floor panel to retain and position the remaining portions of the pneumatic tube.

2. The building structure of claim **1** wherein the said first edge of the member is affixed adjacent the intersection of the first side surface and the lower edge of the side panel.

3. The building structure of claim **1** wherein the said first edge of the member is affixed to the said first side surface of the side panel at a position spaced from the intersection of the first side surface and the lower edge of the side panel.

4. The building structure of claim **1** including means to lock adjacent pairs of panels together.

5. The building structure of claim **4** wherein the locking means comprises longitudinal diametrically opposing shoulders on two adjacent panels, and an elongated clip having inwardly facing flanges for engaging the shoulders, the clip being of resilient spring steel.

The building structure of claim **5** wherein the said two adjacent panels are on separate building modules and the locking means locks the modules together.

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