Nov. 15, 1966 H. C. BOLT 3,284,966

COLLAPSIBLE BUILDINGS

Original Filed July 16, 1959 8 Sheets-Sheet 1

FIG. 1.

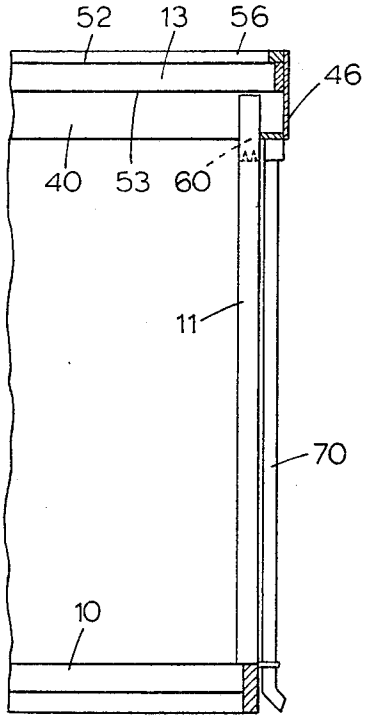
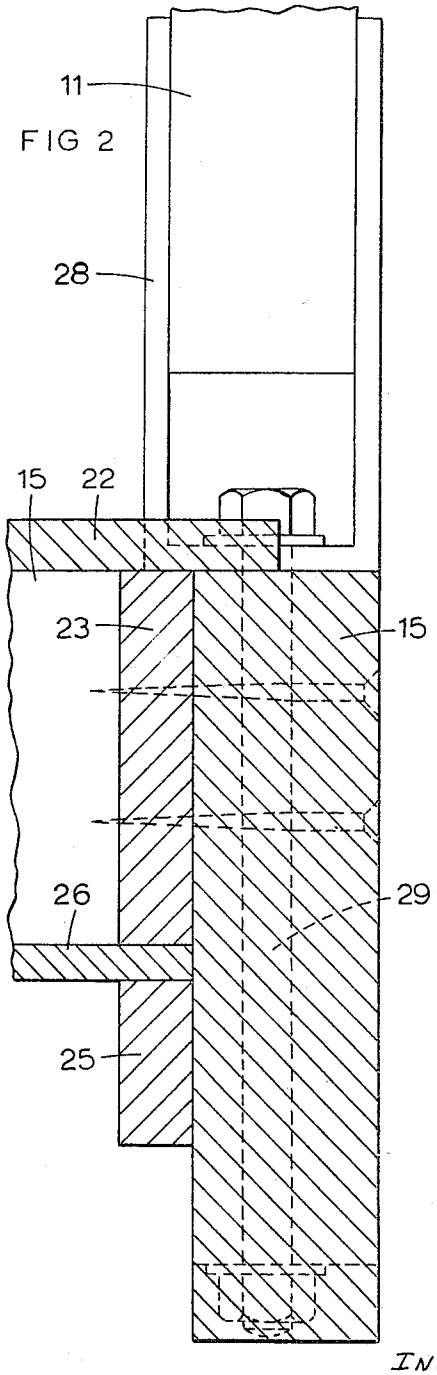


FIG 2



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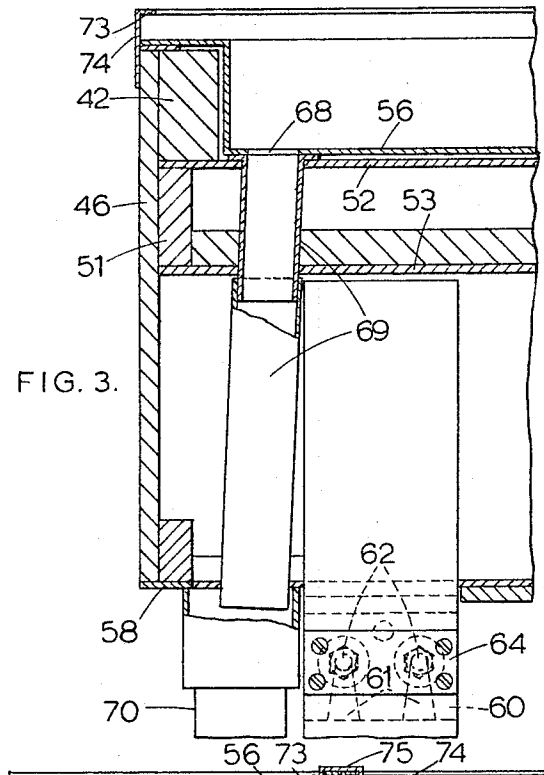


FIG. 3.

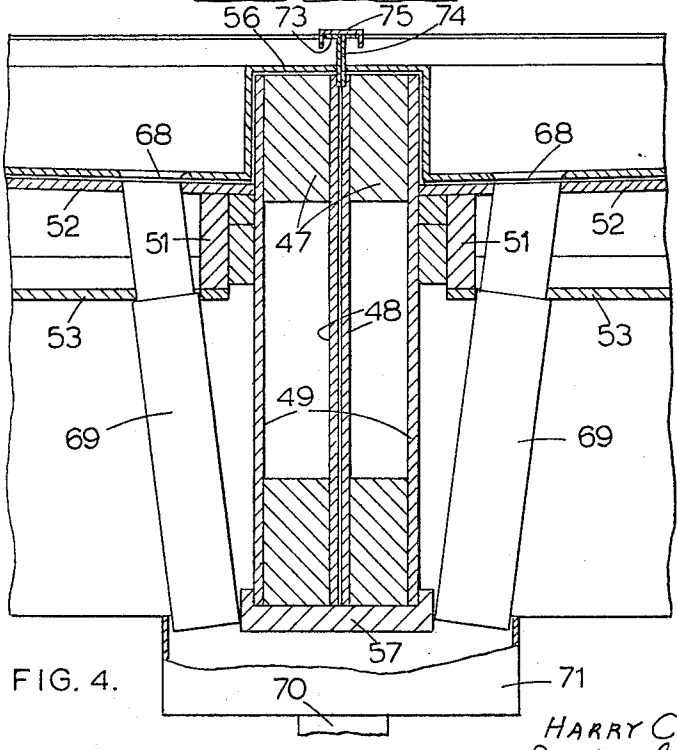


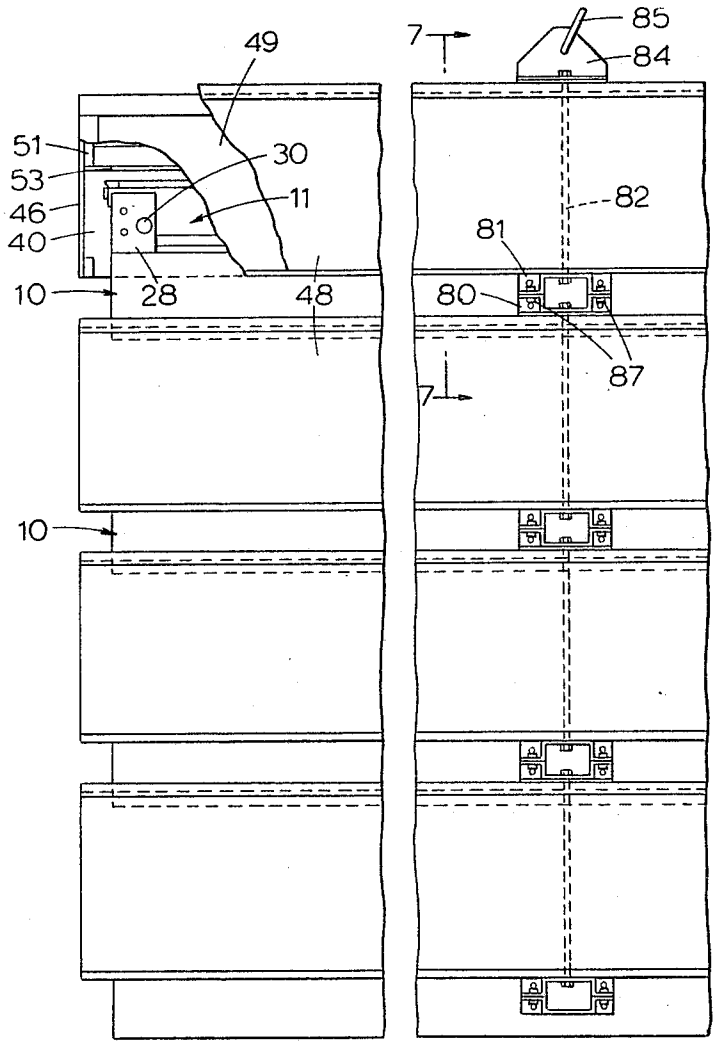
FIG. 4.

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FIG. 5.



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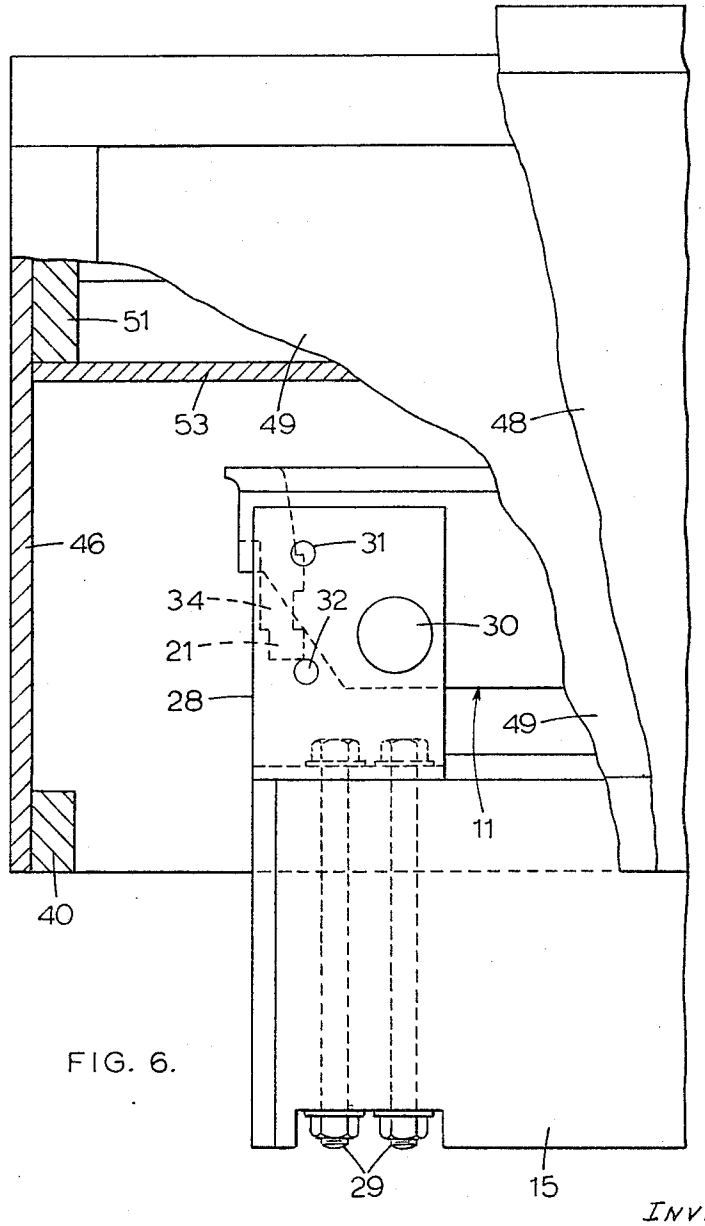


FIG. 6.

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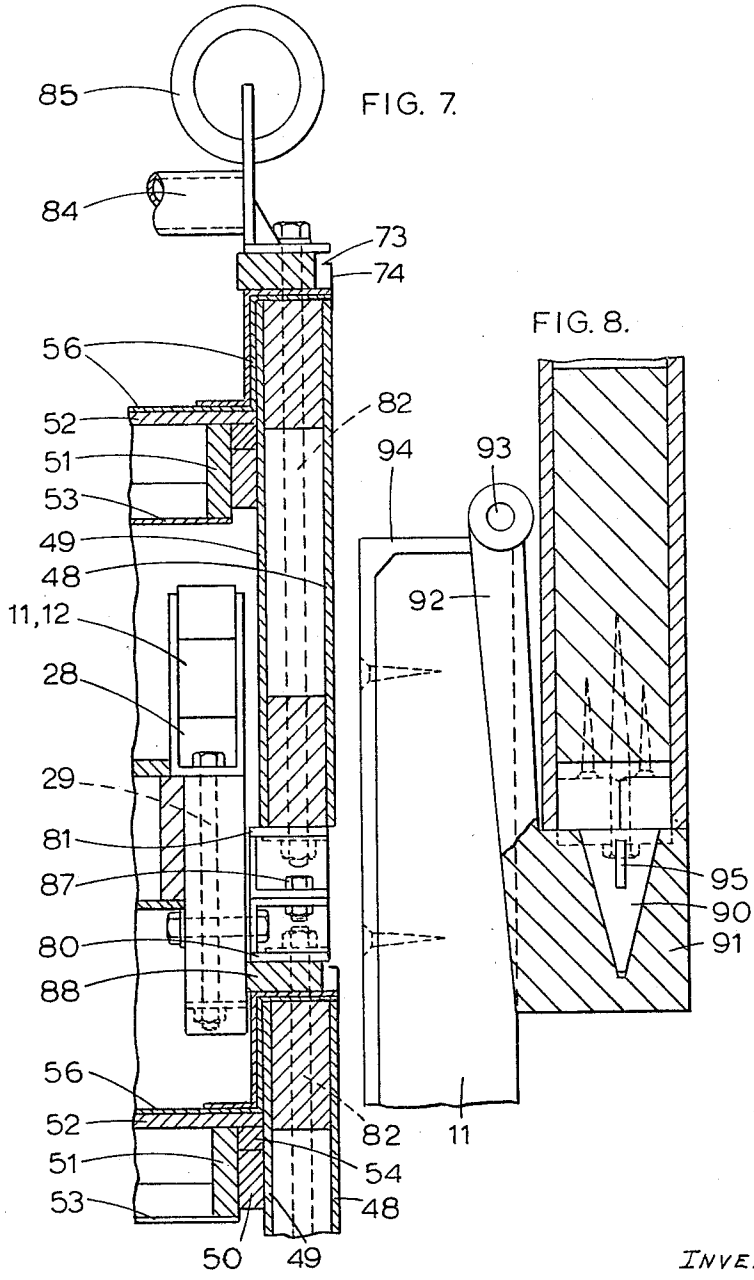


FIG. 7.

FIG. 8.

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FIG. 10.

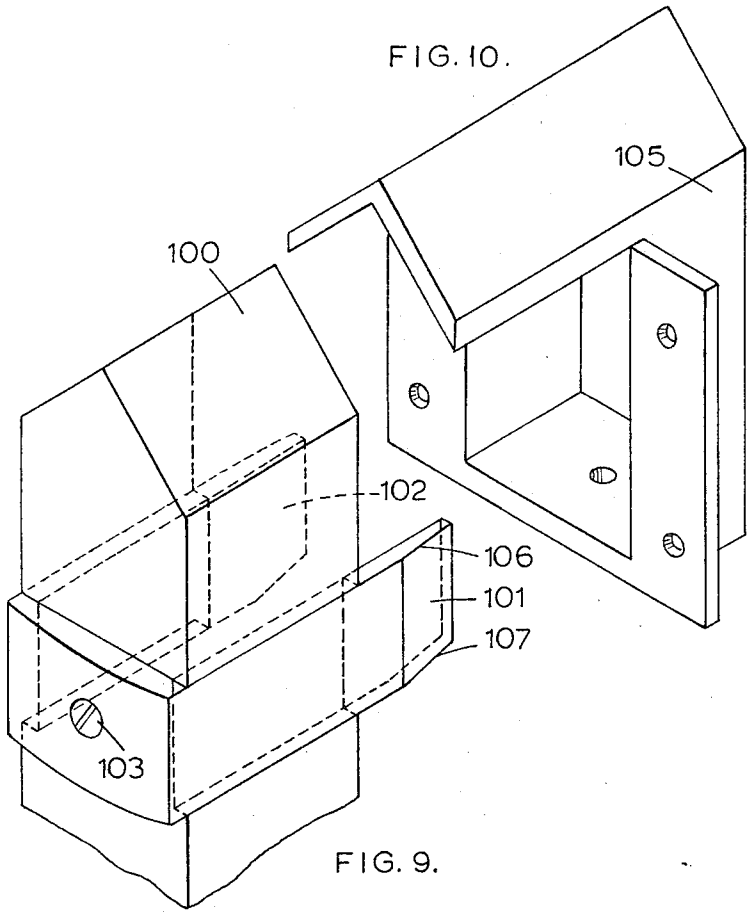
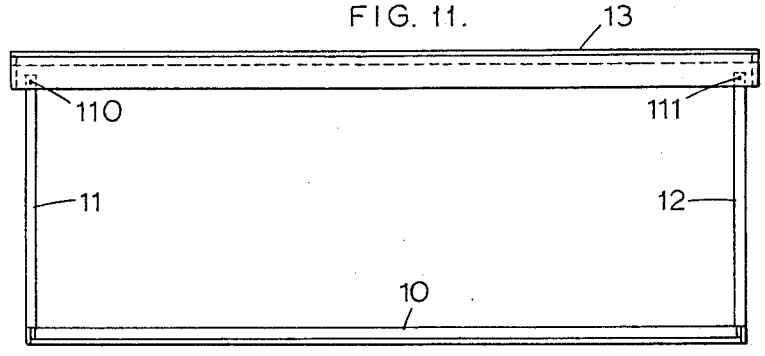


FIG. 9.

FIG. 11.



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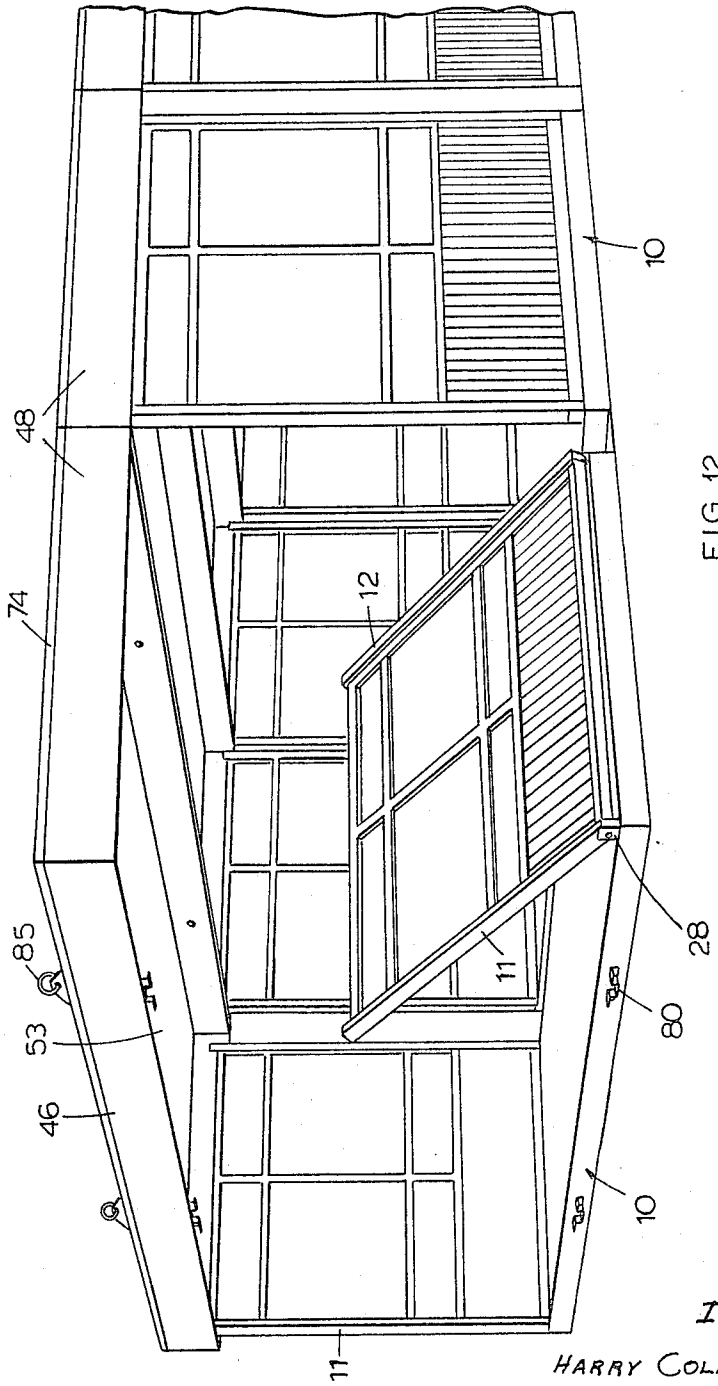


FIG. 12.

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COLLAPSIBLE BUILDINGS

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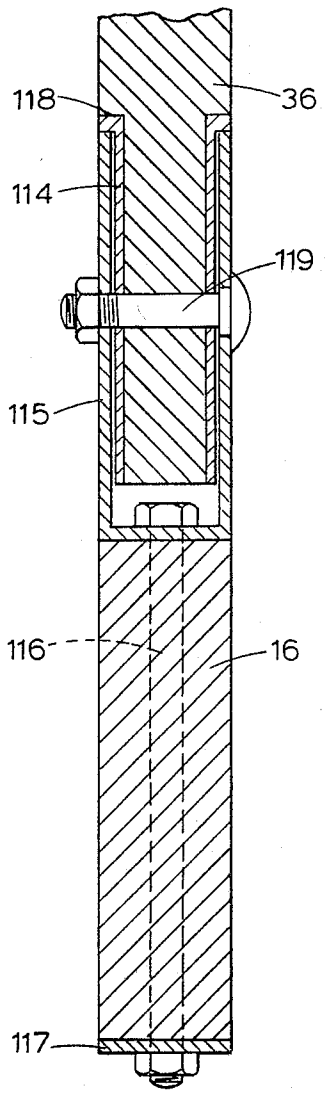


FIG. 13.

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United States Patent Office 3,284,966 Patented Nov. 15, 1966

3,284,966

COLLAPSIBLE BUILDINGS

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Continuation of application Ser. No. 827,516, July 16, 1959. This application Dec. 5, 1963, Ser. No. 328,389
12 Claims. (Cl. 52—16)

This application is a continuation of my co-pending application Serial No. 827,516 filed July 16, 1959 and now abandoned.

This invention relates to buildings which can be factory made ready for speedy assembly on any desired site and which can be easily dismounted, packed on lorries and moved to another site and readily re-erected.

This earlier application disclosed buildings assembled from a plurality of units arranged side-by-side or end-to-end, and each of which comprised a one-piece floor member of greater length than width, end frames movably connected to the floor so that they can be laid flat on the floor and a one-piece roof member of approximately the same length and width as the floor member, which roof member is supported by the end frames when these are upright. In such buildings as heretofore made the roofs were arched and rain-water valleys were provided between the ends of adjacent roofs. Also the arched roofs were of the same area as the floors os that the overall packed height of each building in collapsed condition was such that only two of them could be stacked one upon the other for transport and even this involved the use of a cradle to hold the upper building steady.

Furthermore specifically the end frames were pivoted to the floor.

According to one aspect of the present invention there is provided a building structure capable of being collapsed into a readily transportable condition and into a readily erected condition comprising a floor member of greater length than width, rigid post member disposed at each corner of said floor member, each post member having a length less than half the length of said floor member, means movably connecting said post members to said floor member so that said post members lie on said floor member end-to-end and parallel with the long sides of the floor member without overlapping in said collapsed condition and vertically disposed with respect to said floor member when in said erected position, and a roof member of slightly greater length and width than said floor member and having vertical walls surrounding a rectangular space which is closed at the upper part thereof by a substantially flat rigid roof, said rectangular space being open at the bottom and having a depth and internal area just large enough to receive said rigid post members and at least the upper part of said floor member in said collapsed condition, said vertical walls of said roof member having edges protruding above said flat rigid roof defining a rectangular recess for receiving the lower part of the floor member of another building structure stacked thereupon.

According to a further aspect of the invention the uprights are pivotally attached to the roof member whereby they can be collapsed on to the floor member.

The roof member may be formed with upstanding edges so that the whole of the top forms a large rectangular recess adapted to receive the lower part of the floor of the building stacked upon it. This gives added weatherproofing during storage and transport and fixes the buildings against lateral and longitudinal displacement so that special cradles for this purpose are obviated.

The recessed roof may have the upper surface slightly inclined towards one side where a rain hole is provided at one or each end which leads to a pipe that extends through the roof. If adjacent erected buildings are provided with these rain holes adjacent each other, they may drain into a common rain pipe.

The invention will now be further described by way of example with reference to a constructional form thereof illustrated in the accompanying diagrammatic drawings where:

FIGURE 1 is a sectional view of one end of a building unit made in accordance with the invention;

FIGURE 2 is a transverse sectional view of part of the roof;

FIGURE 3 is a vertical sectional view of the roof with adjacent drain and supporting parts;

FIGURE 4 is a sectional view showing the junction of two building units;

FIGURE 5 is a side elevation of four stacked building units;

FIGURE 6 is an enlarged view of part of FIGURE 5;

FIGURE 7 is a sectional view on the line 7—7 on FIGURE 5;

FIGURE 8 is a sectional view showing a modified form of roof locating device;

FIGURES 9 and 10 show a further modified form of roof locating and fixing device;

FIGURES 11 and 13 show modified methods of fixing the end uprights; and

FIGURE 12 shows the assembly of several units to make a complete building.

Each building unit comprises a floor member **10** having two end pairs of uprights or corner posts **11, 12** pivotally attached thereto at opposite ends thereof so as to be capable of being moved into the upright positions or laid flat on the floor member for transport. For this purpose the length of the floor member must be more than twice the height of the end uprights and in practice must also be of greater length than width. These units each have a roof member **13** fixed to the top of the uprights. Any number of these units can be fixed together end to end and/or side by side to form a building of any required floor area. The floor members of these units are slightly spaced apart as at **14** and the spaces covered by boards.

The floor member is built up from a number of parts all fixed together so as to form in effect substantially a single piece. The floor consists of two side beams such as **15**, connected together by two end beams, all these beams being connected together by floor panels.

The floor panels each consist of a floor board **22** fixed on to beams **23** which are closed underneath by a cover board **26**. The panels seat on blocks **25** (FIGURE 2) fixed on the beams. This makes a structure which can be for example 24 feet long and 8 feet wide and can carry the full weight of the walls, floor and eventual contents.

At each corner of the floor there is a metal U-shaped hinge bracket **28** which is bolted by bolts **29** to the side beams **15**. These brackets **28** serve as cradles to receive the end uprights **11, 12** which are attached to the brackets **28** by hinge pins **30** whereby the end uprights can be erected or folded flat on to the floor member. When the end uprights are erected they are held erect by inserting pins **31, 32**.

The end uprights **11, 12** support the roof and may be left open where walls or partitions are not required or provided with a frame (FIGURE 6) containing glass, opaque panels, doors or other required coverings.

The roof consists of side beams **40**, connected together by end boards **42, 43** and plywood or other sheet material **46**. The side beams consist of frames **47** covered on both sides with sheet material **48, 49**. These side beams have support rails **50** (FIGURE 7) secured to their inner faces at some distance below their upper edges and at a larger distance above their lower edges. Panels

are placed on the rails **50**, these panels consisting of frames **51** covered by sheet material **52, 53** top and bottom and carrying rails or blocks **54** that rest on the rails **50**. These panels constitute the main structural connection between the side beams **40, 41** and end boards **43** and sheet material **46**. A roofing felt **56** is then fixed over the complete roof member. The underneath edges of adjacent roof members are closed by strip **57**. The roof member thus forms an open box from the sheet **53** down to its lower edges and an open tray from **56** to its upper edges.

Brackets **60** are fixed to the roof at each of the four lower corners thereof and these have a pair of recesses **61** in the lower edges which engage a pair of bolts **62** carried by the end uprights **11, 12**. These bolts also pass through metal plates **64**. The brackets **60** carry pins that enter holes in the plates **64** to secure the roof firmly in position.

The upper part of the roof forms in effect a tray with upstanding edges so that when a number of the building units are secured together the complete roof is constituted by a series of trays. The tray has a slight incline down to one side where it has a rain hole **68** connected by pipes **69** that pass through the roof member to a drain pipe **70**. At the adjacent parts of two units the rain holes **68** may be arranged adjacent each other with their pipes **69** leading to a common drain box **71** carried by the drain pipe **70**.

The upper edges of the roof member carries F-section metal strips having their flanges **73** facing inwardly and the base **74** vertical so that the base parts of strips on adjacent buildings will be against each other and a strip of metal **75** may be placed over them and crimped around the upper flanges **73** thus providing waterproofing in a very simple and speedy manner. The F-section has its base extended downwards to lie against the wall of the roof member. The lower of the two flanges **73** is also fixed to the roof.

As more easily seen in FIGURES 5, 6 and 7 the size of the roof member in area and depth of underneath recess is such that it seats like a cap over the collapsed uprights **11, 12** and over part of the depth of the floor member whereby a weatherproofing is achieved during transit and lateral and longitudinal displacement of the roof member is prevented.

The depth of the roof and recess is such that the roofs of adjacent superimposed stacked buildings are spaced apart to the extent of about a third or half of the depth of a floor and in this space brackets are provided for facilitating the lifting of the roof, floor and end uprights by a crane. At each long side of the building unit two sets of brackets are provided suitably spaced apart, viz a floor bracket **80** and a roof bracket **81**. The floor bracket has seven parts, viz first a base plate having a bolt hole in it and two upstanding walls having outwardly extending flanges parallel to the base plate and also having bolt holes therein; and two wings in a common vertical plane having holes in them by which the brackets are permanently fixed to the floor. The roof bracket is similar but if desired omitting the wings and having its flanges bolted by small bolts **87** (FIGURE 7) to the floor bracket flanges when stacked. The brackets form a kind of open box and long bolts **82** pass through the hole in the base plate of the floor bracket **80**. The bolts **82** of the uppermost unit serve to fix a lifting device **84** which carries lifting rings **85**. When the building is to be lifted off a lorry, crane hooks are attached to the rings. The building is then lifted off the lorry and placed on the site. The roof is then to be lifted and for this purpose the small bolts **87** are removed and the roof is lifted. The pivoted end uprights **11, 12** are then raised to the vertical positions and the roof is lowered by the crane on to the uprights and fixed by the brackets **60**.

Loose blocks **88** are provided between stacked units. These loose blocks are merely packing pieces to prevent the floor bracket **80** from damaging the roof covering of the unit below it.

Instead of the brackets **60**, the roof and end uprights all carry conical members, one of which on the roof at each corner fits the other on the adjacent end upright, means being provided for fixing the cones together Thus as shown in FIGURE 8 the roof may carry an inverted hollow cone **90** that seats in a cone **91** carried by an arm **92** pivoted at **93** on a bracket **94** that is secured on the upper end of the end uprights **11, 12**. The cones may have transverse slots **95** into which a tapering key can be driven in order to bring the cones into tight frictional engagement. Vertical and lateral loads are then taken up mainly by the frictionally engaged conical surfaces. By "conical" we also include "frusto conical."

In the modification shown in FIGURES 9 and 10 each end upright has an inverted V-shaped upper end **100** a short distance below which the upright is slotted on opposite sides to receive the legs **101, 102** of a U-shaped connecting member which can be retained on the upright by screw **103**. The screw **103** is screwed back to enable the legs **101, 102** to be drawn clear of the roof and bracket when lowering the roof on to the uprights. After the upright has been raised the ends of the legs **101, 102** (which project outwardly from the uprights) are driven into a box-like bracket **105** that is housed in a recess in the inside of the vertical walls of the roof member. The legs **101, 102** are chamfered at **106** so that as they enter the bracket they are pinched on to the upright. The legs are also chamfered at **107** so as to wedge the brackets downwards and draw the roof member down with the brackets seating tightly on the upper ends **100**.

FIGURE 11 shows an arrangement in which the end uprights **11, 12** instead of being pivotally attached to the floor member **10** are pivoted on axes **110, 111** to the roof member **13**, these axes being near to and parallel to the ends of the roof member so that the end uprights can be folded flat within the roof member into the plane of said axes.

The lower ends of the end uprights instead of being pivoted to the floor member **10** may be made to drop into sockets on the floor member. For example, the floor member may have fixed to it at each of its four corners, and upstanding therefrom, one element of spigot and socket device, the other element of which is fixed on the end upright. Thus as shown in FIGURE 13 the end upright **36** may be of reduced size at its lower end forming a spigot and fitted with a metal shoe **114** which enters a metal socket **115** on the floor beam **16**. A bolt **116** passes through the bottom of the socket and through the beam **16** and through a metal washer **117** and fixes the socket in position. A flange **118** on the upper edges of the shoe seats on the upper edges of the socket and a fixing bolt **119** passes through the socket, shoe and upright **36**. If desired, the lower ends of the walls may be fitted with detachable wheels or rollers to facilitate gradual raising or collapsing of the walls.

I claim:

1. A building structure capable of being collapsed into a readily transportable condition and into a readily erected condition comprising a floor member of greater length than width, rigid post members disposed at each corner of said floor member, each post member having a length less than half the length of said floor member, means movably connecting said post members to said floor member so that said post members lie on said floor member end-to-end and parallel with the long sides of the floor member without overlapping in said collapsed condition and vertically disposed with respect to said floor member when in said erected position, and a roof member of slightly greater length and width than said floor member and having vertical walls surrounding a rectangular space which is closed at the upper part thereof by a substantially flat rigid roof, said rectangular space being open

at the bottom and having a depth and internal area just large enough to receive said rigid post members and at least the upper part of said floor member in said collapsed condition, said vertical walls of said roof member having edges protruding above said flat rigid roof defining a rectangular recess for receiving the lower part of the floor member of another building structure stacked thereupon.

2. A building structure as claimed in claim 1 having four brackets fixed to the roof member one at each corner thereof, U-shaped members fixed to each post member at the upper end thereof, the legs of the U-shaped members extending horizontally when the structure is in said erected condition; the brackets having openings therein engaged by the U-shaped members.

3. A building structure including a plurality of substructures, each substructure capable of being collapsed into a readily transportable condition and into a readily erected condition comprising a floor member of greater length than width, rigid post members disposed at each corner of said floor member, said post member having a length less than half the length of said floor member, means movably connecting said post members to said floor member so that said post members lie on said floor member end-to-end and parallel with the long sides of the floor member without overlapping in said collapsed condition and vertically disposed with respect to said floor member when in said erected position, a roof member of slightly greater length and width than said floor member and having vertical walls surrounding a rectangular space which is closed at the upper part thereof by a substantially flat rigid roof, said rectangular space being open at the bottom and having a depth and internal area just large enough to receive said rigid post members and at least the upper part of said floor member in said collapsed condition, said vertical walls of said roof member having edges protruding above said flat rigid roof defiining a rectangular recess for receiving the lower part of the floor member of another substructure stacked thereupon, the roof members of the substructures being disposed in juxtaposition, and means connecting the roof members together to form a waterproof connection therebetween.

4. A building structure as claimed in claim 3 wherein two adjacent flat rigid roof members are inclined towards each other and a rain hole is provided in each flat rigid roof member at the junction of the flat rigid roof member which hole leads to a pipe that extends through each flat rigid roof member.

5. A building structure capable of being collapsed into a readily transportable condition and into a readily erected condition comprising a floor member of greater length than width, a roof member of slightly greater length and width than said floor member, rigid post members disposed at each corner of said roof member, each rigid post member having a length less than half the length of said floor member, and means pivotally connecting said post members to said roof member so that said post members lie on said floor member end to end and parallel with the long sides of said floor member without overlapping in said collapsed condition and vertically disposed with respect to said roof member when in said erected position; said roof member having vertical walls surrounding a rectangular space which is closed at the upper part thereof by a substantially flat rigid roof, said rectangular space being open at the bottom and having a depth and internal area just large enough to receive said rigid post members and at least the upper part of said floor member in said collapsed condition, said vertical walls of said roof member having edges protruding above said flat rigid roof defining a rectangular recess for receiving the lower part of the floor member of another building structure stacked thereupon.

6. A building structure capable of being collapsed into a readily transportable condition and into a readily erected condition comprising a floor member of greater length than width, a roof member of slightly greater length

and width than said floor member, rigid post members having a length less than half the length of said floor member so that said post members lie on said floor member end-to-end and parallel with the long sides of said floor member without overlapping in said collapsed condition, and means to vertically dispose said rigid post members with respect to and at the corners of said roof member and said floor member when in said erected condition, said roof member having vertical walls surrounding a rectangular space which is closed at the upper part thereof by a substantially flat rigid roof, said rectangular space being open at the bottom and having a depth and internal area just large enough to receive said rigid post members and at least the upper part of said floor member in said collapsed condition, said vertical walls of said roof member having edges protruding above said flat rigid roof defining a rectangular recess for receiving the lower part of the floor member of another building structure stacked thereupon.

7. A building structure including a plurality of substructures, each substructure capable of being collapsed into a readily transportable condition and into a readily erected condition comprising a floor member of greater length than width, a roof member of slightly greater length and width than said floor member, rigid post members having a length less than half the length of said floor member so that said post members lie on said floor member end-to-end and parallel with the long sides of said floor member without overlapping in said collapsed condition, means to vertically dispose said rigid post members with respect to and at the corners of said roof member and said floor member when in said erected condition, said roof member having vertical walls surrounding a rectangular space which is closed at the upper part thereof by a substantially flat rigid roof, said rectangular space being open at the bottom and having a depth and internal area just large enough to receive said rigid post members and at least the upper part of said floor member in said collapsed condition, said vertical walls of said roof member having edges protruding above said flat rigid roof defining a rectangular recess for receiving the lower part of the floor member of another substructure stacked thereupon, the roof members of the substructure being disposed in juxtaposition, and means connecting the roof members together to form a waterproof connection therebetween.

8. A portable building structural unit for assemblage to form at least a portion of a human habitable readily-demountable building having large floor area, comprising: a substantially-rigid, generally-rectangular, unitary framework floor member of greater length than width and having a substantially plane upper surface extending substantially without interruption from end-to-end and from side-to-side of said member; roof-supporting corner posts; means for detachably securing the lower end of each of said posts to the corresponding corner of said floor member; a substantially-rigid, generally-rectangular unitary framework weatherproof roof member of at least the same length and width as said floor member and of sufficient strength to require no support intermediate its ends; and means connecting the upper ends of said posts to the corners of said roof member for pivotal movement about transverse axes so that when said securing means is detached said posts can be moved pivotally between a horizontal position wherein the lower ends of the posts face toward each other and the posts lie flat against said floor member upper surface parallel to the length thereof when the roof is lowered over the floor and an upright position wherein said posts are substantially within the rectangular peripheral outline of said floor member when the roof is raised above the floor, said securing means interrupting said floor member upper surface only at said corners thereof, the length of said floor member being greater than twice the height of each of said posts to enable the latter to be moved inwardly

towards each other and to lie flat on said floor member without overlapping in order to provide, with said roof member superimposed thereon, a compact collapsed pack of minimum height to facilitate transportation to an erection sit and in which said floor member and posts are covered and protected by said roof member, all of said members being of such a size that said pack can be lifted as a unit by a crane and transported as a unit over highways by truck.

9. The structure defined in claim **8** in which each roof member includes vertical walls surrounding a rectangular space closed at the upper part thereof by a substantially flat rigid roof, said rectangular space being open at the bottom and having a depth and internal area large enough to receive the corresponding post members and at least an upper portion of the corresponding floor member when each unit is in its collapsed condition.

10. The structure defined in claim **9** in which each of the vertical walls project above the corresponding flat rigid roof and define, with the latter, a rectangular recess for receiving a lower portion of the floor member of another building unit when the latter is in its collapsed condition.

11. A portable building structural unit for assemblage with similar units to form a human habitable readily-demountable building having a large floor area comprising: a substantially-rigid, generally-rectangular, unitary framework floor member of greater length than width and having a substantially plane upper surface extending substantially without interruption from end-to-end and from side-to-side of said member; roof-supporting corner posts; means for detachably securing the lower end of each of said posts to the corresponding corner of said floor member; a substantially-rigid, generally-rectangular unitary framework weatherproof roof member of at least the same length and width as said floor member and of sufficient strength to require no support intermediate its ends; and means connecting the upper ends of said posts to the corners of said roof member for pivotal movement about transverse axes so that when sadi securing means is detached said posts can be moved pivotally between a horizontal position wherein the corresponding post lies flat against said floor member upper surface parallel to the length thereof and an upright position wherein said post is substantially within the rectangular peripheral outline of said floor member, said securing means interrupting said floor member upper surface only at said corners thereof, the length of said floor member being greater than twice the height of each of said posts to enable the latter to be moved inwardly towards each other and to lie flat on said floor member without overlapping in order to provide, with said roof member superimposed thereon, a compact collapsed pack of minimum height to facilitate transportation to an erection site and in which said floor member and posts are covered and protected by said roof member, all of said members being of such a size that said pack can be lifted as a unit by a crane and transported as a unit over highways by truck, the roof member including vertical walls surrounding a rectangular space closed at the upper part thereof by a substantially flat rigid roof, said rectangular space being open at the bottom and having a depth and internal area large enough to receive the post members and at least an upper portion of the floor member when the unit is in its collapsed condition, the vertical walls projecting above the flat rigid roof and defining, with the latter, a rectangular recess for receiving a lower portion of the floor member of another building unit when the latter is in its collapsed condition.

12. A sectional readily-demountable human habitable building comprising a plurality of portable building structural units of substantially identical over-all dimensions, each of said units comprising a substantially-rigid, generally-rectangular unitary framework floor member of great length and width and having a substantially plane upper surface extending substantially with uninterruption from end-to-end and from side-to-side of said member; roof-supporting corner posts; means detachably securing the lower end of each of said posts to the corresponding corner of said floor member, said posts and said securing means being disposed substantially within the rectangular peripheral outline of said floor member; a substantially-rigid, generally-rectangular unitary framework weatherproof roof member of at least the same length and width as said floor member and of sufficient strength to require no support intermediate its end; and means connecting the upper ends of said posts to the corners of said roof member for pivotal movement about transverse axes so that when said securing means is detached said posts can be moved pivotally to a horizontal position wherein said posts lie flat against said floor member upper surface parallel to the length thereof, the length of said floor member being greater than twice the height of each of said posts to enable the latter to be moved inwardly towards each other and to lie flat on said floor member without overlapping in order to provide, with said roof member in a lowered superimposed position thereon, a compact collapsed pack of minimum height to facilitate transportation to an erection site and in which said floor member and posts are covered and protected by said roof member, all of said members being of such a size that said pack can be lifted as a unit by a crane and transported as a unit over highways by truck, said units being positioned in edge-to-edge relation with adjacent edges of a pair of juxtaposed units being of equal dimensions and with the upper surfaces of their floor members in substantially the same plane; and means detachably connecting adjacent portions of like members of adjacent units together, each roof member including vertical walls surrounding a rectangular space closed at the upper part thereof by a substantially flat rigid roof, said rectangular space being open at the bottom and having a depth and internal area large enough to receive the corresponding post members and at least an upper portion of the corresponding floor member when each unit is in its collapsed condition, each of the vertical walls projecting above the corresponding flat rigid roof and defining, with the latter, a rectangular recess for receiving a lower portion of the floor member of another building unit when the latter is in its collapsed condition.

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