May 2, 1967 H. E. NATALIS 3,316,682

POLYGON BUILDING STRUCTURE

Filed March 2, 1964 3 Sheets-Sheet 1

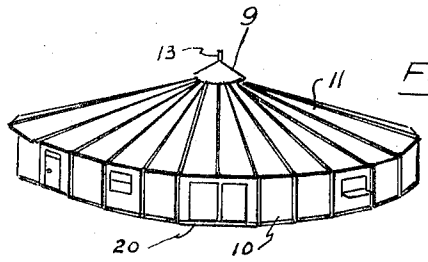


Fig. 1.

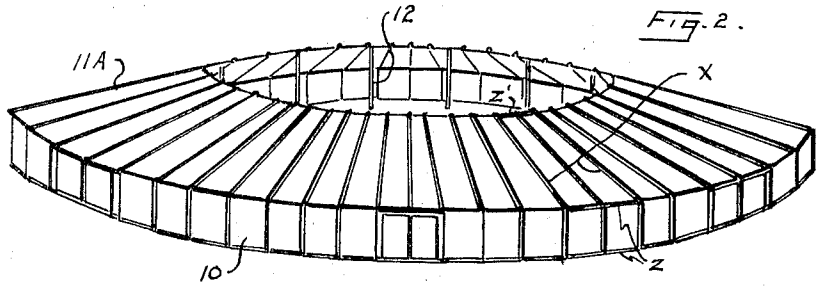


Fig. 2.

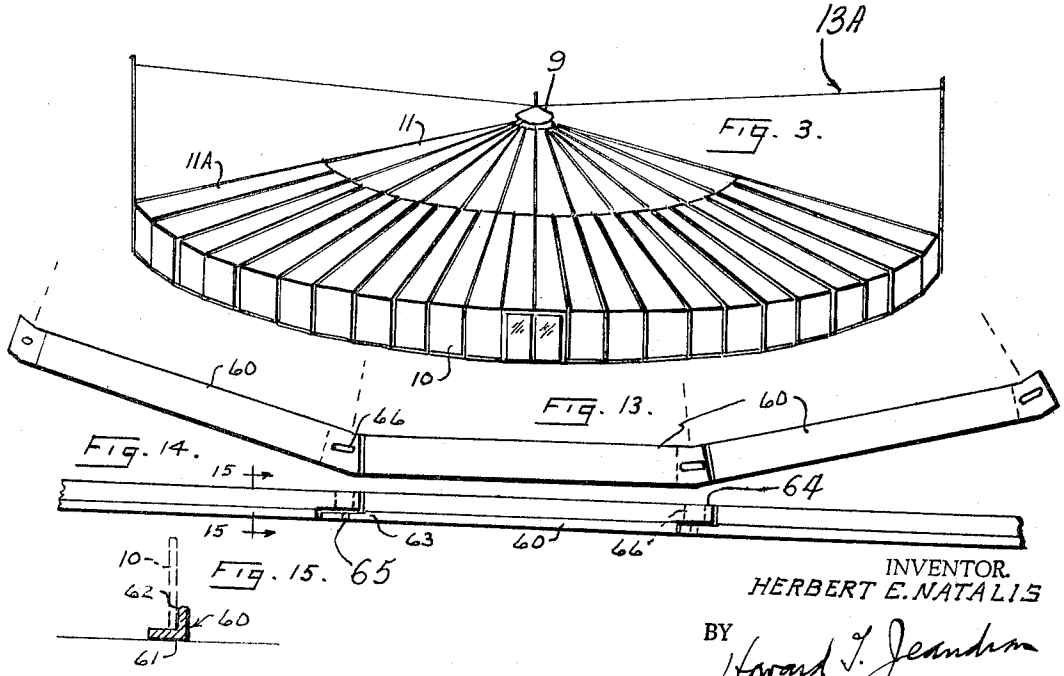


Fig. 3.

Fig. 13.

Fig. 14.

Fig. 15.

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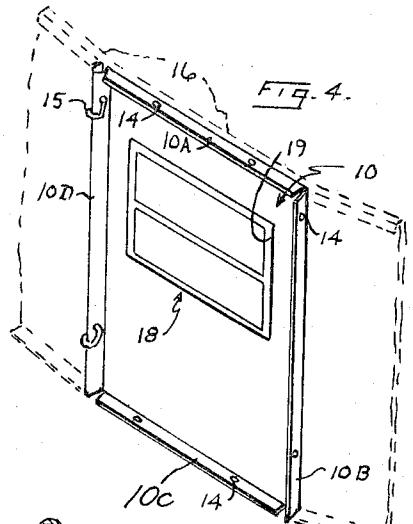


Fig. 4.

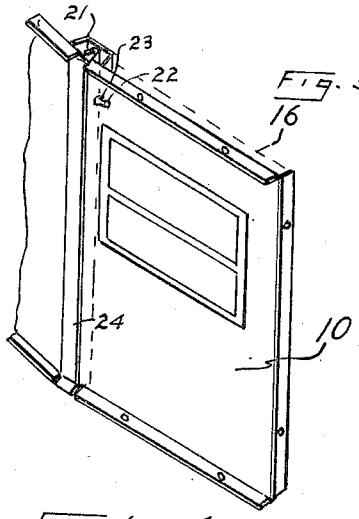


Fig. 5.

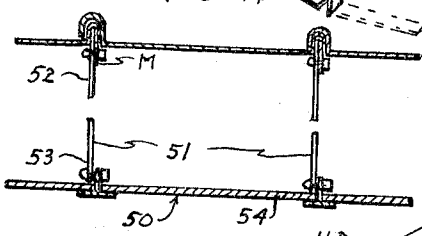


Fig. 16

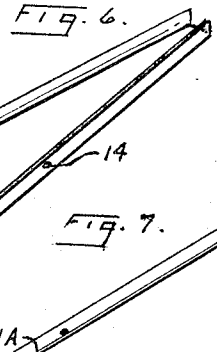
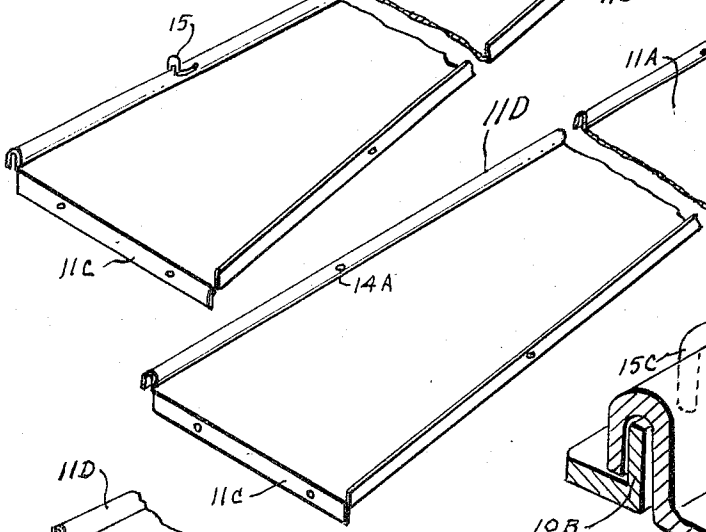


Fig. 6.



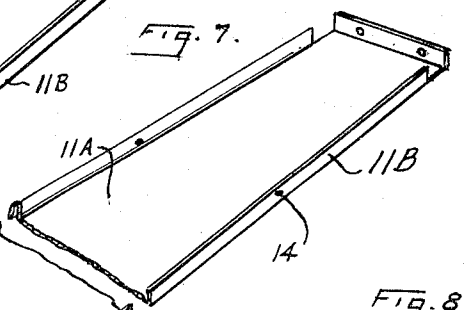


Fig. 7.

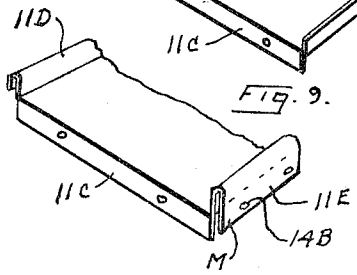


Fig. 9.

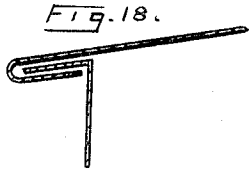


Fig. 18.

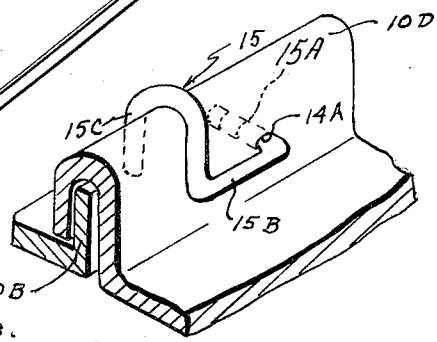


Fig. 8.

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FIG. 11.

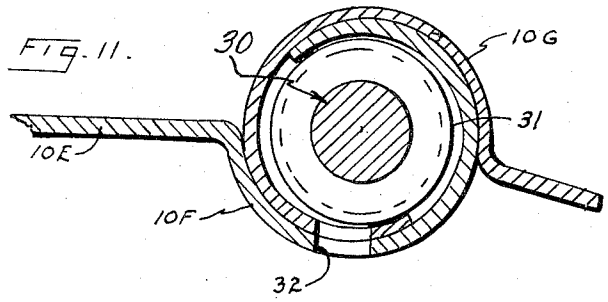


FIG. 10.

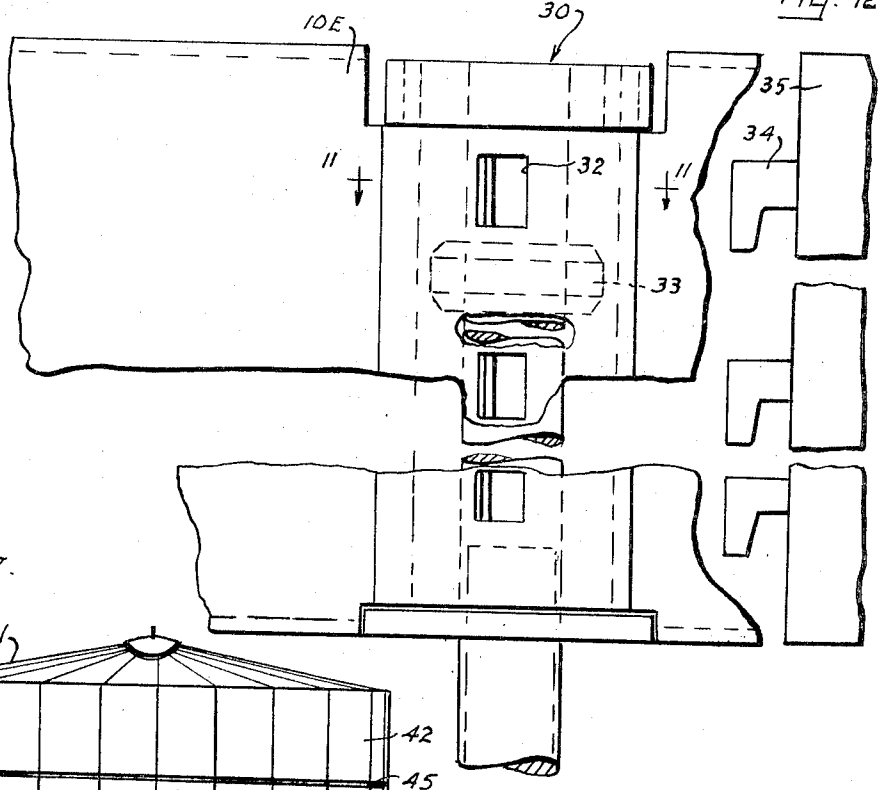
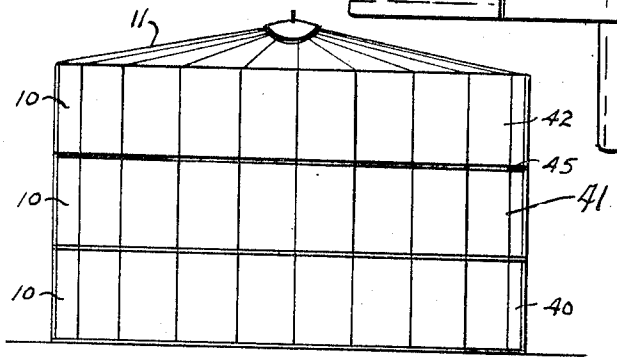


FIG. 12.

FIG. 17.



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POLYGON BUILDING STRUCTURE

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Filed Mar. 2, 1964, Ser. No. 348,414
2 Claims. (Cl. 52—237)

This invention relates to building structures and the components therefor. More particularly, this invention relates to structural units of integrated form, wherein the individual units, when employed for fabrication of a roof and wall of a polygon building or the like, comprise both the protective covering as well as the framework of the structure in which they are incorporated.

One specific example in which the individual structural units of this invention may be employed to great advantage is in the fabrication of a polygon shaped structure. When incorporated into this type of structure the structural units provide a building structure having exceptional strength, lightness, and attractiveness. The individual structural units taken alone are unique in configuration. They are also rugged, light in weight and exceptionally easy to handle and easy to fabricate.

It is an object of this invention to provide a building structure in which the units are exceptionally light in weight and in which the structure may be quickly and easily assembled or disassembled by unskilled labor.

It is an object of this invention to provide a polygon shaped building structure wherein each unit has an exceptionally high strength to weight ratio.

It is a further object of this invention to provide a structural unit for building structures wherein the framework of the finished design is automatically formed by components of the structural units as they are combined to form the completed structure.

A still further object of this invention is to provide a building wall made up of a plurality of structural units according to this invention which are arranged in such a fashion that the distribution of stress is that of a uniform circular shell under similar loading.

A still further object of this invention is to provide a building structure comprised of a plurality of structural units wherein each structural unit comprises both a stressed skin and at the same time performs as the framework of the finished structure.

A still further object of this invention is to provide a structural unit in which the particular design and construction effectively resists flexing and bending after all units have been completely connected.

A still further object of this invention is to provide a building structure comprised of structural units for the wall which are rectangular in form and structural units for the roof that are quadrangular in form with the units being so assembled together that the various load stresses imposed on the units are equally divided to form a continuous shell and equal distribution of stresses.

A further object of this invention is to provide a tank wall made up of a plurality of structural units according to this invention which are arranged in such fashion that the distribution of stress is in the form of a homogeneous shell.

Further objects of this invention shall be apparent by reference to the accompanying detailed description and the drawings in which

FIG. 1 is a perspective illustration of a polygon building structure.

FIG. 2 is a perspective illustration of an enlarged polygon building structure.

FIG. 3 is a perspective illustration of a further embodiment of FIG. 2.

FIG. 4 is a perspective illustration of a single structural wall element, with interlocking flanges facing outward.

FIG. 5 is a perspective illustration of a single structural wall element, with interlocking flanges facing inward.

FIG. 6 is a perspective view of a roof element illustrated in FIG. 1.

FIG. 7 is a perspective view of a roof element illustrated in FIGS. 2 and 3.

FIG. 8 is an enlarged perspective view of a structural detail.

FIG. 9 is a detail of a further embodiment of FIGS. 6 and 7.

FIG. 10 is an elevational view of a further embodiment of the wall structure.

FIG. 11 is a cross-sectional view taken on line 11—11 of FIG. 10.

FIG. 12 is an elevational detail of a partition element.

FIG. 13 is a plan view of a portion of a sectional base for the building shown in FIGS. 1, 2 and 3.

FIG. 14 is an elevational view of FIG. 13.

FIG. 15 is a cross-sectional view taken on line 15—15 of FIG. 14, and

FIG. 16 is a cross-sectional view of a further embodiment of this invention.

FIG. 17 is a perspective elevational view of a further embodiment of this invention, and FIG. 18 is a cross-sectional view of a variation of a structural joint.

Referring to the drawings and specifically FIG. 1 there is illustrated a polygon shaped building structure comprised of a plurality of wall units **10** and a plurality of roof elements **11** all joined at their edges to form a composite structure. Referring to FIG. 2 there is illustrated a further embodiment of this invention in which a building structure of approximately twice the diameter of the structure shown in FIG. 1 may be constructed using the same wall units **10** and provided with a plurality of roof units **11A**. With the structure illustrated in FIG. 2, a plurality of supporting column **12** are necessary to support the inner periphery of the joined elements **11A**. Referring to FIG. 4 there is illustrated a single wall unit **10** which may be comprised of a single sheet of metal in which the edges have been crimped or turned to form four separate edges **10A**, **10B**, **10C** and **10D**. The edges **10B** are in turn perforated with apertures **14** to permit the means of clamping one unit to the next unit as illustrated in FIG. 4. Utilizing clamps **15** and the edges **10D** which are U or V shaped and provided with a pair of aligned apertures **14A**, as illustrated in an enlarged view in FIG. 8, the clamp **15** which is comprised of a pivotal end **15A** and a U shaped and **15C** connected by an arm **15B**, the clamp by means of its end **15A** is passed through one of the apertures **14A** of the edge **10D** and the aperture **14** of an adjoining edge **10B** when it is aligned and then through the opposite aperture **14A** and then pivotally moved so that the U shaped end **15C** clamps over the U shaped formation of the edge **10D** to retain clamp **15** locked in this position to in turn lock the adjoining edges of panels **10** as illustrated in FIG. 4. It is to be noted that in view of the form taken by panel **10** it is easy to install insulating panels **16** to the inside (FIG. 4) or in each of the panels **10** (FIG. 5). It is also to be noted that the panels **10** may be a single sheet of material either metal or plastic boards or a wood board. It is to be further noted that with any treatment, such as doors or windows to be installed within a panel, they do not interrupt the structural value of each panel. In FIG. 4 there is illustrated a window **18** installed as a unit in an aperture **19** that has been cut in panel **10**. Similarly referring to FIG. 1 two panels may be utilized to provide a door **20** and due to the radial stress of the complete wall, the door cannot be cut completely through but a structural element must be used to tie across the top and bottom to provide the panels with the necessary strength to permit tying to the

adjoining panels **10** and to retain the complete radial shell.

Referring to FIG. 5 there is illustrated the same panel **10** but reversed so that the joining edges are faced towards the inside of the building so that the building is completely locked from the inside and cannot be tampered with to be opened from the outside. In this embodiment the edges **10B** and **10D** are joined in the same fashion as illustrated in FIG. 4 and in addition a covering channel **21** may be utilized to cover the joints to provide a more pleasing appearance. The attachment of channels **21** may be in any conventional manner such as inserting tabs **22** through **23** in panel **10** and bending over the tab **22**. A covering strip **24** may be also provided for the exterior edge of the joints between panels for making a water tight seal for the exterior of the building. Strip **24** may also be applied in any conventional manner such as by rivets and a weather proofing seal or caulking fluid may be used to insure a weather tight joint.

Referring to FIG. 6 there is illustrated a typical roof panel **11** quadrangular in form. The manner of connecting adjacent panels as illustrated in FIG. 1 is similar to the manner of connecting panels **10** as illustrated in FIG. 4. The same perforations **14** are formed in the edge **11B** and the same perforations **14A** are formed in the edge **11D** and the same clamps **15** already described are utilized. Thus a plurality of panels **11** may be joined to form a circular roof as illustrated in FIG. 1, the outer periphery resting upon the upper edge **10A** of panels **10**. It is to be noted that panels **11** are joined to form a cone shaped structure, that is, the angle of panel **11** is a minimum of 15° above the horizontal so that the joined structure retains a structural rigidity to support at its periphery the complete structural load or weight of the entire roof plus a required load capacity for snow. Of course if the apex of the cone is increased to greater than 15° from the horizontal, the load capacity of the roof will increase so that the roof may be designed to comply with any building code requirements. In addition it is to be noted that panels **11** when joined to form a circular roof as illustrated in FIG. 1, there is a small circular opening around the apex of the cone shaped area. This is beneficial to the structure, that is, in the hot weather this permits a natural ventilation of the covered area. To provide a complete coverage of this opening to make it rain-proof, a small cone **9** may be mounted over the apex of the cone. The manner of supporting cone **9** may be simply by resting it upon the ridges formed by the joints of panels **11** or an interior structure **13** or exterior structure **13A** may be utilized to carry the cone **9** as an entire separate element over the central opening in the roof.

Referring to FIG. 7 there is illustrated a similar quadrangular panel **11A**, that is, similar to panel **11** of FIG. 6 except that the angle of the joining edges **11D** and **11B** is half the angle of the panels **11** to permit forming a larger structure such as shown in FIG. 2. If the structure shown in FIG. 2 is double the diameter of the structure shown in FIG. 1, the panels **11** and **11A** may be utilized in a structure shown in FIG. 3, that is, the outer tier of roof panels **11A** in FIG. 3 will be similar to the panels **11A** shown in FIG. 2 and the central tier of panels **11** will be similar to the panels **11** shown in FIG. 1 and of course panels **11** at their base edge **11C** will be joined to the upper edge of panel **11A**. However at this joining edge, there will be a plurality of supports **12** as illustrated in FIG. 2 and as in FIG. 1 a central cone **9** may be utilized in the same manner as described in FIG. 1. It is also to be understood that although FIGS. 1 and 3 have been described as completely covered circular structure, the roof and wall structure may be formed with any one or more panels removed. However in this case the missing section X has to be provided with tie bars Z, Z' (FIG. 2) thus holding the structure together. The sector removed may be one or more panels up to half of the structure. Due to the manner of connecting all panels remaining and the tie rods this permits a distribution of stress without weakening the structure unduly. It is thus apparent that the roof structure may be formed as a half-circle with the tie rods across the opening and still retain the required structural support, although a degree of the structural strength is forfeited, but due to the attachment of the roof structure to the wall structure sufficient strength and balance is retained.

A further embodiment of panel **11** and **11A** is illustrated in FIG. 9 in which the edge **11B** is formed in a U shape and the free edge M is extended downward.

Referring to FIG. 16 there is illustrated a hanging ceiling so suspended from the free edge M of the panel **11** or **11A**. The hanging straps **51** may be of any desired length with the upper end **52** attached to edge M by clips or bolts and the lower end **53** similarly attached to an inverted T strip. Ceiling panels **54** are simply slipped into position as illustrated and supported by the T strips.

A further embodiment of this invention is illustrated in FIGS. 10 and 11 in which a plurality of panels **10E** that are similar to panels **10** of the prior embodiment except that one edge **10F** is formed circular to about 315°, and the opposite edge **10G** is formed circular to about 315°. Each circle is formed using two radii. Then edge **10G** mates and fits sidewise into the edge **10F** and rotates into position as illustrated in FIG. 11. Within the center of the mating circular edges there is provided a pin **30**. Pin **30** can be hollow in the form of a pipe of a diameter **31** to fit the internal radius of the circular aperture formed by the mating edges of the panels **10E**. Or pin **30** may be formed as a solid central rod **30** with enlarged bushings **33** of a diameter **31** to fit the central aperture formed by the circular mating edges of the panels **10E**. It is to be noted that pin or pipe **31** or **30** may be inserted through the length of the mating edges of panels **10E** and in addition may extend into the base or ground upon which the structure is to be mounted to thus anchor the structure solidly upon the base. This particular embodiment also lends itself to some variations, that is, by forming apertures **32** in the circular edges **10F** and **10G** so that the apertures **32** will be positioned in alignment when the panels are positioned in their proper angular relationship (in this example 15°) thus forming a complete aperture to permit inserting the anchoring elements **34** illustrated in FIG. 12, elements **34** being extended from a partition wall **35**. Elements **34** must of course be aligned with the position of the apertures **32** so that the partition **35** may be readily placed in abutting relationship with the coacting circular edges thus hanging partition **35** to permit dividing a circular structure into a plurality of compartments and the outer edges of partitions **35** may be anchored or connected in any usual manner to form open compartments or closed compartments as desired.

Referring to FIGS. 13, 14, and 15, there is illustrated a sectional base to be used in connection with the panels **10** as shown in FIGS. 1, 2, 3, 4, 5, and 10. The sectional base is comprised of a plurality of strips **60**. The strips **60** are L shaped in form as illustrated in FIG. 15. With a flat base **61** to rest upon the ground and an upright leg **62** which is placed inside the wall or panel **10**. The base or panel **10** thus rests upon the L shaped strip **60**. The strips **60** are interconnected at each end to the adjoining strip. As illustrated in FIG. 14 and one end **63** of strip **60** is provided with a lower extension while the opposite end **64** of strip **60** is provided with an upper extension. The end **63** is provided with a small circular threaded aperture **65** large enough to receive the center threaded end of the rod or post **30** FIG. 10. While the end **64** is provided with an elongated aperture **66** to permit adjustment or variation in the positioning of the strips with relation to each other. Therefore it is apparent that the

buildings illustrated in FIGS. 1, 2 and 3 may be readily positioned upon the base comprised of strips **60** to prevent the flanged lower edge of panels **10** from sinking into the ground and they will thus retain the complete structure on a fairly level base. Although the base has been described in connection with the use of the pipe or pin **30** it may also be used in connection with the panels shown in FIGS. 4 and 5 without using the pins **30**. In this instance it is possible to utilize anchoring pins simply inserted through the base into the ground, while the panel flange **10C** can be connected to the base through aperture **14**.

Referring to FIG. 17 there is illustrated a still further embodiment of this invention in which the panels **10** illustrated in FIG. 4 are combined to make a first tier or ring **40** and in which a plurality of panels **10** are combined to make a second tier **41** and a third group of panels **10** are combined to make a third tier **42**. In this embodiment the upper and lower edges **10A** and **10C** of panels **10** are utilized and similar apertures **14** are provided so that the first tier **40** may be structurally joined to the second tier **41** by means of the edge **10A** and **10C** and similarly the third tier **42** may be joined to the second tier **41** and the roof panels **11** may be combined as shown in FIG. 1 and the edges **11C** as shown in FIG. 6 may be utilized to join to the edges **10A** of the upper tier. A further embodiment of this particular connection would be to provide the edge **11C** in a U shaped or crimed form (FIG. 18) similar to edge **10D** so that the flange **10A** of panel **10** will fit into the U shaped edge **11C** to provide a better structural joint. With the structure completely joined as illustrated in FIG. 17, a tank may be quickly and easily formed for the storage of bulk material and the radial stress may be reinforced by increasing the number of clamps **15** utilized or by additionally providing reinforcing bands **45** around the complete circular structure if required.

Although this invention is primarily drawn around the formation of a polygon shaped structure comprised of panels of minimum thickness, the panels may be of any rigid material providing the necessary structural strength and the panels may be joined by bolts or any manner of retaining the joints rigidly affixed without departing from the spirit of this invention and although a particular designed panel has been illustrated, the panels may be larger in size and somewhat different in shape, that is, square or elongated rectangularly or trapezoidal in form without departing from the spirit of this invention and the panels although described as joined to form a polygon shaped

structure, they may be joined to form a half-round or half polygon structure or an out of round structure without departing from the spirit of this invention althongh one type of base has been illustrated the base may take other forms such as a foundation type of base unit without departing from the spirit of this invention and this invention shall be limited only by the appended claims.

What is claimed is:

1. A prefabricated structural panel adapted for use in multiple in a wall structure comprising a unitary quadrangular flat member provided with an upper and lower flanged edge and two partially circular mating edges, formed to interlock with an adjoining edge, a locking pin being smaller in diameter than the diameter of said circular mating edges and fitted with bushings that are of the same diameter as said circular mating edge, said bushings spaced apart on said locking pin and a plurality of apertures formed in said partially circular mating edges and located between said bushings, said locking pin fitted between the interlocking partially circular edges of adjoining members, to form a unitary ring shaped wall.

2. In a ring shaped wall according to claim **1**, a plurality of partitions having anchoring hook shaped elements on one side, said anchoring hook shaped elements spaced to fit into said apertures of said mating edges of said panels to hang and support said partitions and provide a plurality of compartments within said ring shaped wall.

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