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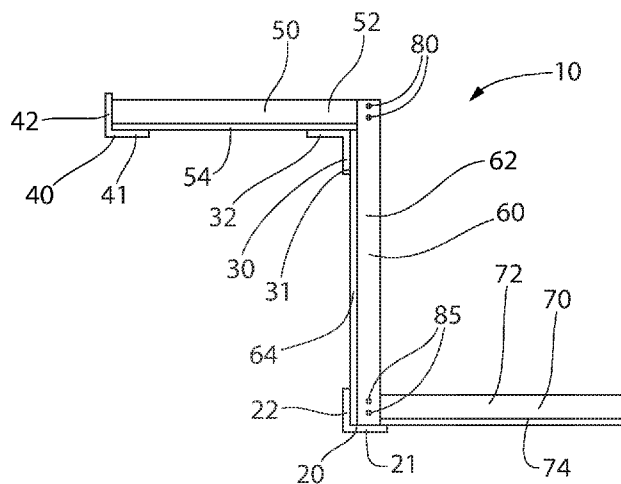


FIG. 1

(57) Abstract: a) providing a collapsible structural frame in a folded state, the collapsible structural frame configured to provide a structure to which building material sheets are attached to form a surface; b) converting the collapsible structural frame from the folded state to a deployed state and fastening the collapsible structural frame to a preexisting support; and c) fastening at least a sheet of building material to the surface of the collapsible structural frame. 42. The method according to claim 41, wherein step c) comprises fastening a first sheet of building material to a first frame portion of the collapsible structural frame and fastening a second sheet of building material to a second frame portion of the collapsible structural frame, whereby the first and second sheets of building material are not parallel. 43. The method according to any one of claims 41 to 42, wherein a fastener locks the collapsible structural frame into the deployed state.

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COLLAPSIBLE STRUCTURAL FRAME SYSTEM FOR A SHEET-LIKE BUILDING MATERIAL

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a PCT International Application of U.S. Provisional Patent Application No. 62/725,611 filed on August 31, 2018. The disclosure of the above application is incorporated herein by reference.

FIELD

[0001] The present invention relates to building systems. Particular embodiments of the invention relate to collapsible systems for forming the structure of a soffit or similar framework. Particular embodiments provide the structure for holding drywall or other sheet-like finish material.

BACKGROUND

[0002] Many office buildings and other buildings have interior designs that include areas of flat ceilings and walls. Some of these buildings also include soffits or other features that include multiple angles between relatively small flat areas. For example, an upper area of an occupiable building space at the junction between a wall and the ceiling can include a rectangular (or other shape) boxed out area having a vertical surface sometimes referred to as a fascia and a horizontal surface that is known as a soffit. A structure is traditionally built and then drywall or some other building material (often a sheet material) is fastened to the structure.

[0003] A problem exists in that traditionally the structure of the soffit and fascia is stick-built by a worker in the field from wood or metal studs or other stock pieces that need to be custom cut and fitted. This procedure is time consuming and requires significant care to ensure that all the appropriate angles and lengths are identical so that a uniform structure results.

[0004] Accordingly, embodiments of the invention provide a system for quickly and easily constructing a dimensionally uniform structural framework for a flat area, soffit, fascia, or other building area.

SUMMARY

[0005] Embodiments of the invention provide a solution to the above problem by allowing more flexibility in grid design and more flexibility in ceiling tile construction and arrangement.

[0006] In one aspect, a collapsible structural frame is provided that is configured to provide a structure to which building material sheets are attached to form a surface. The frame includes a first frame portion that corresponds to a first portion of the surface and is configured to receive a first sheet of the building material; a second frame portion that corresponds to a second portion of the surface and is configured to receive a second sheet of the building material; a pivoting mechanism that attaches the second frame portion to the first frame portion and has a pivoting axis, the pivoting mechanism permitting the second frame portion to rotate about the pivoting axis relative to the first frame portion, and the pivoting mechanism permitting the second frame portion to rotate about the pivoting axis from an undeployed state to a deployed state; and a locking mechanism that fixes a relative position of the first frame portion and the second frame portion in the deployed state. The undeployed state is a folded state compared to the deployed state.

[0007] Other embodiments of the present invention include a building system comprising the previously discussed collapsible structure frame in the deployed state.

[0008] In another aspect, a collapsible structural frame is provided that is configured to provide a soffit structure to which building material sheets are attached to form a first soffit surface and a second soffit surface. The frame includes a first frame portion that corresponds to the first soffit surface and is configured to receive a first sheet of the building material; a second frame portion that corresponds to the second soffit surface and is configured to receive a second sheet of the building material; a pivoting mechanism that attaches the second frame portion to the first frame portion and has a pivoting axis, the pivoting mechanism permitting the second frame portion to rotate about the pivoting axis relative to the first frame portion, and the pivoting mechanism permitting the second frame portion to rotate about the pivoting axis from an undeployed state to a deployed state; and a locking mechanism that fixes a relative position of the first frame portion and the second frame portion in the deployed state at a deployed angle. The undeployed state is a folded state compared to the deployed state, and the deployed angle is more than 0 degrees and less than 180 degrees.

[0009] In another aspect, a collapsible structural soffit frame is provided to which a building material sheet is attached to form a soffit surface. The frame includes a first rigid member; a

second rigid member; a first collapsible member that connects the first rigid member to the second rigid member, the first collapsible member having a collapsed position and a deployed position; and a second collapsible member that connects the first rigid member to the second rigid member, the second collapsible member having a collapsed position and a deployed position. In the deployed position of both the first and second collapsible members the first and second collapsible members are structural members configured to support the building material sheet.

[0010] Other embodiments of the present invention include a building system comprising the previously discussed collapsible structure soffit frame in the deployed state.

[0011] Other embodiments of the present invention include a method of installing a soffit comprising: a) providing a collapsible structural frame in a folded state, the collapsible structural frame configured to provide a structure to which building material sheets are attached to form a surface; b) converting the collapsible structural frame from the folded state to a deployed state and fastening the collapsible structural frame to a preexisting support; and c) fastening at least a sheet of building material to the surface of the collapsible structural frame.

[0012] Further areas of applicability of the present invention will become apparent from the detailed description provided hereinafter. It should be understood that the detailed description and specific examples, while indicating preferred embodiments of the invention, are intended for purposes of illustration only and are not intended to limit the scope of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] The present invention will become more fully understood from the detailed description and the accompanying drawings, wherein:

[0014] FIG. 1 is a side view of a conventional soffit structure;

[0015] FIG. 2 is a perspective view of the structure of FIG. 1;

[0016] FIG. 3 is a top view of the structure of FIG. 1;

[0017] FIG. 4 is top view of a first embodiment of the invention in an unfolded state;

[0018] FIG. 5 is a detail view of the embodiment shown in FIG. 4 in a folded state;

[0019] FIG. 6 is a side view of a soffit system in accordance with exemplary embodiments of the invention in a deployed state;

[0020] FIG. 7 is a side view of the embodiment shown in FIG. 6 in a flat, non-deployed state;

[0021] FIG. 8 is a side view of a holding mechanism in accordance with exemplary embodiments of the invention;

[0022] FIG. 9 is a side view of the soffit system of FIG. 6 in an alternate deployed state;

[0023] FIG. 10 is a side view of the soffit system of FIG. 6 in an alternate deployed state;

[0024] FIG. 11 is a side view of the soffit system of FIG. 6 in an alternate deployed state;

[0025] FIG. 12 is a top view of a soffit system in accordance with exemplary embodiments of the invention in a folded, non-deployed state;

[0026] FIG. 13 is a top view of the soffit system of FIG. 12 in a deployed state; and

[0027] FIG. 14 is a perspective view of an occupiable building space having a soffit structure using the soffit system of FIG. 12.

[0028] All drawings are schematic and not necessarily to scale. Parts given a reference numerical designation in one figure may be considered to be the same parts where they appear in other figures without a numerical designation for brevity unless specifically labeled with a different part number and described herein.

DETAILED DESCRIPTION

[0029] The following description of the preferred embodiment(s) is merely exemplary in nature and is in no way intended to limit the invention, its application, or uses.

[0030] In the description of embodiments disclosed herein, any reference to direction or orientation is merely intended for convenience of description and is not intended in any way to limit the scope of the present invention. Relative terms such as "lower," "upper," "horizontal," "vertical," "above," "below," "up," "down," "top" and "bottom" as well as derivative thereof (e.g., "horizontally," "downwardly," "upwardly," etc.) should be construed to refer to the orientation as then described or as shown in the drawing under discussion. These relative terms are for convenience of description only and do not require that the apparatus be constructed or operated in a particular orientation. Terms such as "attached," "connected," "coupled," "interconnected," and similar refer to a relationship wherein structures are secured or attached to one another either directly or indirectly through intervening structures, as well as both movable or rigid attachments or relationships, unless expressly described otherwise. The term "fixed" refers to two structures that cannot be separated without damaging one of the structures. The term "filled" refers to a state that includes completely filled or partially filled.

[0031] As used throughout, ranges are used as shorthand for describing each and every value that is within the range. Any value within the range can be selected as the terminus of the range. In addition, all references cited herein are hereby incorporated by reference in their entireties. In the event of a conflict in a definition in the present disclosure and that of a cited reference, the present disclosure controls.

[0032] Figure 1 shows an example of a traditional building structure for supporting drywall panels to form a soffit and fascia. The thickness of some members in the figures is not to scale and are made thicker in proportion to other members for clarity. Actual members may be relatively thin sheet metal or other material such as wood, plastic, composite or other material.

[0033] In Figure 1, a structural frame 10 includes an upper horizontal section formed by members 50, a vertical section formed by members 60 and a lower horizontal section formed by members 70. In this example, the upper horizontal section and the vertical section intersect at a right angle, and the vertical section and the lower horizontal section intersect at a right angle. In other examples, different angles exist between the particular sections and the sections have different relative lengths. Members 50, 60, 70 are, in this example, longitudinal members having a “T” shaped cross section. Angles 20, 30, 40 are, in this example, longitudinal members having an “L” shaped cross section. Although Figures 1-3 show surfaces 54, 64, 74 being offset from surfaces 21, 22, 31, 32, 41, 42 by the thickness of angles 20, 30, 40, other examples are fabricated so that surfaces 54, 64, 74 are flush with surfaces 21, 22, 31, 32, 41, 42. In this example, member 50 is fixed to member 60 by two screws 80, and member 60 is fixed to member 70 by two screws 85.

[0034] The structural frame 10 may comprise a first frame portion that may form a first portion of the surface and is configured to receive a first sheet of the building material. The first frame portion may comprise a first longitudinal member 50 and a second longitudinal member 40, the first longitudinal member 50 arranged orthogonal to the second longitudinal member 40.

[0035] The structural frame 10 may further comprise a first pivoting mechanism 80 that attaches the second frame portion to the first frame portion and has a first pivoting axis. The first pivoting mechanism 80 may permit the second frame portion to rotate about the first pivoting axis relative to the first frame portion, and the first pivoting mechanism 80 permitting the second frame portion to rotate about the first pivoting axis from an undeployed state to a deployed state. The undeployed state may be a folded state compared to the deployed state.

[0036] The structural frame 10 may further comprise a first locking mechanism that fixes a relative position of the first frame portion and the second frame portion in the deployed state.

[0037] The first longitudinal member 50 may have a T-shaped cross-section. The T-shaped cross-section of the first longitudinal member 50 may comprise a bottom flange 54 that forms part of the first portion of the surface.

[0038] The second longitudinal member 40 may have an L-shaped cross-section. The L-shaped cross-section of the second longitudinal member 40 may comprise a bottom flange 64 that forms part of the first portion of the surface.

[0039] The second longitudinal member 40 of the first frame portion may extend along a direction that is substantially parallel to the first pivoting axis.

[0040] The structural frame 10 may comprise a second frame portion that may form a second portion of the surface and is configured to receive a second sheet of the building material. The second frame portion may comprise a third longitudinal member 60 and a fourth longitudinal member 20, the third longitudinal member 60 arranged orthogonal to the fourth longitudinal member 20.

[0041] The third longitudinal member 60 may have a T-shaped cross-section. The T-shaped cross-section of the third longitudinal member 60 may comprise a bottom flange 64 that forms part of the first portion of the surface.

[0042] The fourth longitudinal member 20 may have an L-shaped cross-section. The L-shaped cross-section of the fourth longitudinal member 20 may comprise a bottom flange 22 that forms part of the first portion of the surface.

[0043] The fourth longitudinal member 20 of the second frame portion may extend along a direction that is substantially parallel to the first pivoting axis.

[0044] The structural frame 10 may comprise a third frame portion that corresponds to a third portion of the surface and is configured to receive a third sheet of the building material. The third frame portion may comprise a fifth longitudinal member 70. The fifth longitudinal member 70 may be arranged orthogonal to the fourth longitudinal member 20.

[0045] The structural frame 10 may further comprise a second pivoting mechanism 85 that attaches the third frame portion to the second frame portion and has a second pivoting axis. The second pivoting mechanism 85 may permit the second frame portion to rotate about the second pivoting axis relative to the third frame portion, and the second pivoting mechanism 85 may

permitting the second frame portion to rotate about the second pivoting axis from an undeployed state to a deployed state.

[0046] The structural frame 10 may further comprise a second locking mechanism that fixes a relative position of the second frame portion and the third frame portion in the deployed state.

[0047] The fifth longitudinal member 70 may comprise a T-shaped cross-section. The T-shaped cross-section of the fifth longitudinal member 70 may comprises a bottom flange 74 that forms part of the third portion of the surface.

[0048] The fifth longitudinal member 70 of the third frame portion may extends along a direction that is substantially orthogonal to the second pivoting axis.

[0049] Figure 2 is a perspective view of frame 10 and Figure 3 is a top view of frame 10. These figures help illustrate the stick-built nature of this example of a traditional building structure for supporting drywall panels.

[0050] Figures 4 and 5 show an example of an embodiment of the invention that simplifies the work needed in the field to create a frame for supporting drywall or other sheet-like material. In this example, framework 100 has two panels 200, 300 that are hinged at a folding line 150 such that panels 200, 300 can be folded into a condition in which panel 200 is positioned on top of panel 300, as shown in Figure 5. This example provides a frame that can be constructed off-site and then quickly and easily unfolded on-site to provide a dimensionally correct framework.

[0051] The sheet-like material may be formed from a first sheet of the building material and a second sheet of the building material. The first sheet and the second sheet may be two completely separate sheets of material. In another embodiment, the first and second sheets may be formed from a single panel of building material, whereby the single panel has a V-shaped cut formed into one of the major surfaces, thereby allowing the single panel to be folded to a shape conforming to a first frame portion and a second frame portion of the frame, whereby the single panel extends continuously from the first frame portion to the second frame portion. The V-shaped cut may be formed such that a 90 degree fold is formed on the single panel. Other fold angles may range from 30 to 170 degrees – including all angles and subranges there-between.

[0052] Panel 200 has a longitudinal member 210 and a parallel longitudinal member 215 that establish the length of panel 200. Two end transverse members 220 bridge between longitudinal members 210, 215. In this example, two interior transverse members 230 are parallel to end

transverse members 220 and bridge between longitudinal members 310, 315. Similarly to panel 200, panel 300 has a longitudinal member 310 and a parallel longitudinal member 315 that establish the length of framework panel 300. Two end transverse members 320 bridge between longitudinal members 310, 315. In this example, two interior transverse members 330 are parallel to end transverse members 320 and bridge between longitudinal members 310, 315.

[0053] Figure 5 shows framework 100 in a folded state where panel 200 is rotated relative to panel 300 about folding line 150 such that panel 200 is positioned on top of panel 300. The movement of panel 200 relative to panel 300 can be controlled by one or more hinging mechanisms. The hinging mechanism can be located at folding line 150 and be a simple hinge, or they can be located remotely from folding line 150 and/or be some other type of mechanism that permits the desired relative movement of panels 200, 300. The hinging mechanism can be configured to allow relative rotation of the panels 200, 300 through any angle of rotation. For example, as shown in Figure 4, panels 200, 300 can rotate to a position at which they are 180 degrees from each other. In other examples, panels 200, 300 can rotate to a position in which they are more or less than 180 degrees from each other. For example, in the case of a common soffit in a building space (or other application), panels 200, 300 can be moved to a position in which they are 90 degrees from one another.

[0054] One or more locking mechanisms can be provided to lock panels 200, 300 in a desired position relative to one another. Such locking mechanisms can be of any configuration that securely holds the panels in the desired position sufficiently to allow the attachment of the drywall, or other, building panels. Figures 6-11 show an example of locking mechanisms in accordance with the invention.

[0055] Figure 6 shows an example of a framework 600 in accordance with embodiments of the invention. Framework 600 has an upper member 700 that is T-shaped in cross-section. The T-shaped cross-section is formed by a rib portion 710 and a flange portion 720 that extends laterally away from rib portion 710 on both sides of rib portion 710. While upper member 700 is shown as a T-shaped member in this example, in other examples upper member 700 has an L-shaped cross-section, a box-shaped cross-section, or another shaped cross-section. Any appropriately shaped cross-section can be used as long as it is sufficiently strong to support the drywall or other building sheet that is to be attached to framework 600.

[0056] Framework 600 has a middle member 800 that is attached to upper member 700 by a swiveling joint 805 that can be, for example, a bolt, pin, rivet, or other swiveling fastener. In this example, middle member 800 is T-shaped in cross-section. The T-shaped cross-section is formed by a rib portion 810 and a flange portion 820 that extends laterally away from rib portion 810 on both sides of rib portion 810. While middle member 800 is shown as a T-shaped member in this example, in other examples middle member 800 has an L-shaped cross-section, a box-shaped cross-section, or another shaped cross-section. Any appropriately shaped cross-section can be used as long as it is sufficiently strong to support the drywall or other building sheet that is to be attached to framework 600.

[0057] Framework 600 has a lower member 900 that is attached to middle member 800 by a swiveling joint 806 that can be, for example, a bolt, pin, rivet, or other swiveling fastener. In this example, lower member 900 is T-shaped in cross-section. The T-shaped cross-section is formed by a rib portion 910 and a flange portion 920 that extends laterally away from rib portion 910 on both sides of rib portion 910. While lower member 900 is shown as a T-shaped member in this example, in other examples lower member 900 has an L-shaped cross-section, a box-shaped cross-section, or another shaped cross-section. Any appropriately shaped cross-section can be used as long as it is sufficiently strong to support the drywall or other building sheet that is to be attached to framework 600.

[0058] Framework 600 is only one example of a collapsible framework in accordance with embodiments of the invention. Other examples have a different number of members and/or different shape members and/or a different relative configuration of members. For example, instead of three members 700, 800, 900, Framework 600 can have two members or more than three members. In some embodiments, members 700, 800, 900 can have different relative lengths. In some embodiments, members 700, 800, 900 do not intersect at 90 degree angles. In some embodiments members 700 and 800 intersect at a first angle and members 800 and 900 intersect at a different angle.

[0059] In some embodiments, members 700, 800, 900 can be locked in a particular relative position such that they form a particular included angle relative to each other. For example, framework 600 is locked into a configuration where upper member 700 and middle member 800 form a 90 degree angle, and middle member 800 and lower member 900 form a 270 degree angle. In this example, a locking mechanism includes a first locking member 650, a pin 730 on upper

member 700, and a pin 831 on middle member 800, as well as a second locking member 670, a pin 832 on middle member 800, and a pin 930 on lower member 900. Locking members 650, 670 are rigid material such as metal, plastic or composite. Pins 730, 831, 832, 930 are a shoulder bolt configuration including a head of a diameter A, a large diameter shaft portion adjacent the head and having a diameter B that is less than diameter A, and a small diameter shaft portion adjacent to the large diameter shaft portion and having a diameter C that is less than diameter B. A detailed view of an example of locking member 650, 670 is shown in Figure 8. In this example, locking member 650, 670 has a main body 651 in which a longitudinal slot 657 is located. Longitudinal slot 657 has an enlarged area 655 at each end of slot 657 for receiving pins 730, 831. The width in the transverse direction of longitudinal slot 657 is slightly larger than the small diameter shaft portion of pins 730, 831, 832, 930, but smaller than the large diameter shaft portions of pins 730, 831, 832, 930. In this example, locking members 650, 670 are curved to act as a spring such that the ends of locking members 650, 670 are urged away from members 700, 800, 900. This urging action pushes enlarged areas 655 onto the large diameter shaft portion so that members 700, 800, 900 cannot move relative to each other due to the large diameter shaft portions not being able to pass through longitudinal slot 657. In other examples, enlarged areas 655 are a slight interference fit with the large diameter shaft portions of pins 730, 831, 832, 930 such that a user can force enlarged areas 655 of locking members 650, 670 onto the large diameter shaft portions of pins 730, 831, 832, 930 to lock locking members 650, 670 in a position that prevents relative movement of members 700, 800, 900.

[0060] Figure 7 shows frame 600 in a flat condition that can be used for shipping. Once on the jobsite, frame 600 can be folded to the desired configuration to act as a support for a soffit or other building surface. To provide the deployed configuration shown in Figure 6, upper member 700 is rotated in the direction of Arrow A to a position in which upper member 700 forms a 90 degree angle with middle member 800, and lower member 900 is rotated in the direction of Arrow B to a position in which lower member 900 forms a 270 degree angle with middle member 800.

[0061] The example shown in Figure 6 uses locking members 650, 670 of a given length that result in frame 600 having included angles of 90 degrees and 270 degrees. Using locking members of other lengths results in different angles between members 700, 800, 900.

[0062] Figure 9 shows an example where the frame 600 of Figure 7 is deployed such that upper member 700 forms a 135 degree angle with middle member 800 and middle member 800 forms a

225 degree angle with lower member 900. This configuration is the result of locking member 650 being shorter in the longitudinal direction than the locking member 650 shown in Figure 6, and locking member 670 being longer in the longitudinal direction than the locking member 670 shown in Figure 6.

[0063] Figure 10 shows an example where the frame 600 of Figure 7 is deployed such that upper member 700 forms a 45 degree angle with middle member 800 and middle member 800 forms a 315 degree angle with lower member 900. This configuration is the result of locking member 650 being longer in the longitudinal direction than the locking member 650 shown in Figure 6, and locking member 670 being shorter in the longitudinal direction than the locking member 670 shown in Figure 6.

[0064] Figure 11 shows an example where the frame 600 of Figure 7 is deployed such that upper member 700 forms a 90 degree angle with middle member 800 and middle member 800 forms a 225 degree angle with lower member 900. This configuration is the result of locking member 650 being the same length in the longitudinal direction than the locking member 650 shown in Figure 6, and locking member 670 being longer in the longitudinal direction than the locking member 670 shown in Figure 6.

[0065] Although Figures 6 and 8-11 show various deployed configurations, it is noted that any number of deployed configurations are possible using locking members of different lengths. In addition, fewer or more than three members 700, 800, 900 can be used to form different shaped structures. In some cases, a 180 degree angle can be provided between two adjacent members to for a flat section in the structure.

[0066] Figures 12-14 show another embodiment of the invention that involves collapsible members within a flat panel structure. Figure 12 shows a framework 1000 having two rigid members 1010, 1020. Rigid members 1010, 1020 are attached to each other by two collapsible members, each having a first member 1030 (also referred to as a “first portion”) and a second member 1040 (also referred to as a “second portion”). First member 1030 is pivotably attached to second member 1040 by a pin 1050 (also referred to as a “first pin” 1050). First member 1030 is pivotably attached to rigid member 1010 by a pin 1052 (also referred to as a “second pin” 1052), and second member 1040 is pivotably attached to rigid member 1020 by a pin 1054 (also referred to as a “third pin” 1054).

[0067] Figure 12 is an example of framework 1000 in a collapsed state where the collapsible members are folded so that rigid members 1010 and 1020 are relatively close to each other. This collapsed state can be preferable for transport to the job site. Figure 13 shows framework 1000 is a deployed state where rigid members 1010 and 1020 are at a maximum distance apart. The state shown in Figure 13 is just one of many possible deployed states. For example, a deployed state between that shown in Figure 12 and that shown in Figure 13 can also be used. Further, the state shown in Figure 12 can be a deployed state and a state in which rigid members 1010, 1020 are closer together, or even touching, can be the collapsed state.

[0068] Figure 14 shows an example of two frameworks 1000 installed to form a soffit and fascia in an occupiable space in a building having a wall W, a ceiling C, and a door D in wall W. Ceiling C makes an angle α with wall W at a corner CO. In this case the two frameworks 1000 cover corner CO with a box structure in which the two frameworks 1000 form a 90 degree angle. The two frameworks 1000 can be attached to one another and to wall W and ceiling C using screws, clips, or some other fastener. In other examples, more than two frameworks 1000 are used. In other examples, frameworks 1000 are attached to ceiling C, wall W, and/or each other at angles other than 90 degrees. In other examples, one framework 1000 is fully deployed such that first members 1030 are aligned with second members 1040, and another framework 1000 is partially deployed such that first members 1030 are not aligned with second members 1040.

[0069] While the foregoing description and drawings represent exemplary embodiments of the present disclosure, it will be understood that various additions, modifications and substitutions may be made therein without departing from the spirit and scope and range of equivalents of the accompanying claims. In particular, it will be clear to those skilled in the art that the present invention may be embodied in other forms, structures, arrangements, proportions, sizes, and with other elements, materials, and components, without departing from the spirit or essential characteristics thereof. In addition, numerous variations in the methods/processes described herein may be made within the scope of the present disclosure. One skilled in the art will further appreciate that the embodiments may be used with many modifications of structure, arrangement, proportions, sizes, materials, and components and otherwise, used in the practice of the disclosure, which are particularly adapted to specific environments and operative requirements without departing from the principles described herein. The presently disclosed embodiments are therefore to be considered in all respects as illustrative and not restrictive. The appended claims should be

construed broadly, to include other variants and embodiments of the disclosure, which may be made by those skilled in the art without departing from the scope and range of equivalents. In addition, all combinations of any and all of the features described in the disclosure, in any combination, are part of the invention.

CLAIMS

What is claimed is:

1. A collapsible structural frame configured to provide a structure to which building material sheets are attached to form a surface, the frame comprising:

a first frame portion that corresponds to a first portion of the surface and is configured to receive a first sheet of the building material;

a second frame portion that corresponds to a second portion of the surface and is configured to receive a second sheet of the building material;

a first pivoting mechanism that attaches the second frame portion to the first frame portion and has a first pivoting axis, the first pivoting mechanism permitting the second frame portion to rotate about the first pivoting axis relative to the first frame portion, and the first pivoting mechanism permitting the second frame portion to rotate about the first pivoting axis from an undeployed state to a deployed state; and

a first locking mechanism that fixes a relative position of the first frame portion and the second frame portion in the deployed state,

wherein the undeployed state is a folded state compared to the deployed state.

2. The collapsible structure frame according to claim 1, wherein the first frame portion comprises a first longitudinal member and a second longitudinal member, the first longitudinal member arranged orthogonal to the second longitudinal member

3. The collapsible structure frame according to claim 2, wherein the first longitudinal member has a T-shaped cross-section.

4. The collapsible structure frame according to claim 3, wherein the T-shaped cross-section comprises a bottom flange that forms part of the first portion of the surface.

5. The collapsible structure frame according to any one of claims 2 to 4, wherein the second longitudinal member has an L-shaped cross-section.

6. The collapsible structure frame according to claim 5, wherein the L-shaped cross-section forms part of the second portion of the surface.
7. The collapsible structure frame according to any one of claims 2 to 6, wherein the second longitudinal member of the first frame portion extends along a direction that is substantially parallel to the first pivoting axis.
8. The collapsible structure frame according to any one of claims 2 to 7, wherein the second frame portion comprises a third longitudinal member and a fourth longitudinal member, the third longitudinal member arranged orthogonal to the fourth longitudinal member
9. The collapsible structure frame according to claim 8, wherein the third longitudinal member has a T-shaped cross-section.
10. The collapsible structure frame according to claim 9, wherein the T-shaped cross-section comprises a bottom flange that forms part of the second portion of the surface.
11. The collapsible structure frame according to any one of claims 8 to 10, wherein the fourth longitudinal member has an L-shaped cross-section.
12. The collapsible structure frame according to claim 11, wherein the L-shaped cross-section forms part of the second portion of the surface.
13. The collapsible structure frame according to any one of claims 8 to 12, wherein the fourth longitudinal member of the first frame portion extends along a direction that is substantially parallel to the first pivoting axis.
14. The collapsible structure frame according to any one of claims 1 to 13, further comprising:
 - a third frame portion that corresponds to a third portion of the surface and is configured to receive a third sheet of the building material;

a second pivoting mechanism that attaches the third frame portion to the second frame portion and has a second pivoting axis, the second pivoting mechanism permitting the second frame portion to rotate about the second pivoting axis relative to the third frame portion, and the second pivoting mechanism permitting the second frame portion to rotate about the second pivoting axis from an undeployed state to a deployed state; and

15. The collapsible structure frame according to claim 14, further comprising a second locking mechanism that fixes a relative position of the second frame portion and the third frame portion in the deployed state.

16. The collapsible structure frame according to any one of claims 14 to 15, wherein the third frame portion comprises a fifth longitudinal member having a T-shaped cross-section.

17. The collapsible structure frame according to claim 16, wherein the T-shaped cross-section comprises a bottom flange that forms part of the third portion of the surface.

18. The collapsible structure frame according to any one of claims 14 to 17, wherein the fifth longitudinal member of the third frame portion extends along a direction that is substantially orthogonal to the second pivoting axis.

19. A building system comprising the collapsible structure frame according to any one of claims 1-18 in the deployed state.

20. The building system according to claim 19, wherein a first sheet of building material is coupled to the first portion of the surface formed by the first frame portion.

21. The building system according to any one of claims 19 to 20, wherein a second sheet of building material is coupled to the second portion of the surface formed by the second frame portion.

22. The building system according to any one of claims 19 to 21, wherein a third sheet of building material is coupled to the third portion of the surface formed by the third frame portion.

23. The building system according to any one of claims 20-22, wherein the first sheet of building material and the second sheet of building material are not parallel.

24. A collapsible structural soffit frame to which a building material sheet is attached to form a soffit surface, the frame comprising:

- a first rigid member;

- a second rigid member;

- a first collapsible member that connects the first rigid member to the second rigid member, the first collapsible member having a collapsed position and a deployed position;
- and

- a second collapsible member that connects the first rigid member to the second rigid member, the second collapsible member having a collapsed position and a deployed position,

- wherein in the deployed position of both the first and second collapsible members the first and second collapsible members are structural members configured to support the building material sheet.

25. The collapsible structural soffit frame according to claim 24, wherein the first collapsible member comprises a first portion and a second portion, the first portion of the first collapsible member pivotably coupled to the second portion of the first collapsible member by a first pin of the first collapsible member.

26. The collapsible structural soffit frame according to claim 25, wherein the first portion of the first collapsible member is pivotable coupled to the first rigid member by a second pin of the first collapsible member and the second portion of the first collapsible member is pivotable coupled to the second rigid member by a third pin of the first collapsible member.

27. The collapsible structural soffit frame according to any one of claims 25 to 26, wherein in the deployed position, the first and second portions of the first collapsible member are parallel.

28. The collapsible structure frame according to any one of claims 24 to 27, wherein the first and second portions of the first collapsible member have an L-shaped cross-section.

29. The collapsible structural soffit frame according to any one of claims 24 to 28, wherein the second collapsible member comprises a first portion and a second portion, the first portion of the second collapsible member pivotably coupled to the second portion of the second collapsible member by a first pin of the second collapsible member.

30. The collapsible structural soffit frame according to claim 29, wherein the first portion of the second collapsible member is pivotable coupled to the first rigid member by a second pin of the second collapsible member and the second portion of the second collapsible member is pivotable coupled to the second rigid member by a third pin of the second collapsible member.

31. The collapsible structural soffit frame according to any one of claims 29 to 30, wherein in the deployed position, the first and second portions of the second collapsible member are parallel.

32. The collapsible structure frame according to any one of claims 29 to 31, wherein the first and second portions of the second collapsible member have an L-shaped cross-section.

33. The collapsible structure frame according to any one of claims 24 to 32, wherein the first rigid member has an L-shaped cross-section.

34. The collapsible structure frame according to any one of claims 24 to 33, wherein the second rigid member has an L-shaped cross-section.

35. A collapsible structural frame configured to provide a soffit structure to which building material sheets are attached to form a first soffit surface and a second soffit surface, the frame comprising:

a first frame portion that corresponds to the first soffit surface and is configured to receive a first sheet of the building material;

a second frame portion that corresponds to the second soffit surface and is configured to receive a second sheet of the building material;

a pivoting mechanism that attaches the second frame portion to the first frame portion and has a pivoting axis, the pivoting mechanism permitting the second frame portion to rotate about the pivoting axis relative to the first frame portion, and the pivoting mechanism permitting the second frame portion to rotate about the pivoting axis from an undeployed state to a deployed state; and

a locking mechanism that fixes a relative position of the first frame portion and the second frame portion in the deployed state at a deployed angle,

wherein the undeployed state is a folded state compared to the deployed state, and the deployed angle is more than 0 degrees and less than 180 degrees.

36. A building system comprising the soffit structure according to any one of claims 24-35 in the deployed state.

37. The building system according to claim 36, wherein a first sheet of building material is coupled to the first portion of the surface formed by the first frame portion.

38. The building system according to any one of claims 36 to 37, wherein a second sheet of building material is coupled to the second portion of the surface formed by the second frame portion.

39. The building system according to any one of claims 36 to 38, wherein a third sheet of building material is coupled to the third portion of the surface formed by the third frame portion.

40. The building system according to any one of claims 36 to 39, wherein the first sheet of building material and the second sheet of building material are not parallel.

41. A method of installing a soffit comprising

- a) providing a collapsible structural frame in a folded state, the collapsible structural frame configured to provide a structure to which building material sheets are attached to form a surface;
- b) converting the collapsible structural frame from the folded state to a deployed state and fastening the collapsible structural frame to a preexisting support; and
- c) fastening at least a sheet of building material to the surface of the collapsible structural frame.

42. The method according to claim 41, wherein step c) comprises fastening a first sheet of building material to a first frame portion of the collapsible structural frame and fastening a second sheet of building material to a second frame portion of the collapsible structural frame, whereby the first and second sheets of building material are not parallel.

43. The method according to any one of claims 41 to 42, wherein a fastener locks the collapsible structural frame into the deployed state.

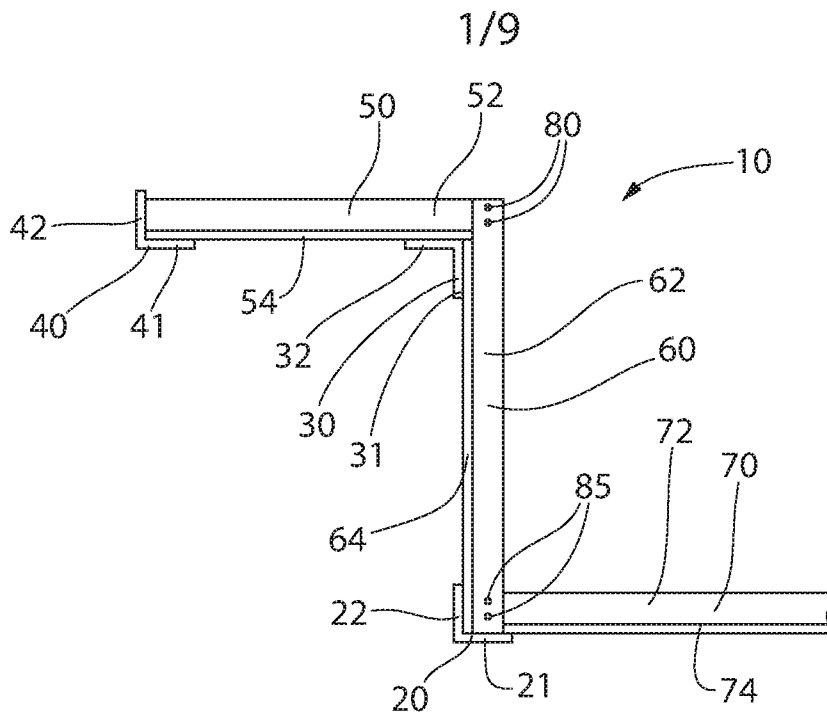


FIG. 1

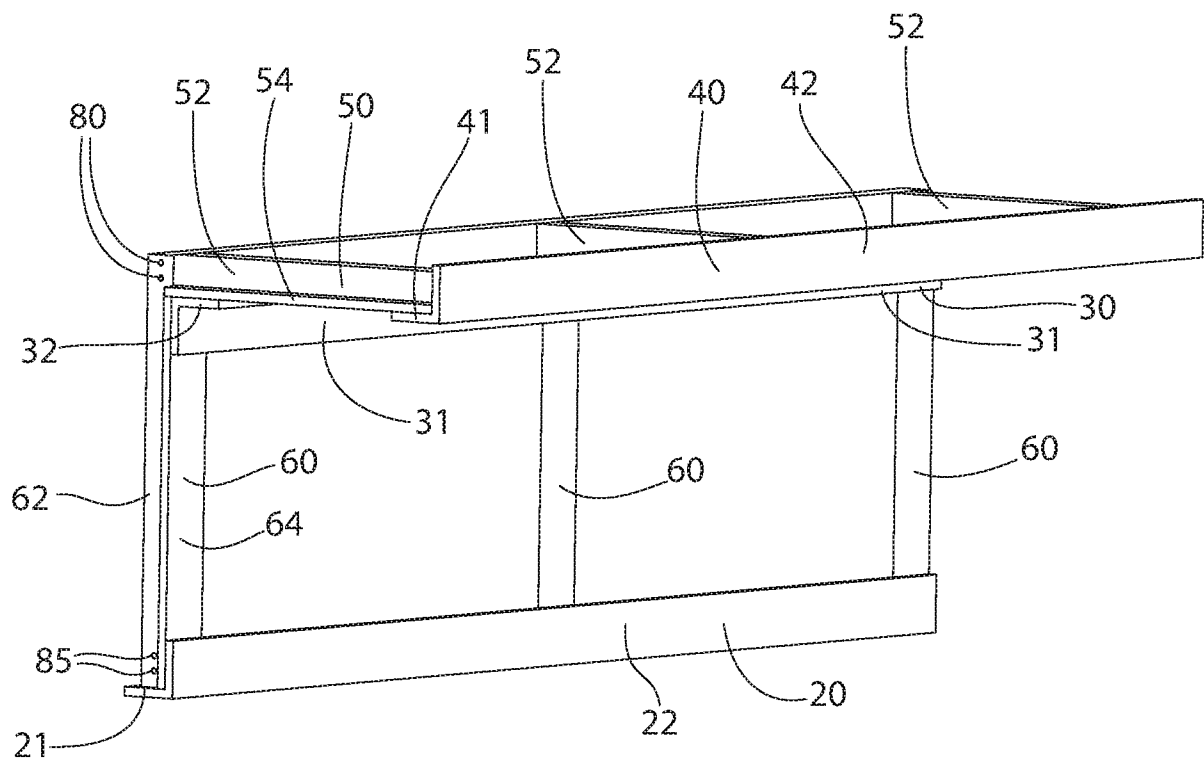


FIG. 2

2/9

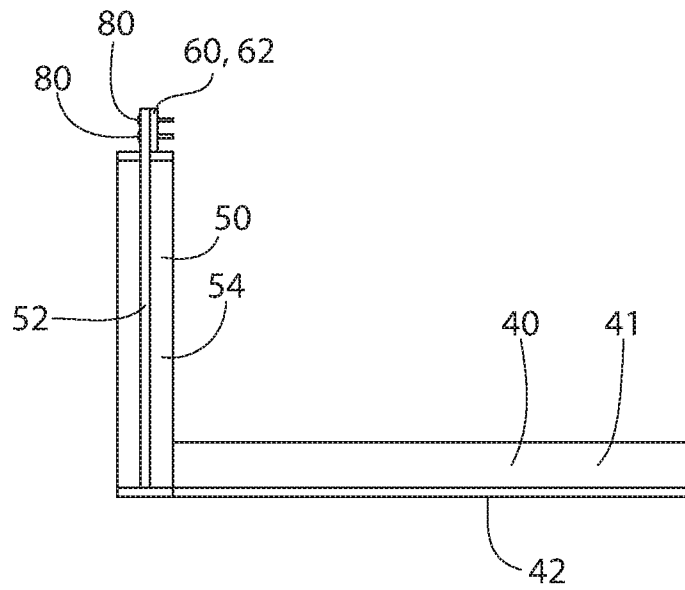


FIG. 3

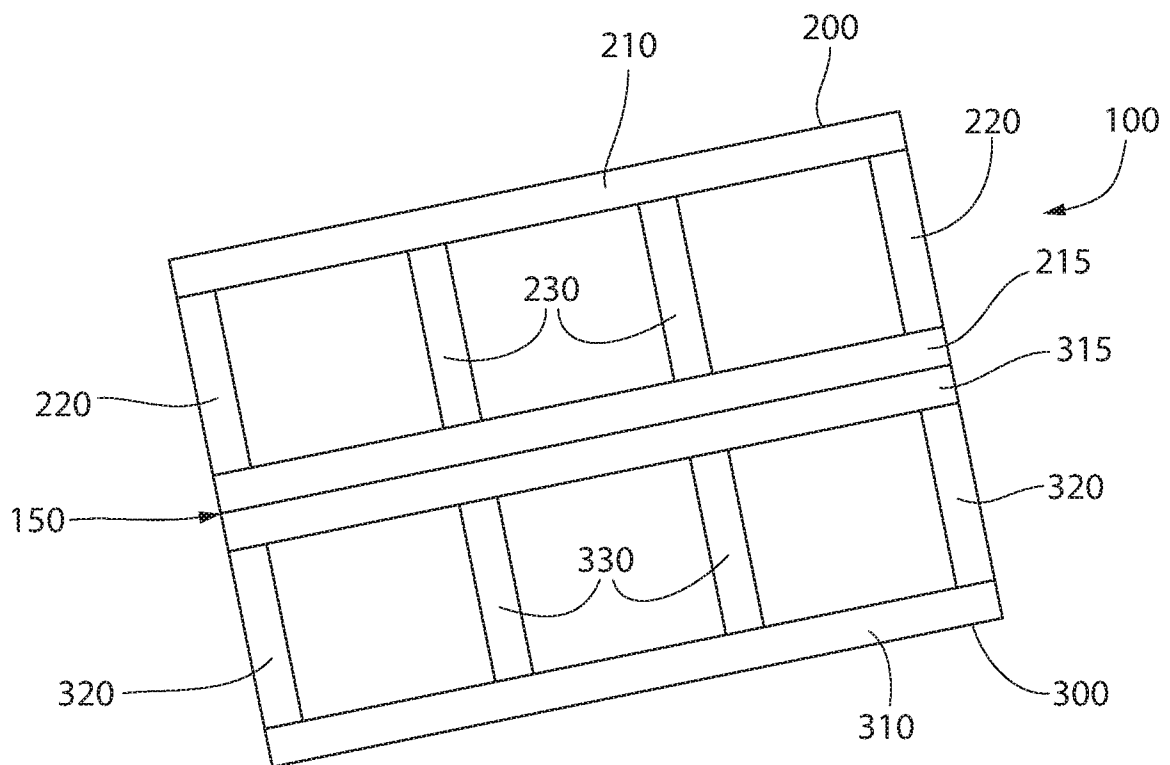


FIG. 4

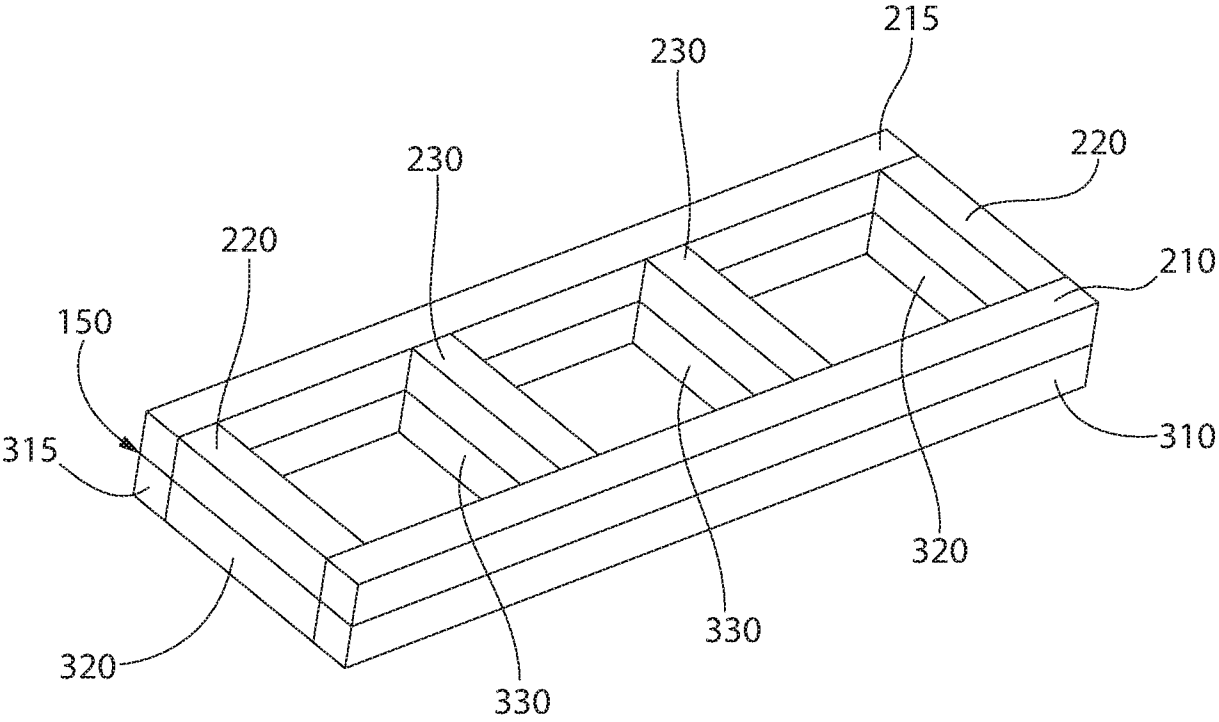


FIG. 5

4/9

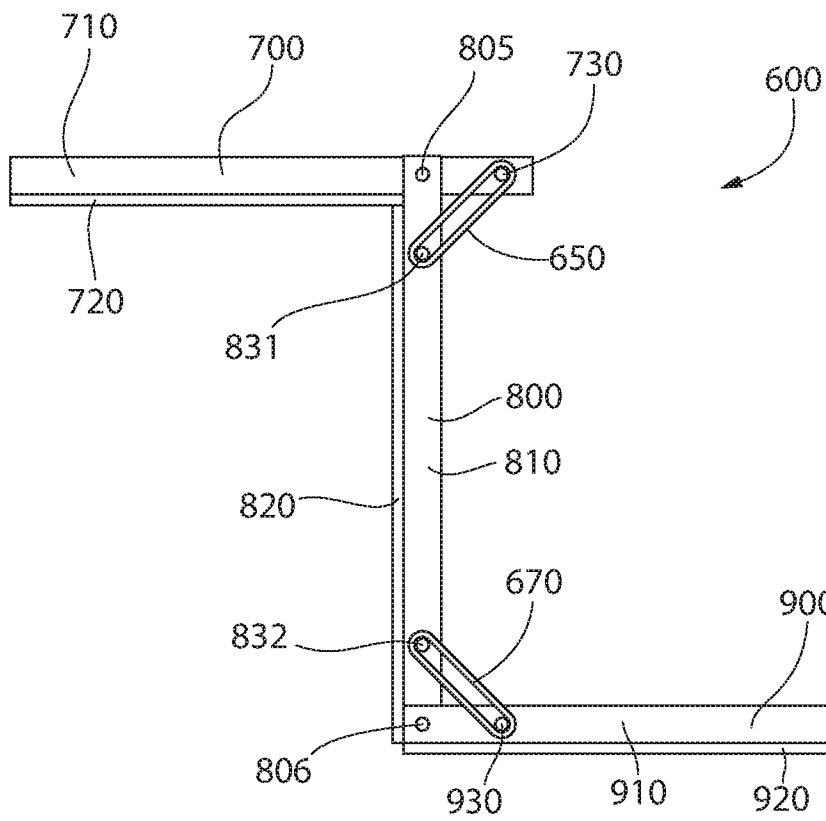


FIG. 6

5/9

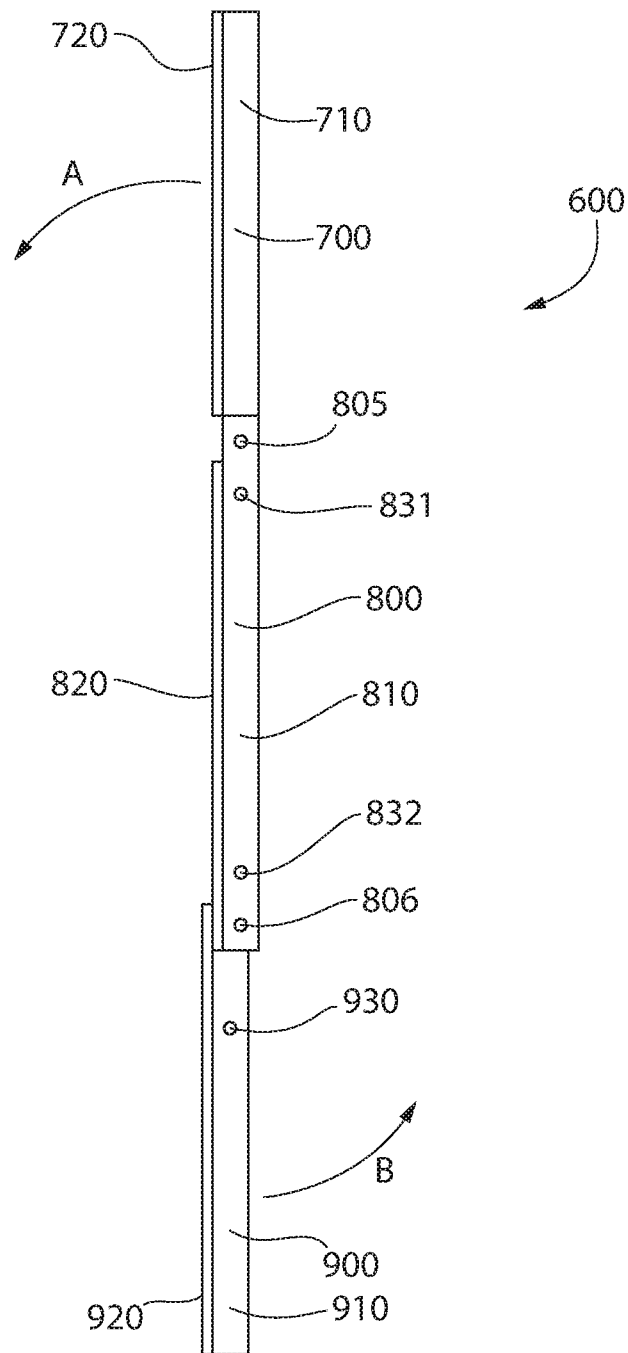


FIG. 7

6/9

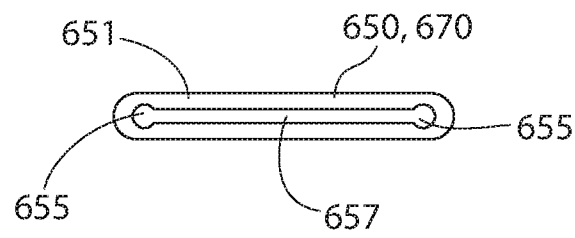


FIG. 8

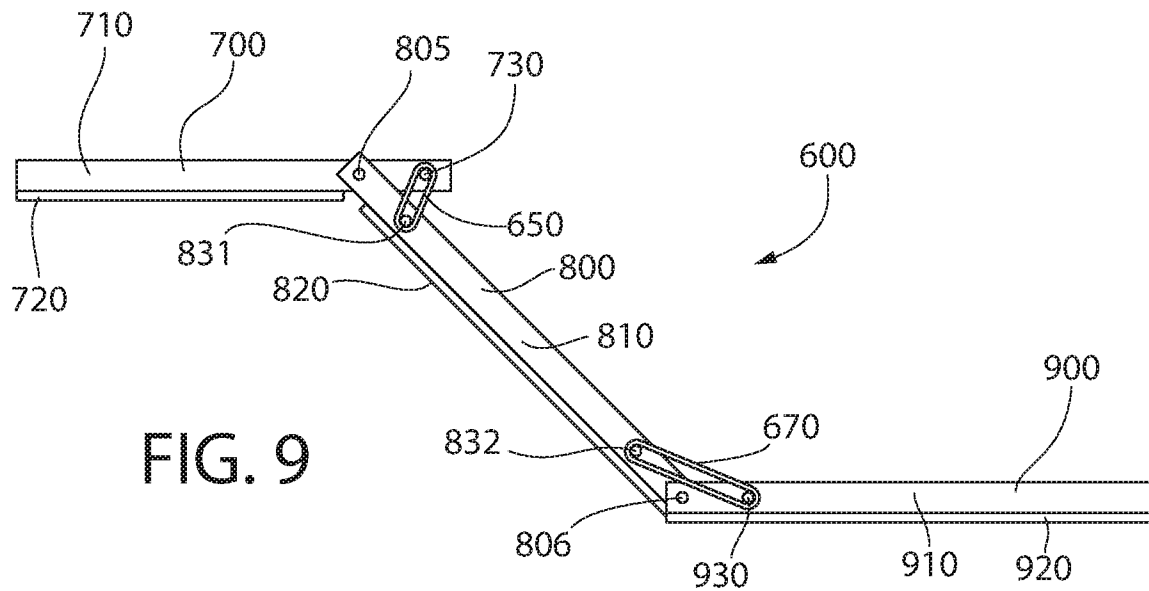


FIG. 9

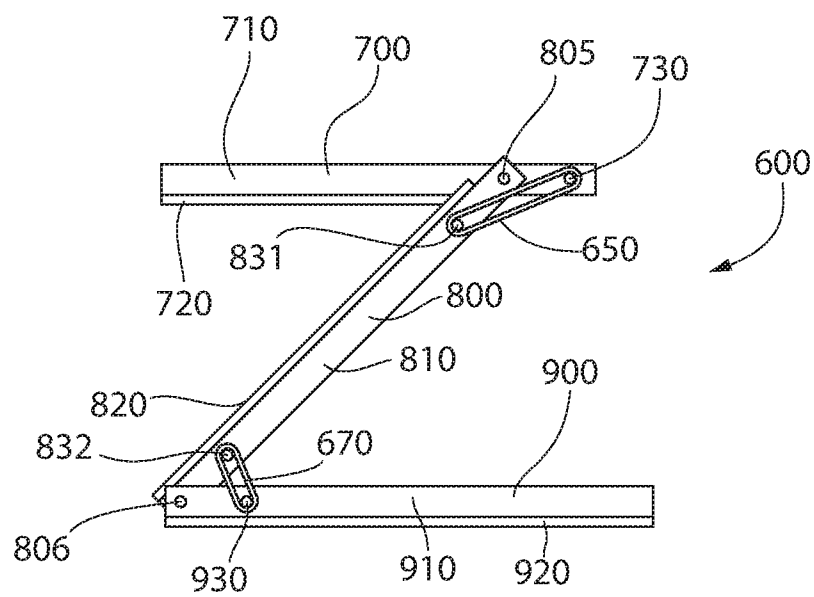


FIG. 10

7/9

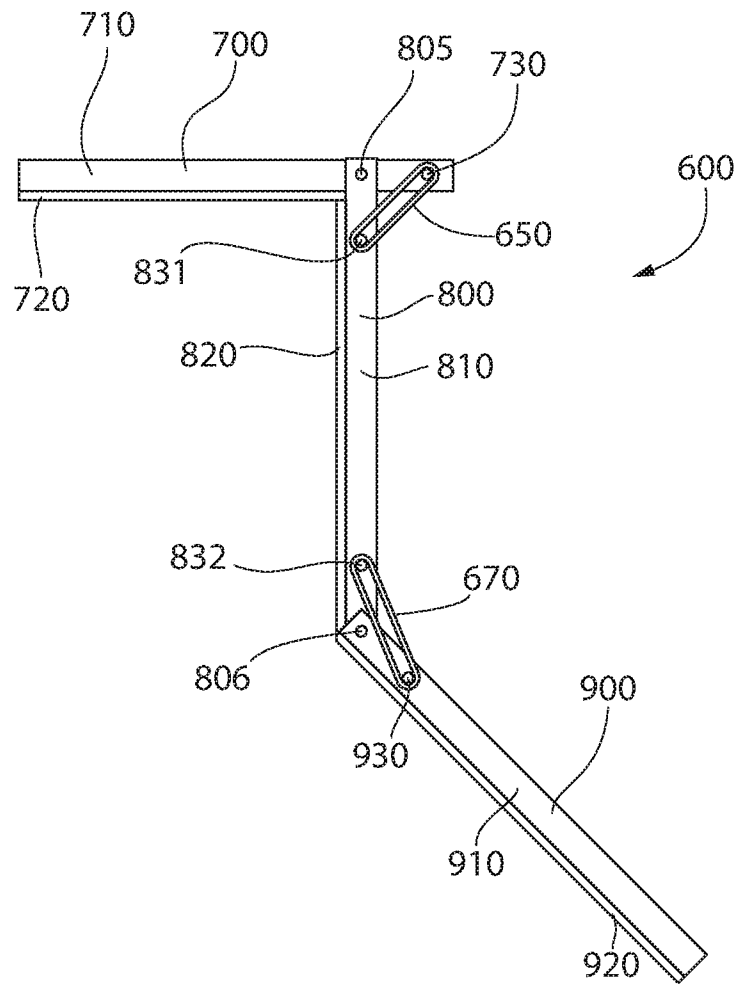


FIG. 11

8/9

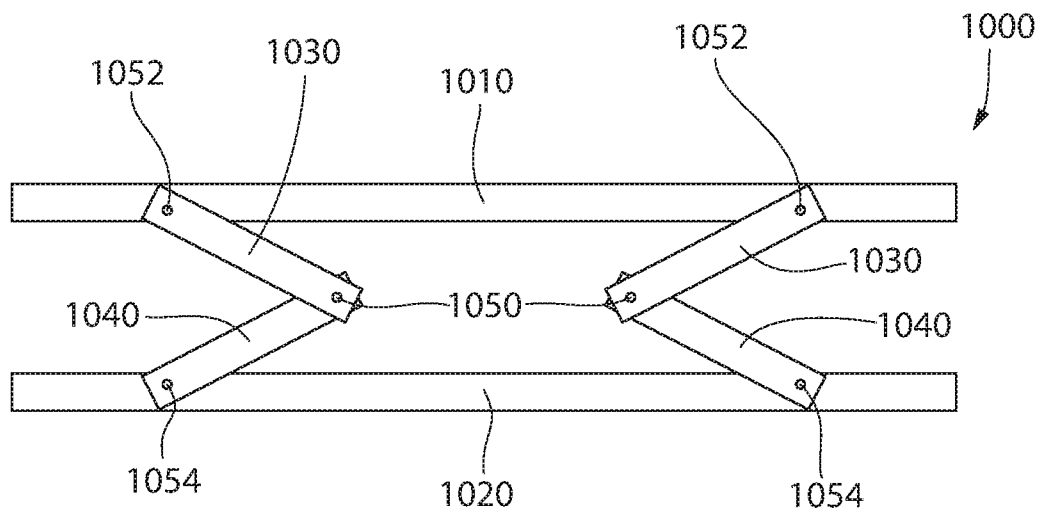


FIG. 12

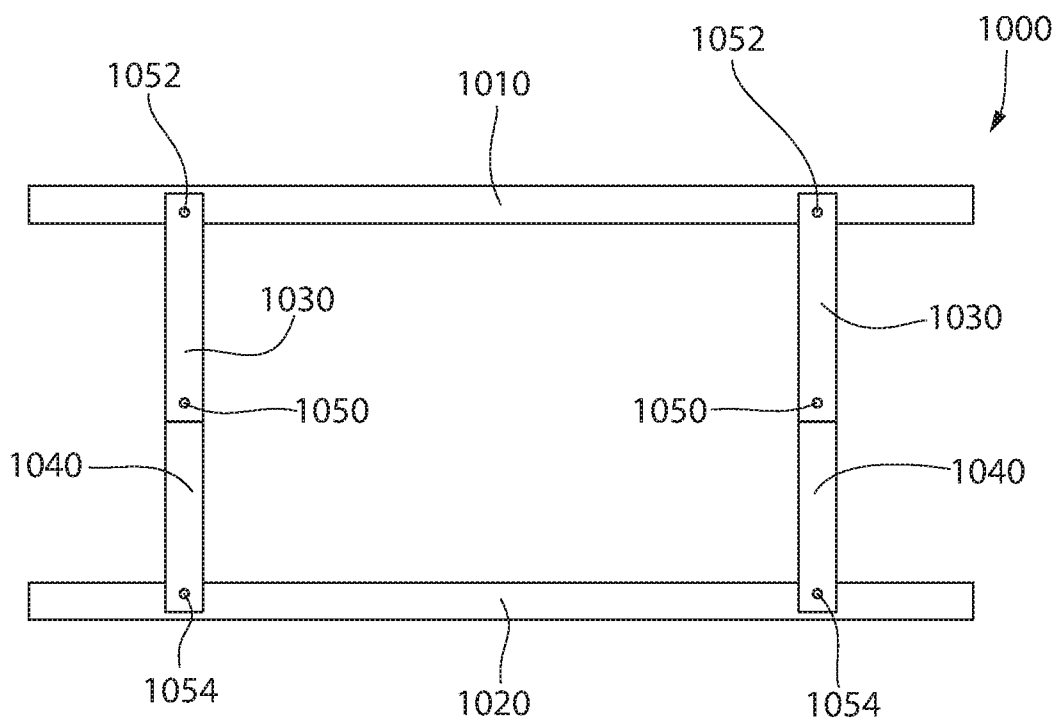


FIG. 13

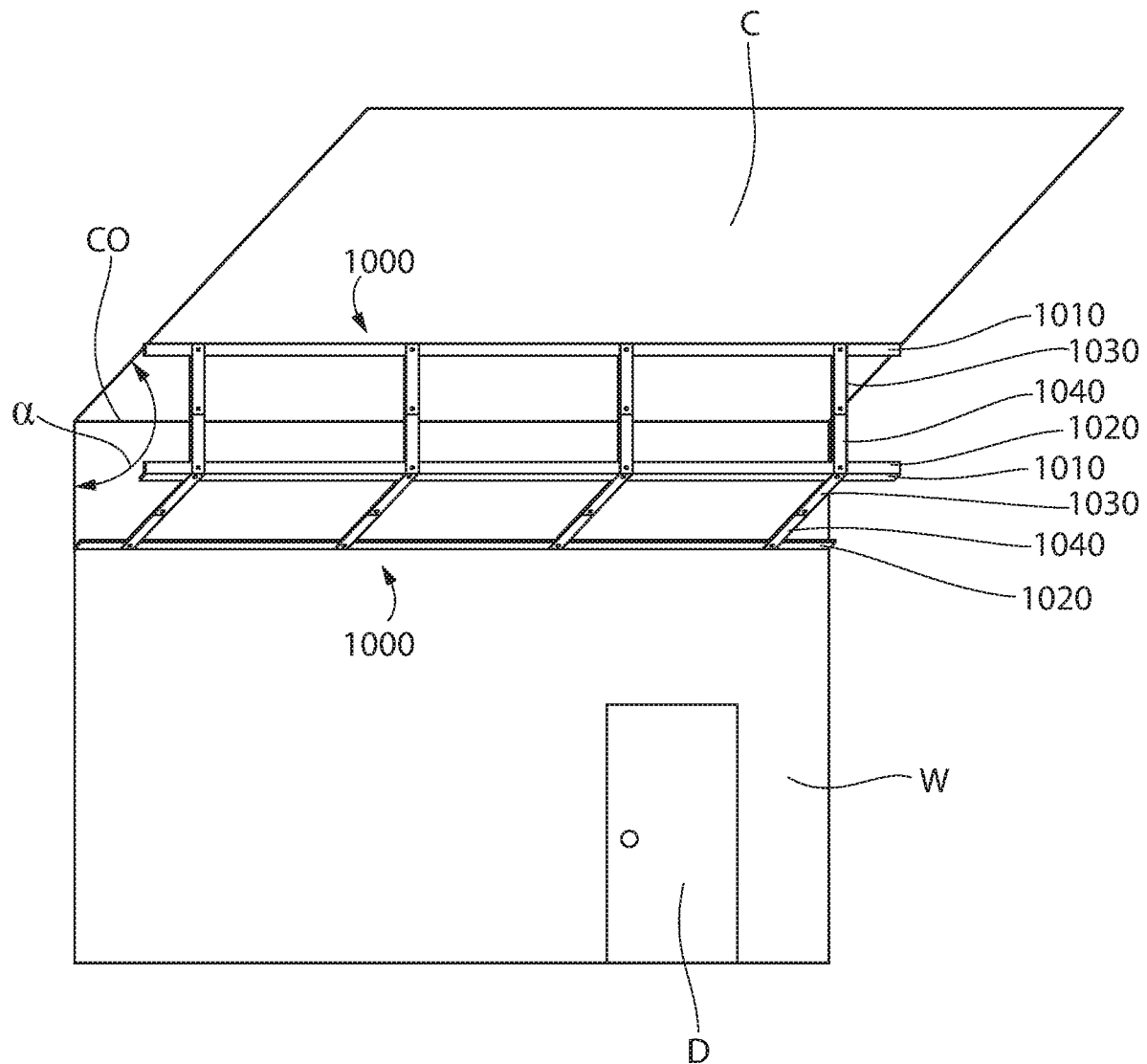


FIG. 14

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2019/049020**A. CLASSIFICATION OF SUBJECT MATTER****E04B 1/343(2006.01)i, E04B 1/344(2006.01)i**

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

E04B 1/343; E04B 1/19; E04B 1/344; E04B 7/02; E04G 21/28

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS(KIPO internal) & Keywords: collapsible, frame, pivoting mechanism, soffit, deployed state

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 05-321386 A (MISAWA HOMES CO., LTD.) 07 December 1993 paragraphs [0010]-[0013] and figures 1-3	1-23,35-43
Y		24-34
Y	JP 2834060 B2 (NIMURA, YUJI) 09 December 1998 paragraphs [0009]-[0012] and figures 2, 5-6	24-34
A	US 2012-0279142 A1 (MICHAUD, DENNIS R.) 08 November 2012 paragraphs [0070]-[0071] and figures 10-11	1-43
A	US 2014-0157714 A1 (SHIFT STRATEGY + DESIGN INC.) 12 June 2014 claim 1 and figures 1A-4C	1-43
A	JP 08-260608 A (MISAWA HOMES CO., LTD.) 08 October 1996 claims 1-3 and figures 1-4	1-43



Further documents are listed in the continuation of Box C.



See patent family annex.

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"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

Date of the actual completion of the international search

02 January 2020 (02.01.2020)

Date of mailing of the international search report

02 January 2020 (02.01.2020)

Name and mailing address of the ISA/KR

International Application Division

Korean Intellectual Property Office

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2019/049020

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