United States Patent [19]

Powell

[11] **3,811,235**

[45] **May 21, 1974**

[54] **PREFABRICATED MULTI-STORY STRUCTURE**

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[22] Filed: **Jan. 26, 1971**

[21] Appl. No.: **109,836**

[52] **U.S. Cl.** **52/69**

[51] **Int. Cl.**..... **E04b 1/344,** E04b 1/348, E04b 1/36

[58] **Field of Search** ..... 52/69, 64, 71, 66, 52/639, 640, 641, 642; 296/23 G, 23 F, 23 R, 27; 217/15

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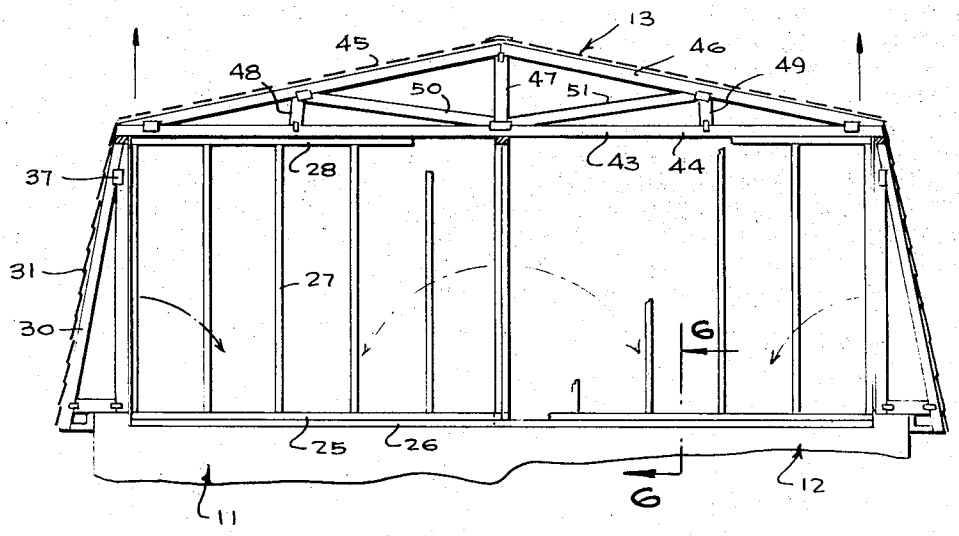
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Attorney—Mason, Fenwick & Lawrence

[57] **ABSTRACT**

A prefabricated building structure generally consisting of at least two modular units rigidly secured together to provide an integral structure, each of the modular units including a permanently constructed lower story section, and a collapsible upper story section mounted on the lower story section, the upper story section including at least one interior junction wall hingedly connected to the lower story section and movable between an inoperative, substantially horizontally disposed position, and an operative, substantially vertically disposed position, in abutting relation with an interior junction wall of the upper story section of the other modular unit, disposed in its operative position, and exterior walls hingedly connected to the lower story section and movable between inoperative, substantially horizontally disposed positions, and operative, substantially vertically disposed positions, and a roof section mounted on the upper story sections when the interior and exterior wall thereof are disposed in their operative positions.

1 Claim, 6 Drawing Figures



PATENTED MAY 21 1974 3,811,235

SHEET 1 OF 2

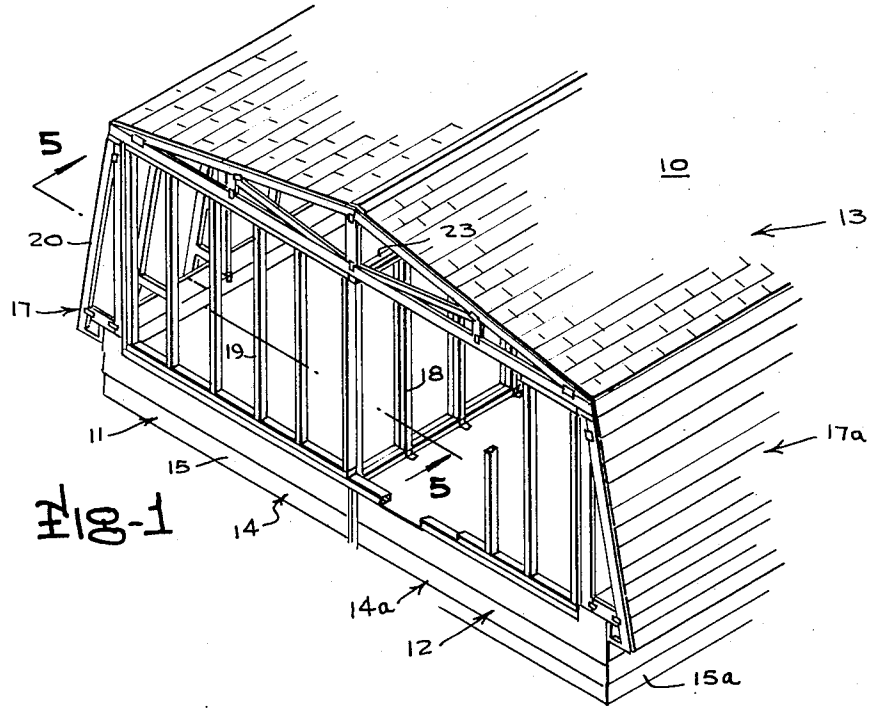


Fig-1

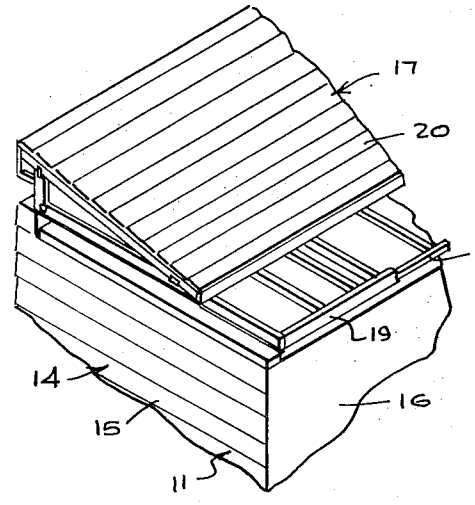
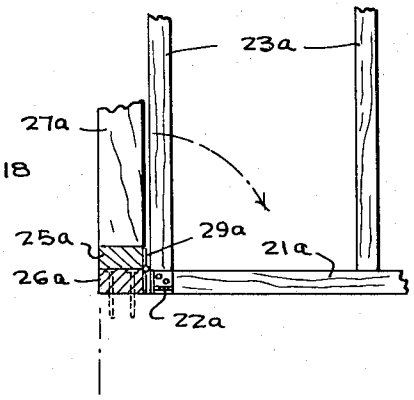


Fig-2

Fig-6

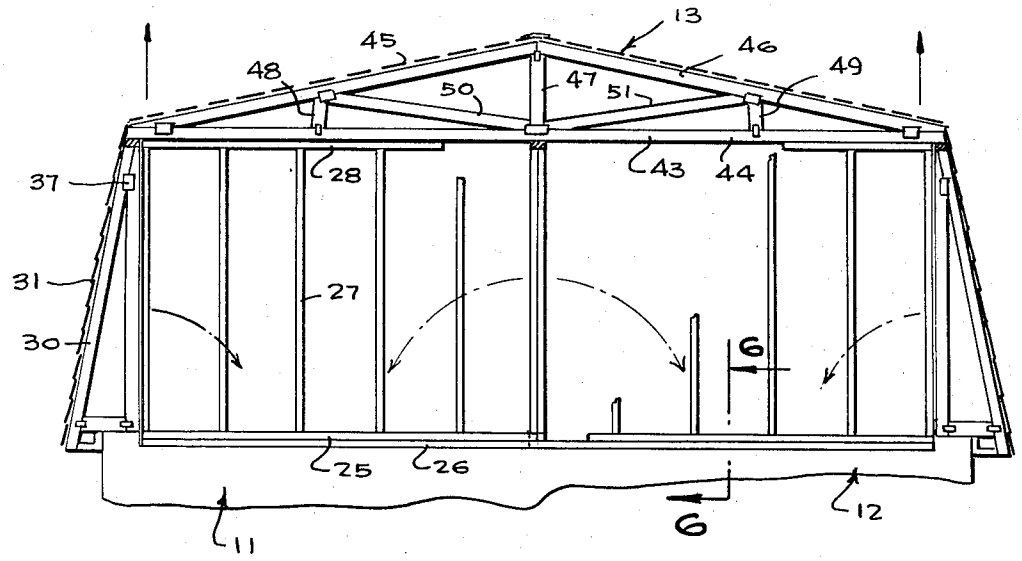


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Fig-3



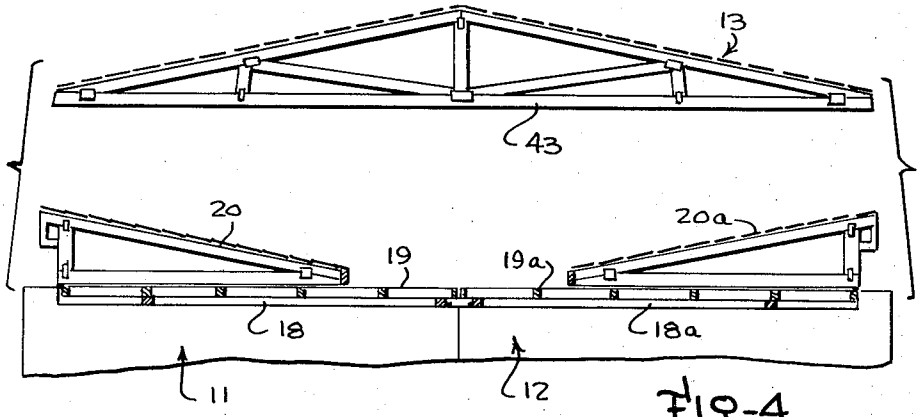


Fig-4

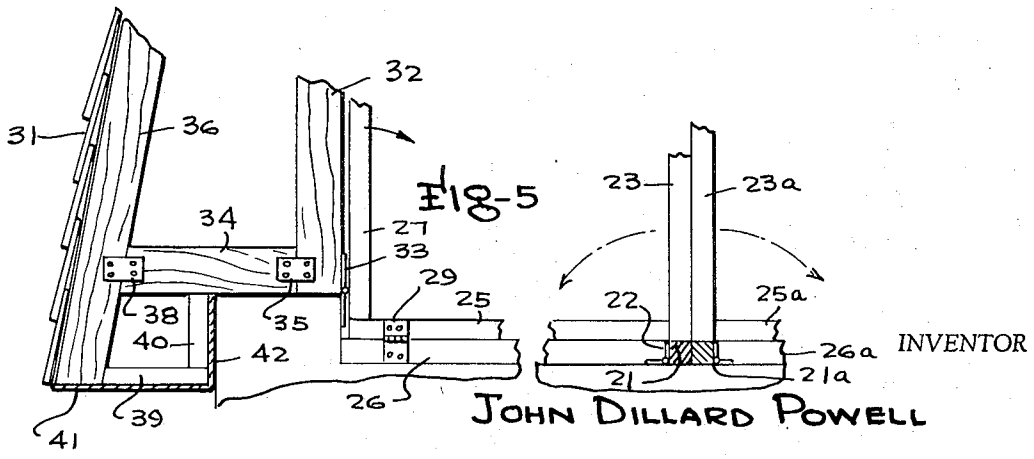


Fig-5

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PREFABRICATED MULTI-STORY STRUCTURE

This invention relates to a prefabricated building structure, and more particularly to a prefabricated two story building structure consisting of two or more modular units which are adapted to be fabricated at a manufacturing site, transported to a remote erection site, transferred onto a foundation and positioned in side-by-side relation, secured together and provided with a roof system, to provide a two story building structure ready for occupancy upon connection of the various utility lines. The invention further contemplates a novel two story modular unit which may be collapsed to reduce its height thereby facilitating its transportation from a manufacturing site to a final erection site.

In the building construction industry, there has been developed and extensively used, a technique for constructing building structures which consists of fabricating modular building units at a manufacturing site, hauling such units on vehicles to remote erection sites, transferring the units from the hauling vehicles onto a foundation at the erection site, securing the units together to form an integral building structure, and then connecting the electrical, water and sewage lines of the structure to appropriate utility lines. The use of such technique has enabled the employment of mass production methods in the fabrication of building structures, thus providing increased economy, improved product quality and reduced construction time.

Since prefabricated modular units must be transported over public highways from a manufacturing site to remote erection sites, one of the principal limiting factors in the design of such structures has been the restrictions on the size of the component modular units, either imposed by municipal, county or state governments, or dictated by highway conditions such as road and tunnel widths, clearance heights of underpasses and the like. Generally, municipal, county and state governments have enacted traffic regulations restricting the height, width and length of any unit transported over public highways.

The height limitations imposed by statute, has had the effect of limiting the prefabricated building industry to the manufacture and sale of single story structures, except in those instances where single story modular units are arranged in stacked relation to provide a multi-story structure. The practice of stacking one story modular units, however, has been found not to be entirely satisfactory in that additional costs are incurred in the additional handling required in transporting the modular units from the manufacturing site to the final erection site, and in transferring the additional units from their hauling vehicles onto other single story units.

Accordingly, it is the principal object of the present invention to provide a novel prefabricated building structure.

Another object of the present invention is to provide a novel prefabricated building structure consisting of two or more prefabricated modular units secured together to form an integral building structure.

A further object of the present invention is to provide a novel prefabricated multi-story building structure consisting of two or more prefabricated modular units secured together in side-by-side relation to form an integral multi-story building structure.

A still further object of the present invention is to provide a novel prefabricated multi-story building structure consisting of two or more modular units which may be fabricated at a manufacturing site, and transported to a remote erection site and secured together, to form an integral building structure.

Another object of the present invention is to provide a novel prefabricated multi-story building structure consisting of two or more multi-story modular units fabricated at a manufacturing site and transferred to a remote erection site to be secured together to form an integral multi-story building structure, wherein the modular units are provided with widths, lengths and heights which fall within permissible dimensional limitations imposed by municipal, county and state governments with respect to the size of objects hauled over the public highways.

A further object of the present invention is to provide a novel prefabricated, multi-story modular unit.

A still further object of the present invention is to provide a novel multi-story modular unit which may be fabricated at a manufacturing site utilizing mass production methods and techniques, and transported to a final erection site and secured to one or more similar units on a foundation, to provide an integral multi-story structure.

Another object of the present invention is to provide a novel prefabricated modular unit having a permanent lower story and a collapsible upper story which may be collapsed to reduce the height of the unit for transportation over public highways, which may be assembled in an upright position, secured to a similar upper story section of a similar modular unit, and provided with a roof system, to provide an integral two story building structure.

A further object of the present invention is to provide a novel prefabricated modular unit having a permanent lower story section and an upper collapsible section, which is simple in construction, comparatively inexpensive to manufacture, and readily adapted to be moved to a final building site as a component of an integral two story building structure.

Other objects and advantages of the present invention will become more apparent to those persons having ordinary skill in the art to which the invention pertains, from the following description, taken in conjunction with the accompanying drawings, wherein:

FIG. 1 is a perspective view of an embodiment of the invention, having portions thereof broken away;

FIG. 2 is a perspective view of a modular unit forming a part of the embodiment shown in FIG. 1, illustrating an upper story section disposed in a collapsed or inoperative position;

FIG. 3 is an enlarged, vertical cross-sectional view of the embodiment illustrated in FIG. 1;

FIG. 4 is a view similar to the view shown in FIG. 3, illustrating the upper story sections of the embodiment in their collapsed or inoperative positions, and the roof section in exploded relation;

FIG. 5 is an enlarged cross-sectional view taken along line 5,5 in FIG. 1; and

FIG. 6 is an enlarged cross-sectional view taken along line 6,6 in FIG. 3.

Briefly described, the present invention relates to a prefabricated multi-story building structure generally consisting of at least two modular units rigidly secured together to provide an integral structure, each of the

modular units including a permanently constructed lower story section, and a collapsible upper story section mounted on the lower story section, the upper story section having at least one interior junction wall hingedly connected to the lower story section and movable between an inoperative, substantially horizontally disposed position, and an operative, substantially vertically disposed position, in abutting relation with an interior junction wall of the upper story section of the other modular unit, disposed in its operative position, and exterior walls hingedly connected to the lower story section and movable between inoperative, substantially horizontally disposed positions and operative, substantially vertically disposed positions, and a roof section mounted on the upper story sections when the interior and exterior walls thereof are disposed in their operative positions.

In the preferred embodiment of the invention, the hinge axes of the interior and exterior walls lie at different levels to permit the walls to lie substantially horizontally in overlapping relation when the walls are disposed in their inoperative positions, the interior walls consist of frame assemblies having interior finishes applied thereon, the exterior walls consist of frame assemblies having interior and exterior finishes applied thereon, and the roof section consists of a plurality of transversely disposed, longitudinally spaced trusses seated on the exterior and interior walls, and roofing applied to the trusses.

Referring to the drawings, there is illustrated an embodiment of the invention. The embodiment consists of a prefabricated building structure **10** formed from a pair of substantially similar modular units **11** and **12** disposed in side-by-side relation, and a roof unit **13** mounted on the modular units **11** and **12**, rigidly secured together to form an integral two story building structure. The modular unit **11** consists of a lower story section **14** provided with a conventional floor system, a plurality of exterior walls **15** mounted on the floor system, and an interior junction wall **16**, and an upper story section **17** which is connected to the upper end of the lower story section **14**. Similarly, the modular unit **12** consists of a lower story section **14a** provided with exterior walls **15a** and an interior junction wall (not shown) engageable with the interior junction wall **16** of modular unit **11**, and an upper story section **17a**.

The upper story section **17** includes a longitudinally disposed, interior junction wall **18**, a pair of transversely disposed, longitudinally spaced exterior end walls **19,19** and a longitudinally disposed, exterior side wall **20** which is spaced from the interior junction wall **18**. The interior wall **18** consists of a frame assembly including a longitudinally disposed bottom plate **21** hingedly connected to the upper inner edge of lower story section **14**, by means of strap hinges **22**, studing **23** and a top plate **23**, and an interior finish applied to the frame assembly, which is not shown. The interior finish applied to the inner side of the frame assembly for interior wall **18**, can be of any conventional type including rock sheet, wood panelling and the like. The hinged connection of the interior wall **18** permits the wall to be pivoted downwardly into an inoperative position, resting on the upper end of lower story section **14**, as illustrated in FIGS. **2** and **4**, and swung upwardly to an operative, upright position, as illustrated in FIGS. **1**, **3** and **5**.

The exterior end walls **19** are substantially similar in construction, each consisting of a frame assembly including a transversely disposed bottom plate **25** hingedly connected to a support plate **26** mounted on an upper end of the lower story section **14**, studing **27** secured to the lower plate **25** and a top plate **28** secured to the upper ends of the studing **27**, an interior finish applied to the inner side of the frame assembly, an exterior finish applied to the outer side of the frame assembly and insulation disposed within the frame assembly between the studing. The exterior and interior finishes and the insulation applied to the frame assembly for the exterior end wall **19** is not shown in order to more clearly illustrate the construction of the frame assembly. It is to be understood, however, that the interior finish may be of any conventional type including sheet rock, wood panelling and the like, the exterior finish may be of any conventional type including wood or aluminum siding, wood or snythetic panelling, and the like, and the insulation can be of any suitable type. It is contemplated that the exterior finish, however, would most likely include sheathing applied to the frame assembly, a layer of weatherproofing material applied to the sheathing, and wood siding applied to the felt material and nailed to the sheathing and frame assembly.

The bottom plate **25** is hingedly connected to the support plate **26** by means of strap hinges **29**. The hinge connections of the exterior end walls **19,19** permit the walls to be swung downwardly into inoperative positions resting on the interior wall **18**, when the interior wall is resting on the upper end of the lower story section **14**, as illustrated in FIGS. **2** and **4**, and swung upwardly into an operative, upright position, with the bottom plates **25** seated on the support plates **26**, as illustrated in FIGS. **1**, **3**, **5** and **6**. As best illustrated in FIGS. **5** and **6**, the axes of strap hinges **29** lie at a level above the level of the axis of strap hinges **22**, so that when the interior wall **23** is swung downwardly into its inoperative position resting on the upper end of the lower story section **14**, the exterior end walls **19** may be swung downwardly into their inoperative positions, resting on the interior wall **18** thereby permitting the exterior end walls **19** to lie horizontally, without being obstructed by the interior wall **18**.

The exterior wall **20** consists of a frame assembly provided with a plurality of transversely disposed, longitudinally spaced sections **30**, an interior finish (not shown) applied to the inner side of the frame assembly, and an exterior finish **31** applied to the outer side of the frame assembly. Each of the frame sections **30** includes a vertical frame member **32** hingedly connected to a longitudinally disposed, raised section of the lower story section **15**, by means of strap hinges **33**, a laterally projecting, bottom frame member **34** secured to the lower end of frame member **32**, by means of nail plates **35**, a laterally inclined frame member **36** interconnecting the ends and secured to the frame members **32** and **34**, by means of nail plates **37** and **38**, an inwardly projecting beam **39** secured to the lower end of the frame member **36**, and a beam **40** interconnecting the inner end of the beam **39** and the bottom frame member **34** intermediate the ends thereof. The frame sections **30** are maintained rigidly in longitudinally spaced, relation by means of interconnecting blocking, the interior finish applied to the vertical frame members **32**, the exterior finish **31** applied to the frame members **36**, a soffet

41 applied to the lower ends of the frame members 36 and the beams 39, and a longitudinal strip 42 applied to the inner ends of the beams 39 and the beams 40.

The exterior finish 31 may consist of conventional siding including wood or aluminum siding, panelling consisting of wood or a synthetic material, and the like, or may consist of conventional roofing including sheathing applied to the frame members 36, a layer of felt or similar material applied to the sheathing, and courses of shingles applied to the layer of felt.

As best illustrated in FIGS. 2, 4 and 5, the axis of strap hinges 33 is disposed at a level above the level of the axes of strap hinges 29 so that when the interior wall 18 and the exterior end walls 19 are swung downwardly into their inoperative positions, the exterior side wall 20 may be swung downwardly and rested in an inoperative position on the exterior end walls 19,19, as illustrated in FIGS. 2 and 4, and swung upwardly to an operative, upright position, as illustrated in FIGS. 1, 3 and 5.

The construction of the second story section 17*a* is similar to the construction of the second story construction 17, and includes an interior wall 18*a*, exterior end walls 19*a*, 19*a*, and an exterior side wall 20*a* which may be swung downwardly into inoperative positions, overlying the upper end of the lower story structure 14*a* and swung upwardly into operative, upright positions as illustrated in FIGS. 1 and 3, with the interior wall 18 abutting the interior wall 18 of modular unit 11.

The roof unit 13 is adapted to be applied to the upper story sections 17 and 17*a* in the field when the interior and exterior walls of the upper story sections 17 and 17*a* are rigidly secured in their operative, upright positions. The roof unit specifically consists of a plurality of transversely disposed, longitudinally spaced trusses 43 seated on and rigidly secured to the upper ends of the interior and exterior walls of the upper story sections 17 and 17*a*, and roofing applied to the trusses. As best illustrated in FIGS. 3 and 4, each of the trusses 43 includes a bottom chord member 44 adapted to be seated on and secured to the walls of the upper story sections, a pair of diagonal, top chord members 45 and 46 vertical components 47, 48 and 49, and diagonal chord members 50 and 51. The trusses 43 are adapted to be secured together by conventional blocking when mounted on the walls of the upper story sections. The roofing applied to the trusses may be of any conventional type, and most likely would consist of sheathing applied to the top truss chord members 45 and 46, a layer of felt or similar material, and courses of shingles.

The modular units 11 and 12 are prefabricated at a manufacturing site utilizing mass production methods and techniques. When the units have been completed, the walls of the upper story sections are collapsed into their inoperative positions for shipment. This is accomplished with the interior modular unit 11 by swinging the interior wall 18 downwardly so that it comes to rest on the upper end of the lower story section 15, swinging the exterior end walls 19,19 downwardly so that they rest on the collapsed interior wall 18, and then swinging the exterior side wall 20 downwardly so that it rests on the collapsed exterior end walls 19,19. The upper story section 17a of modular unit 12 is collapsed in a similar manner.

When the second story structures of the modular units have been collapsed in their inoperative positions, providing compact units of minimum width and height, the units are loaded on trailers or dolleys and hauled along with a set of trusses 43 and roofing material, to an erection site provided with a foundation. The units 11 and 12 are then transferred onto the foundation and positioned in side-by-side relation. After the units have been positioned, they are rigidly secured together to complete the first story of the structure. Next, the exterior side walls 20 and 20*a*, the exterior end walls 19 and 19*a*, and the interior walls 18 and 18*a* are swung upwardly into their operative, upright positions, and rigidly secured together. With the walls of the upper story section in their upright positions, the interior walls 18 and 18*a* will be secured in abutting relation, exterior end walls 19 and 19*a* will be disposed in transverse alignment and exterior side walls 20 and 20*a* will be disposed in spaced parallel relation to the interior walls 18 and 18*a*.

After the second story structure has thus been assembled, the trusses 43 are set on the upper end thereof, and the roofing is applied to the trusses. To complete the structure, a ceiling, additional partition walls, and various fixtures may be installed in the second story structure, and the water, sewage and electrical outlets may be connected to appropriate utility lines. With the structure thus assembled, it would be ready for immediate occupancy.

The interiors of the modular units of 11 and 12, are completely finished at the manufacturing site, so that upon securing the unit together and assemblying the roof system at the construction site, a minimum amount of work is required to complete the structure in the field. It is contemplated that the interior of the lower story sections of the modular units be provided with conventional partition walls, sheet rock and panelling applied to the interior walls, and conventional floor coverings including hardwood, resilient tile and ceramic tile. The units further would be provided with kitchen cabinets and appliances, bathroom cabinets and fixtures, lighting fixtures, and electrical, heating and plumbing systems.

In the embodiment as described, it will be noted that there is provided a prefabricated two story building structure in which the structure is formed of at least two modular units which can be packaged in compact units having widths and heights falling within permissible limits imposed by law with respect to the hauling of such units over the public highways. The design of the unit combines the advantages of utilizing mass production methods and techniques for fabricating the modular components of the building structure, and providing a finished product which is comparable in quality and aesthetic appeal to multi-story building structures erected entirely at a building site.

The prefabricated multi-story building structure as described, eliminates the additional handling and alignment normally required in erecting conventional multi-story building structures from prefabricated modular units which are stacked one on top of another to form such structures. Accordingly, the present invention provides the advantage of reduced handling time, and correspondingly, reduced erection costs. It will be appreciated, however, that modular units with collapsible upper stories, as described herein, also may be used in combination with conventional single story modular units to construct various types of multi-story building structures such as garden type apartments, row or town houses, and the like. An example of this would involve

a modular unit with a collapsible upper story positioned on a conventional single story modular unit to provide a three story structure which can be combined with similar three story structures to provide garden type apartments or town houses.

From the foregoing detailed description, it will be evident that there are a number of changes, adaptations and modifications of the present invention which come within the province of those skilled in the art. However, it is intended that all such variations not departing from the spirit of the invention be considered as within the scope thereof as limited solely by the appended claims.

I claim:

1. A modular unit adapted to be positioned in side-by-side relation and secured to at least one similar unit, and to be provided with a roof section, to form a prefabricated building structure, comprising a permanently constructed lower story section, and a collapsible upper story section mounted on said lower story section, said upper story section including at least one interior junction wall hingedly connected to said lower story section and movable between an inoperative, substantially horizontally disposed position, and an operative, substantially vertically disposed position to engage a similar interior junction wall of the upper story section of said similar modular unit, disposed in its operative position, and exterior walls hingedly connected to said lower story section and movable between operative, substantially horizontally disposed positions and operative, substantially vertically disposed positions, the hinge axis of said interior junction wall being disposed longitudinally, and the exterior walls include a pair of end walls having transversely disposed, longitudinally spaced hinge axes disposed at a level higher than the hinge axis of said interior junction wall, and a side wall having a longitudinally disposed hinge axis disposed at a level higher than the level of the hinged axes of said end walls.

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