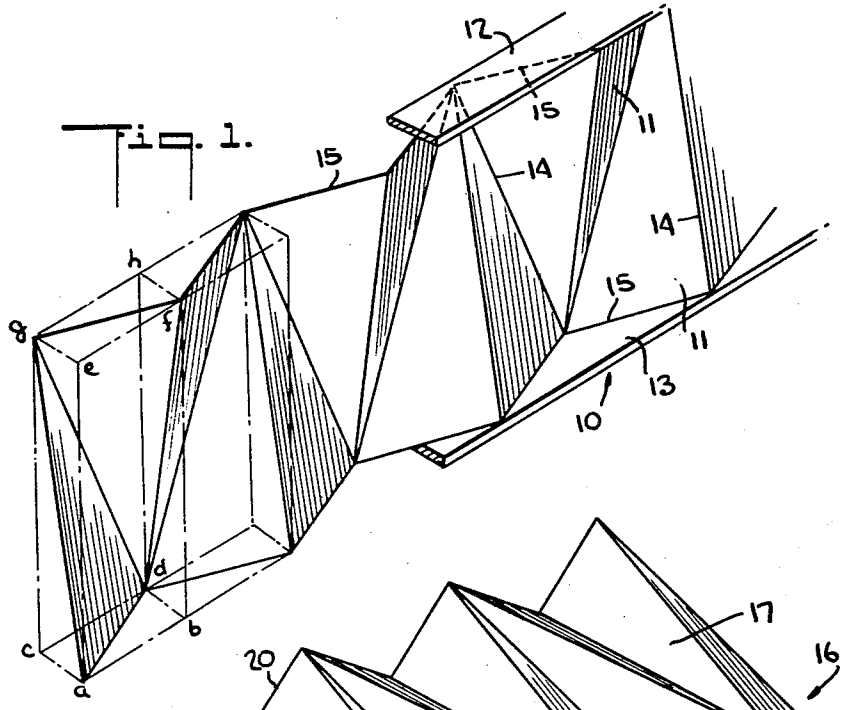
Aug. 4, 1964 R. E. HART 3,143,194

BUILDING STRUCTURE

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Fig. 1.



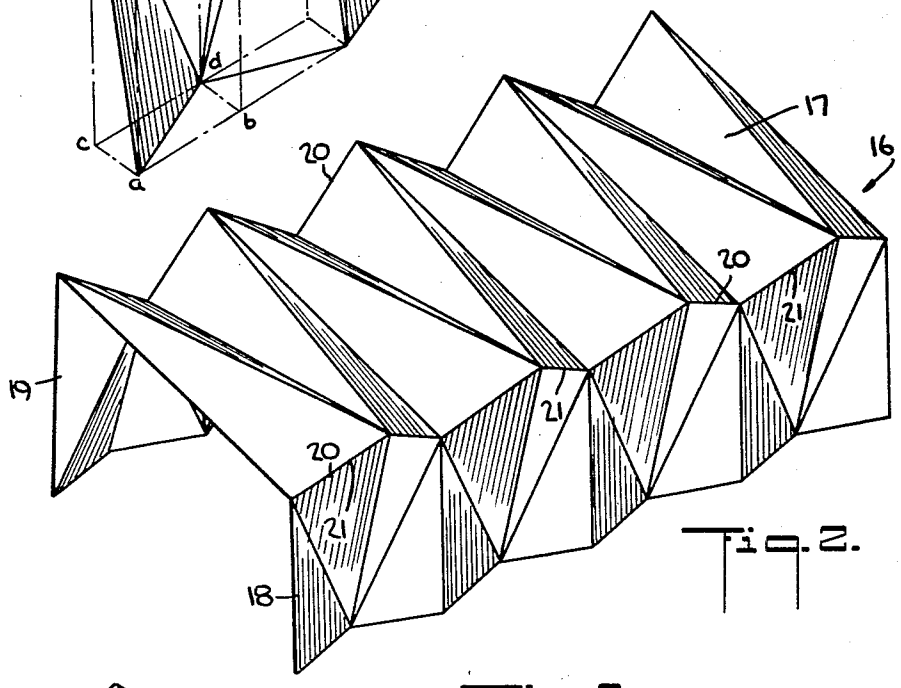
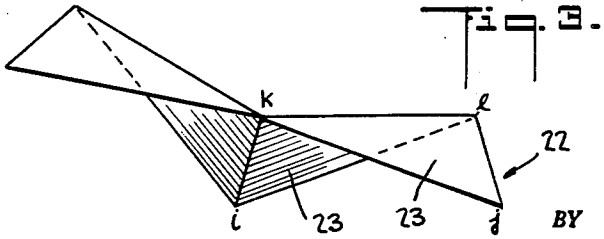


Fig. 2.

Fig. 3.



INVENTOR.
ROBERT E. HART

BY Kenyon & Kenyon

ATTORNEYS

Aug. 4, 1964 R. E. HART 3,143,194

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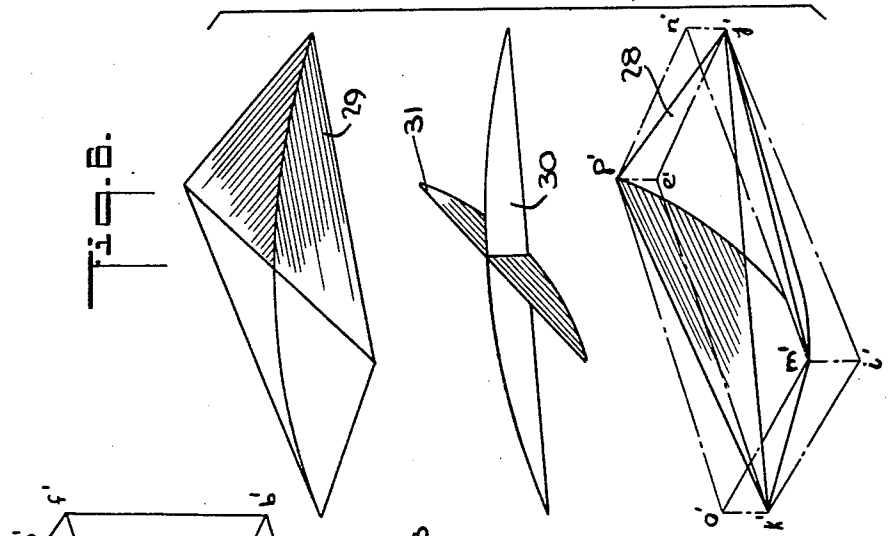


Fig. 6.

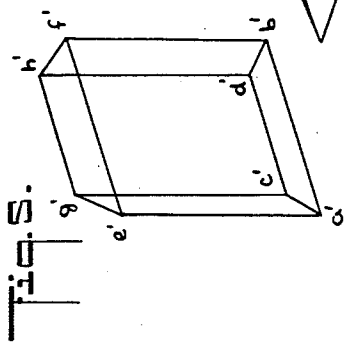


Fig. 5.

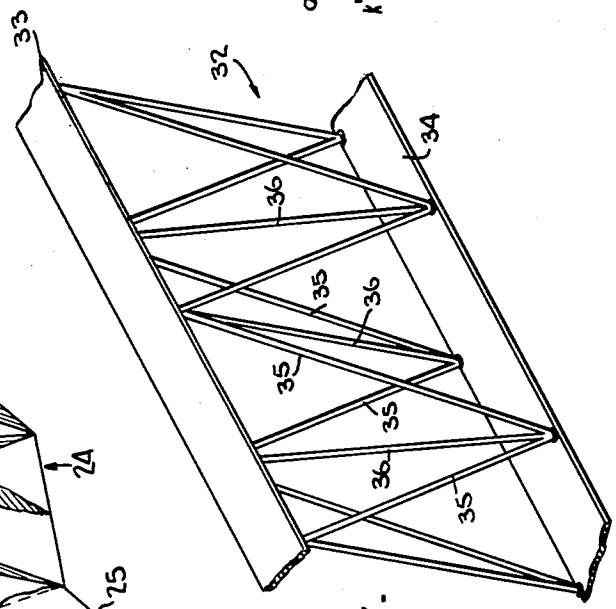


Fig. 7.

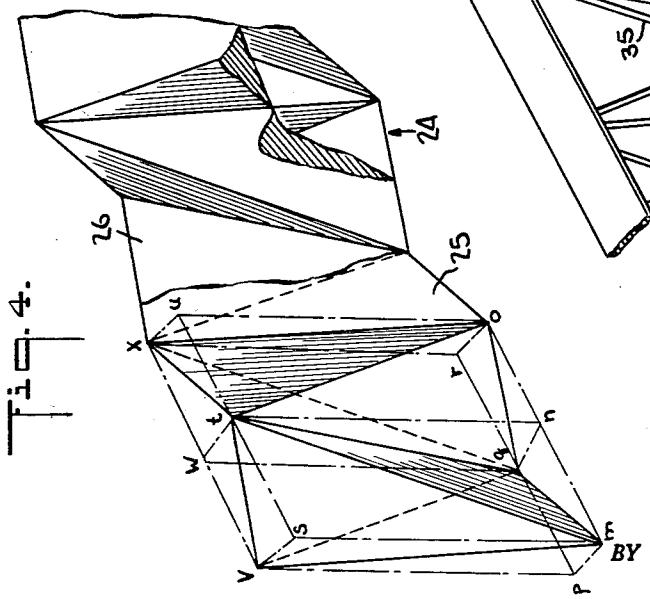


Fig. 4.

INVENTOR.
ROBERT E. HART
BY
Kenyon & Kenyon
ATTORNEYS

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BUILDING STRUCTURE

Robert E. Hart, Peekskill, N.Y., assignor to Designs for Recreation Areas, Inc., New York, N.Y., a corporation of Delaware

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8 Claims. (Cl. 189—34)

This invention relates to building structures and more particularly to a modular alternating pyramidal building structure.

Pyramidal structures are known to possess outstanding strength and stability, and it is an object of my invention to provide a building structure in which panels or framing members are arranged to form alternating pyramidal shapes. It is another object of my invention to provide a structure which can be prefabricated with a minimum number of different parts.

It is a further object of my invention to provide a structure which can be assembled or disassembled by unskilled labor with a minimum of tools or equipment.

It is still another object to provide a structure which, when formed from panels, is self-supporting and requires no vertical framing for support.

Briefly, one embodiment of my invention is a wall formed of a plurality of triangular panels arranged in an extended row. One edge of each triangle is in an upper or lower horizontal plane, and each other edge of each panel abuts an edge of an adjacent panel. Panels are arranged in pairs, and each pair defines two sides of a triangular pyramid whose third side is perpendicular to its base.

Another embodiment of my invention is a wall formed of struts or framing members arranged to define adjacent triangular pyramids each having a base in a common plane wherein at least one edge of each base is common to an adjacent base.

Other objects and features may be inferred from the following description of specific examples of this invention, illustrated by the accompanying drawings in which:

FIG. 1 is a perspective view of a modular alternating pyramidal wall constructed of triangular panels;

FIG. 2 is a perspective view of a building constructed of triangular panels in alternating pyramidal shapes;

FIG. 3 is a plan view of a portion of a curved modular alternating pyramidal wall;

FIG. 4 is a perspective view, partially broken away for purposes of clarity, of a double layer modular alternating pyramidal wall;

FIG. 5 is a perspective view of a curved double layer modular alternating pyramidal wall;

FIG. 6 is a perspective view of panels and inner portions of a double panel section of modular alternating pyramidal wall; and

FIG. 7 is a perspective view of a wall constructed of struts arranged in modular alternating pyramidal shapes.

In a preferred embodiment of my invention, a wall is shown in FIG. 1 at **10**. A series of identical triangular panels **11** are disposed between an upper plate **12** and a lower plate **13**. Side edges **14** of adjacent panels **11** meet and are joined either permanently or temporarily by any conventional fastening means, such as nails, bolts, screws, straps and bolts, plates and bolts, etc. (not shown). Base edges **15** of alternating adjacent pairs of panels **11** are fastened by conventional fastening means (not shown) either to the upper plate **12** or lower plate **13**.

Triangular panels **11** may be of any size and proportion, depending upon the properties of materials employed and the use for which the structure is designed. Plywood panels are particularly appropriate for use in this kind of structure. In general, no panel should be so wide

in relation to its stiffness as to introduce the problem of local buckling.

As can be seen in FIG. 1, the triangular upper plates **12** and lower plates **13** may in like manner be of any convenient size and constructed of any suitable building material. For example, an upper plate **12** may be a plywood panel sufficiently wide to cover base edges **15**, and a lower plate may be a concrete foundation for a building or another plywood panel similar to the upper plate **12**, depending on the desired permanence of the structure.

As can be seen in FIG. 1, the triangular panels **11**, taken in pairs with each pair having its base edges **15** in a common plane, define two sides of a triangular pyramid, whose third side is perpendicular to its base. The pyramids thus defined are arranged with their bases alternately in an uppermost or lowermost position and coinciding alternately with the upper plate **12** or lower plate **13** respectively.

In order to determine the dimensions of a panel **11** in a straight wall, as in FIG. 1, a rectangular parallelepiped *a–b–c–d–e–f–g–h* is constructed, in which the dimension *a–c* represents the desired width of the wall, and *a–e* represents the desired height. It is convenient to let *a–d* represent the maximum practical width of the particular building material from which panels **11** are to be made. Each triangular panel **11** will then be of the dimensions of a triangle, *a–d–g* or *g–d–f*, which are equal in size but inverted and reversed relative to each other from the point of view of FIG. 1.

In FIG. 2, a structure **16** is shown in which a modular alternating pyramidal roof **17** is suspended in a horizontal plane across the tops of spaced apart vertical walls **18** and **19**. In order for outside edges **20** of the roof **17** to meet top edges **21** of the walls, the top edges **21** must be raised above the plane of top edges of a wall structure covered by a flat plate such as plate **12** in FIG. 1. Also, the outside edges **20** of the roof **17** will not be in a single plane perpendicular to the horizontal plane of the roof if the outside edges **20** meet the top edges **21**.

In the building structure shown in FIG. 2, the roof or wall panels may be made of any suitable building material and may be fastened together by any conventional fastening means (not shown).

Curved walls may be constructed in similar fashion to straight walls, and in a curved wall having a single center of curvature, all triangular panels will be of equal dimensions. In FIG. 3, a portion of a curved wall **22** is shown, formed of triangular panels **23**. The dimensions of each panel **23** are determined by constructing a trapezoidal solid similar to the parallelepiped construction for a straight wall. The bases of a trapezoidal solid would have the dimensions *i–j–k–l*, as shown in FIG. 3. Sides *i–k* and *j–l* should both be segments of radii drawn from the center of curvature desired for the wall. The curve of the wall is then defined by the arcs whose chords are represented by *i–j* or *k–l*.

If a wall consisting both of straight and curved sections is desired, the two different sections can be fitted together exactly if their height and thickness are equal. The thickness of a straight wall is exemplified by *a–c* in FIG. 1, and the thickness of a curved wall by *i–k* in FIG. 3. If those two dimensions and the height of the walls are equal respectively, the side edges of end triangular panels in each wall will have equal lengths and be at equal angles to the vertical and will therefore abut each other. The same rule applies to joining of two wall sections having different centers of curvature.

A double paneled wall may be constructed by forming triangular panels **11** or **23** each of which consists of two single panels disposed parallel to each other and separated by suitable spacing means. For example, two ply-

wood panels may be separated by wooden framing members (not shown). Double walled triangular panels thus constructed are joined together to form a wall just as panels **11** and **23** in FIGS. 1 and 3 are joined.

In FIG. 4, another embodiment of a double paneled wall **24** is shown. The wall **24** is formed of two single paneled modular alternating pyramidal walls **25** and **26** arranged so that in a solid rectangular space *m–n–o–p–q–r–s–t–u–v–w–y–x*, where panels of a wall **25** define a pyramid *m–n–o–q–t* whose base *m–n–o–q* is in a lower plane, panels of the other wall **26** define a pyramid *t–v–w–x–q* whose base *t–v–w–x* is in an upper plane.

Taking the rectangular space *m–n–p–q–s–t–v–w* as a modular unit, it can be seen from FIG. 4 that triangular panels *m–q–t* and *m–t–v* of wall **25** and triangular panels *q–t–v* and *m–q–v* of wall **26** define a tetrahedron *m–q–t–v* whose edges *m–q*, *q–t*, *t–v*, *m–v*, *m–t*, and *q–v* define six peripheral diagonals of a rectangular parallelepiped *m–n–p–q–s–t–v–w*, where the six diagonals are drawn so that each end of each diagonal is coterminous with an end of each of two other diagonals. For example, the end *q* of diagonal *m–q* is coterminous with *q–t* and *q–v*.

In FIG. 5, a modular unit of a curved double paneled wall **27** is shown. In the case of a curved wall, the space occupied by each modular unit *a'–b'–c'–d'–e'–f'–g'–h'* is an isosceles trapezoidal prism, and the triangular panels *a'–d'–f'*, *g'–f'–a'*, *d'–f'–g'*, and *a'–d'–g'* define a tetrahedron *a'–d'–f'–g'* whose edges *a'–d'*, *d'–f'*, *f'–g'*, *a'–f'*, *a'–g'*, and *d'–g'* define six peripheral diagonals of the isosceles trapezoidal prism *a'–b'–c'–d'–e'–f'–g'–h'*. Each end of each diagonal is coterminous with an end of each of two other diagonals.

As in the case of single paneled walls described in connection with FIGS. 1 and 3, double paneled walls may consist of straight and curving sections joined together in an abutting relationship provided that the requirements of equal height and thickness outlined above are met. Joining methods for double paneled walls are the same as for single paneled walls, and suitable means for joining are nails, screws, bolts etc. (not shown).

A further embodiment of a double paneled wall is shown in FIG. 6. Quadrilateral panels **28** and **29** are bent over ribs **30** and **31** to form a pillow like structure bounded by the sides of a rectangular parallelepiped *i'–j'–k'–l'–m'–n'–o'–p'*, and abutting edges of the panels **28** and **29** are fastened together by any conventional fastening means (not shown). Panels **28** and **29** are thus bent into cylindroidal shapes, and the edges of the panels define diagonals *m'–j'*, *j'–p'*, *p'–k'*, and *k'–m'* which are four peripheral diagonals of the parallelepiped *i'–j'–k'–l'–m'–n'–o'–p'*, each diagonal being coterminous with an end of another diagonal.

A structure *m'–j'–k'–l'* formed from panels **28** and **29** is the structural equivalent of a modular structure *m–q–t–v* shown in FIG. 4, and can be used in the same way. The former structure is also stronger than the latter for a given weight and thickness of panels because the panels are curved in the former structure.

Any suitable building material panels can be used for panels **28** and **29**, but plywood and pressed-wood or composition panels are particularly appropriate. Rectangular panels may be bent in a jig of the outline *m'–j'–k'–l'* and their edges then trimmed to remove the excess extending beyond the boundaries *m'–j'–k'–l'*.

All the double paneled wall structures described above are suited for filling with insulating or sound proofing materials, or they may be left empty.

Both the single and double paneled walls may be placed between upper and lower plates **12** and **13**, as shown in FIG. 1 or may be placed on any firm foundation. By the omission of modular structures at selected intervals, spaces for doors or ventilation are created. Any type of roof may be supported by the walls if building materials of appropriate strength are chosen, and no additional vertical framing is required for support of the walls.

Another embodiment of a modular alternating pyramidal wall is shown in FIG. 7. Framing members **32**, such as poles, rods, tubes, pipes, channels, beams, or any other long stiff components are arranged between upper plates **33** and lower plates **34** to define triangular pyramidal shapes. In each pyramid, two side members **35** and a cross member **36** define a triangular pyramid wherein the side defined by the side members **35** is perpendicular to the base lying in the plane either of the upper plate **33** or lower plate **34**.

Framing members **32** may be fastened to upper plates **33** or lower plates **34** by any conventional fastening means (not shown). If a permanent installation is desired, concrete blocks (not shown) with suitable angular openings to receive framing members **32** may be used in lieu of a lower plate **34**.

Alternate structures of the same general type as are shown in FIG. 7 include one in which side members **35** are omitted from one side of the wall structure. This structure offers a cost advantage if there is no need for the strength of side members **35** on both sides. Fabric panels or panels of any other structural material may be fastened to the framing members or to some of them by conventional fastening means.

All the modular alternating pyramidal walls described above are suited for standing alone as a wall of any desired height, within limits of the strength of available building materials, or a plurality of walls may be stacked one above the other to form a larger wall. If walls are stacked on each other, either the base edge of an upper wall may be fastened to the top edge of a lower wall or the upper plate **12** of a lower wall may serve as a lower plate **13** of an upper wall.

While several embodiments of the present invention have been shown and described, it is to be understood that certain changes and additions can be made by those skilled in the art without departing from the scope and spirit of this invention.

I claim:

1. A load bearing structure having a first wall comprising a plurality of pairs of triangular members, each said pair defining two sides of a triangular pyramid, adjacent ones of said triangular pyramids having a common edge, the apex of any one of said triangular pyramids being in the plane of the base of an adjacent one of said triangular pyramids, the plane of the base of any one of said triangular pyramids being substantially parallel to the plane of the base of an adjoining one of said triangular pyramids, the center of gravity of any one of said triangular pyramids falling within the base area defined by the two adjoining triangular pyramids, said base area constituting the area between a line connecting the inner set of base intersections of said adjoining pyramids and a second line connecting the outer set of base intersections of said adjoining pyramids.

2. The invention of claim 1 wherein each of said triangular members is a triangular plate of sheet material.

3. The invention of claim 1 wherein each of said triangular members is defined by a perimeter member.

4. A load bearing structure having a first wall comprising struts arranged to define adjacent triangular pyramids, adjacent ones of said pyramids being inverted with respect to each other, the apex of any one of said triangular pyramids being in the plane of the base of an adjacent one of said triangular pyramids, the plane of the base of any one of said triangular pyramids being substantially parallel to the plane of the base of an adjoining one of said triangular pyramids, the center of gravity of any one of said triangular pyramids falling within the wall base area defined by the two adjoining triangular pyramids, said wall base area constituting the area between an inner line connecting the inner set of base intersections of said adjoining pyramids and an outer

line connecting the outer set of base intersections of said adjoining pyramids.

5. The load bearing structure of claim 4 further characterized by a second wall having the same characteristics as said first wall, said first and said second walls being disposed relative to each other so that an edge of each of said triangular pyramids in said first wall is common with an edge of a corresponding one of the triangular pyramids in said second wall, the corresponding ones of said triangular pyramids of said first wall and of said second wall being inverted relative to each other.

6. The load bearing structure of claim 1 further characterized by a second wall having the same characteristics as said first wall, said first and said second walls being disposed relative to each other so that an edge of each of said triangular pyramids in said first wall is common with an edge of a corresponding one of the triangular pyramids in said second wall, the corresponding ones of said triangular pyramids of said first wall and of said second wall being inverted relative to each other.

7. The load bearing structure of claim 6 wherein each

of said triangular members is a triangular plate of sheet material.

8. The load bearing structure of claim 6 wherein each of said triangular members is defined by a perimeter member.

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