

Aug. 29, 1944.

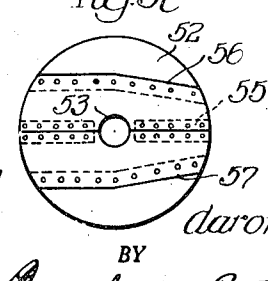
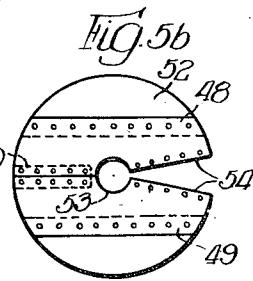
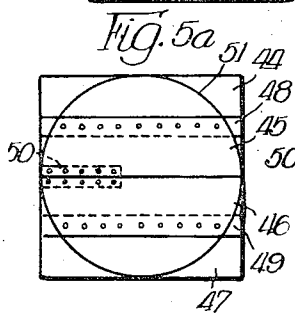
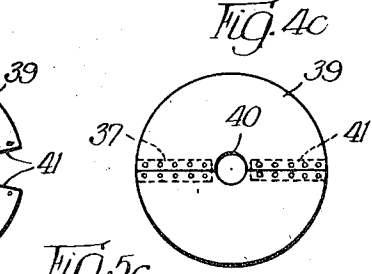
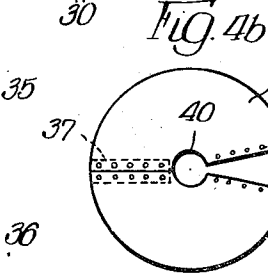
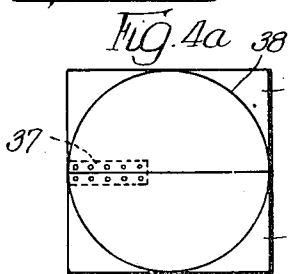
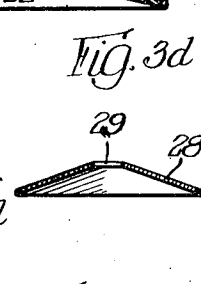
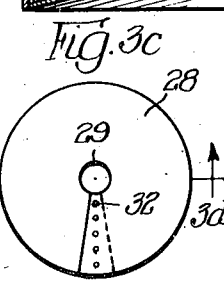
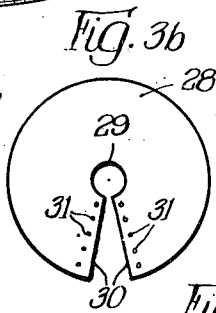
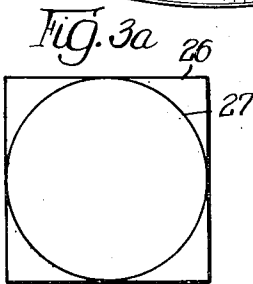
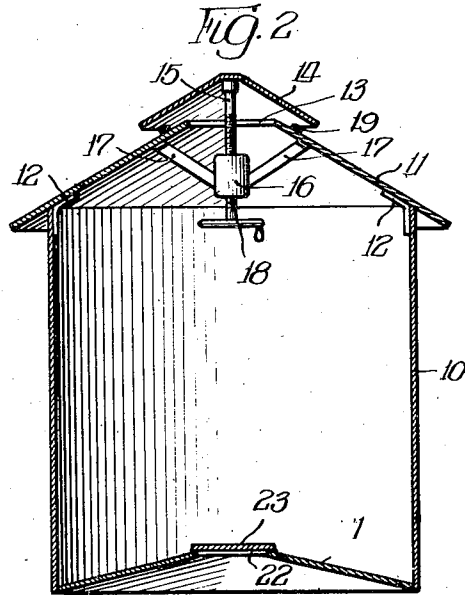
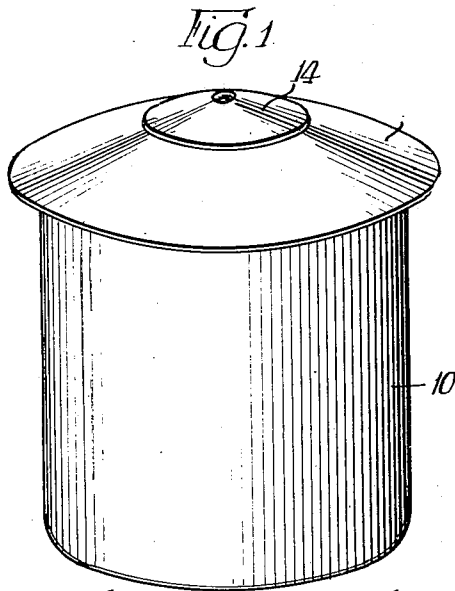
A. A. LADON

2,356,768

BUILDING CONSTRUCTION

Filed June 22, 1942

2 Sheets-Sheet 1



INVENTOR.
A. A. Ladon.
BY
Maurice A. Borden, Attorney

Aug. 29, 1944.

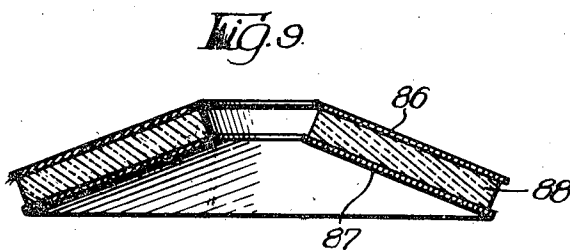
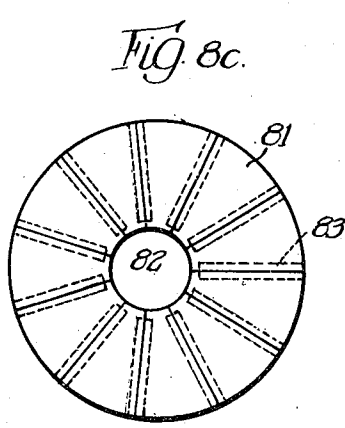
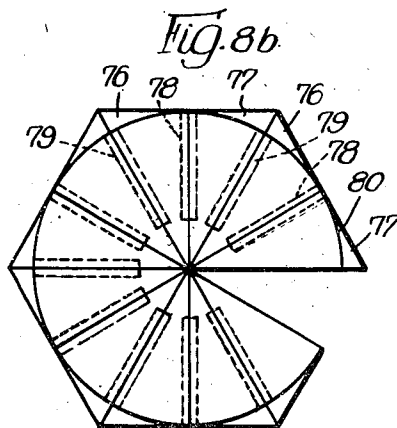
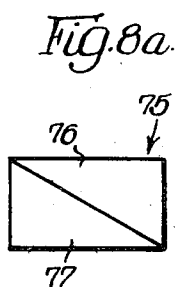
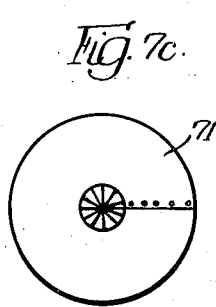
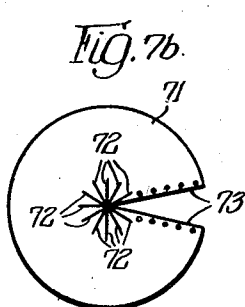
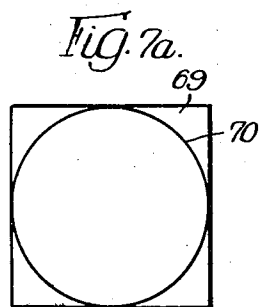
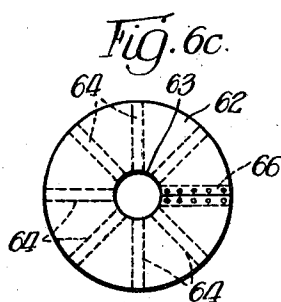
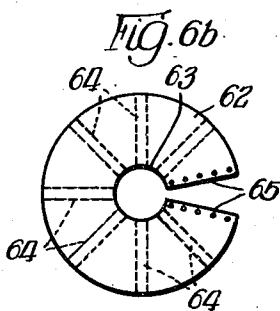
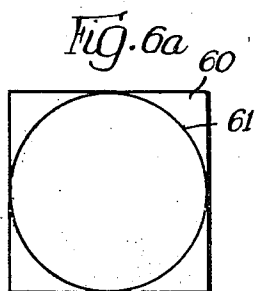
A. A. LADON

2,356,768

BUILDING CONSTRUCTION

Filed June 22, 1942

2 Sheets-Sheet 2



INVENTOR
A. A. Ladon,
BY
Brewster B. Bowers, Attorney
attys

UNITED STATES PATENT OFFICE

2,356,768

BUILDING CONSTRUCTION

Aaron A. Ladon, Evanston, Ill., assignor to
Masonite Corporation, Laurel, Miss., a corpora-
tion of Delaware

Application June 22, 1942, Serial No. 447,912

15 Claims. (Cl. 108—32)

My invention relates, generally, to building construction and it has particular relation to the construction of roofs for various kinds of buildings such as grain storage bins, brooder houses, machinery storage buildings, play houses and the like.

An object of my invention is to provide a roof structure that is inherently weather resisting and self supporting so that no additional weatherproof covering is required and no frame structure need be provided.

Another object of my invention is to employ relatively thin building board cut to special configurations so as to permit its being formed into a cone shape and stressed so as to be self-supporting.

Another object of my invention is to provide a roof construction in which two or more standard widths of building board can be assembled into a single composite sheet so as to provide any desired roof area in a construction employing the present invention.

It is also an object of my invention to provide, for reenforcing a large area low slope roof construction made in accordance with the present invention.

A further object of my invention is to provide for relieving the stress incident to the formation of the cone structure at the center and at the same time provide at the apex means whereby the same can be readily weather proofed.

A still further object of my invention is to provide for heat insulating a roof construction made in accordance with my invention.

Other objects of my invention will, in part, be obvious and in part appear hereinafter.

For a more complete understanding of the nature and scope of my invention reference can be had to the following detailed description taken in connection with the accompanying drawings in which:

Figure 1 is a perspective view of a building construction in which my invention is incorporated;

Figure 2 is a longitudinal sectional view of the building construction shown in Figure 1;

Figures 3a, 3b, 3c, and 3d illustrate different stages in the construction of one form of roof structure employing initially only a single sheet of building board;

Figures 4a, 4b and 4c show the different steps employed in making a roof construction using initially two sheets of standard size building board;

Figures 5a, 5b and 5c show the different steps

used in making a roof construction employing initially four standard size sheets of building board;

Figures 6a, 6b and 6c show the different steps that may be followed in making a roof construction having a relatively large area and a relatively small slope employing initially a single sheet of building board and reenforcing strips;

Figures 7a, 7b and 7c show the steps that may be followed in making a roof construction in which the central portion is radially slitted to relieve the pressure and facilitate weatherproofing;

Figures 8a, 8b and 8c shows the various steps that can be followed in making a roof construction in which initially several relatively small standard sized sheets are employed; and

Figure 9 is a cross-sectional view of a roof construction made in accordance with the present invention and incorporating therein heat insulation.

Referring now particularly to Figures 1 and 2 of the drawings, it will be observed that the reference character 10 designates a generally cylindrical supporting structure which is positioned so that its longitudinal axis is vertically disposed. It will also be noted that the support structure 10 has a roof 11 at its upper end. It is to the details of construction of the roof 11 that the present invention is particularly addressed.

While the support structure 10 has been shown and described as being generally cylindrical, it will be understood that, if desired, it may be rectangular or polygonal, suitable steps being taken as are necessary to provide a weather tight construction and joinder with the roof 11. The cylindrical construction for the support structure 10 is illustrated since it is one of the most practical for certain uses such as grain storage bins, silos, and the like. The support structure 10 can be formed of any suitable material such as metal or relatively thin sheets of building board such as Presdwood, plywood and the like.

As shown in Figure 2 of the drawings, the roof structure 11 can be secured to the support section 10 by suitable clips 12. If desired a space can be provided between the under surface of the roof 11 and the upper edge of the support structure 10 for ventilation purposes.

The roof structure 11 is in the form substantially of a right circular cone and in certain embodiments there is provided an aperture 13 at the apex which facilitates the formation of the conical

roof construction. In addition it provides an excellent means for ventilating the building construction.

With a view to covering the aperture 13 there is provided a cap 14 which is of conical construction and may be formed in the same manner that the roof structure 11 is formed, as will be described hereinafter. The cap 14 is supported on the upper end of a threaded member 15 which, as shown, may be threaded in a nut 16 that is carried by arms 17 and fastened to the under side of the roof structure 11. A hand wheel 18 is secured to the member 15 to facilitate moving the cap 14 vertically as will be readily understood. A suitable gasket 19 of rope or the like is provided on the upper surface of the roof construction 11 and underneath the cap 14 so as to permit a substantially sealed and weather tight joint therebetween. It will be understood that any other suitable means can be provided for raising and lowering a cap 14, the particular means shown being for illustrative purposes only.

If the construction is employed for grain storage purposes, then the floor 21 can be formed of the conical construction employed for the roof construction 11. The central opening 22 can be closed by any suitable means such as a plate 23.

As previously indicated the roof construction 11 is preferably formed of building board. This may be any the hard boards such as Presdwood, plywood, Asbestos Wood or insulation and wall boards. These materials are relatively thin. They are obtainable in standard widths and thicknesses. The widths that are commonly used are 4 ft., 8 ft., and 12 ft. The thicknesses that are commonly used are $\frac{1}{8}$ ", $\frac{1}{4}$ ", $\frac{1}{2}$ " and $\frac{3}{4}$ ". While such building boards have considerable tensile and compression strengths, because of their relatively thin character they are exceedingly flexible and, when unsupported or used flat they can be readily warped out of shape.

In accordance with my invention I propose to employ this relatively thin and flexible material for making a roof construction, particularly a circular roof construction that shall be inherently self-supporting. Since some of the building boards, particularly Presdwood, are inherently weatherproof, the resulting construction is not only self-supporting but also is weatherproof and does not require any additional covering such as paint or roofing to protect it from the weather.

According to my invention, I stress the relatively thin sheet of building board so as to form it into substantially a right circular cone. When the building board is so stressed in the form of a right circular cone, it is arched throughout except along the slant height. As the result of this arched configuration, the conical roof structure is able to resist a substantial load without appreciable deflection and a load which is far greater than the load which it could support without substantial deflection if applied to the sheet when flat or unstressed.

The conical roof construction can be formed of relatively thin building board using standard widths and thicknesses. Various areas of roof construction can be made and various slopes provided as desired. Certain of the preferred forms of construction will now be described.

In Figure 3a of the drawings it will be observed that the reference character 26 designates a sheet of building board. It may be of standard width and thickness such as 4 ft. by 4 ft. by

$\frac{3}{4}$ ". The square shape is preferred in this instance to reduce the amount of material to the minimum. As indicated at 27 a circle is scribed on the sheet 26 having a diameter which is equal to the width of the sheet. The sheet 26 is then cut along this outline to provide a circular plate, as shown in Figure 3b at 28. Now a circular opening 29 is cut at the center of the plate 28. The reason for the opening 29 or its equivalent is to relieve the stress at the center of the plate 28 incident to the formation of the conical roof construction. The plate 28 is then radially cut along the lines 30 to remove a wedge or sector shaped portion. The angular distance apart of the radial slits 30 governs the degree of overlap, if a lap joint is used, and also the slope of the resulting roof structure. Holes 31 are then drilled along the edges of the plate 28 which face each other. Preferably these holes 31 are drilled on radial lines and are spaced so that they register with each other in the assembled position.

Now the central portion of the plate 28 is deformed with respect to its periphery. For example, the central portion about the opening 29 is suitably supported at a substantial distance from the surface of a bench or floor and the outer periphery is moved downwardly and the spaced apart edges are drawn together sufficiently far so that the holes 31 are in registry. Suitable bolts 32, as shown in Figure 3c, are then inserted in the holes 31 for holding the structure in assembled relation. It will be observed in Figure 3c that a lap joint is employed. If desired a butt joint can be used and a furring strip placed underneath it with two rows of bolt holes for registry with corresponding holes in the plate 28 along the juxtaposed edges. The resulting conical structure is then shown in section in Figure 3d. While the initial square sheet 26 of Figure 3a is relatively flexible and when picked up by one edge, it tends to bend, the resulting conical structure as shown in Figure 3d is relatively rigid and, when picked up at the edge exhibits no tendency to bend or deform.

In some instances it may be desirable to wet the central portion of the plate 28 about the opening 29 so as to facilitate formation of the conical structure. This may be particularly desirable where the opening 29 is relatively small or the slope of the roof is to be relatively high.

The resulting roof structure then can be embodied in the building construction such as the roof 11 in Figures 1 and 2 of the drawings. It will be observed that it is unnecessary to provide any framing or support structure for the roof when it is made as described and shown in Figures 3a through 3d of the drawings. Further, since the building board preferably used is inherently weatherproof, it is then unnecessary to either paint the resulting construction or cover it with roofing to protect it from the weather.

In Figure 4a of the drawings there is illustrated how the roof construction of the present invention can be made employing two standard widths of building board. For example, two sheets 35 and 36 can be employed each being 4 ft. wide and 8 ft. long for the purpose of making a roof structure having a diameter slightly less than 8 ft. The sheets 35 and 36 are positioned so as to form a square and are joined together along portions of their abutting edges by a suitable furring strip 37. A circle 38 is then scribed on the upper surface of the composite sheet and the plate 39, as shown in Figure 4b is then cut out. An open-

ing 40 is cut in the center of the plate 39 for the purpose described hereinbefore. The plate 39 is then radially cut along the lines 41, the angle being determined by the slope desired. The spaced apart edges of the plate 39 are then joined by deforming the central portion with respect to the periphery and the juxtaposed edges are then held together by a suitable furring strip 41 as shown in Figure 4c.

In Figure 5a of the drawings there is shown how four standard widths of building board can be assembled for the purpose of making a conical roof structure in accordance with the present invention. The four sheets 44, 45, 46 and 47 are arranged so that a lap joint 48 is provided between sheets 44 and 45 and another lap joint 49 is provided between sheets 46 and 47. The edges of the sheets 45 and 46 are juxtaposed and they are secured together along portions of their respective lengths by a furring strip 50. A circle 51 is then scribed on the upper surface of the composite sheet and the circular plate 52 is then cut out, as shown in Figure 5b. An opening 53 is provided at the center for the reason set forth hereinbefore and then the plate 52 is radially cut along the lines 54 to remove a wedge shaped section. The central portion about the opening 53 is then deformed with respect to the periphery of the plate 52 so as to provide the conical construction shown in plan view in Figure 5c. The juxtaposed edges of the plate 52 are held together by a furring strip 55. It will be observed that the edges 56 and 57 of the sheets 45 and 46 are shown as being curved toward each other in Fig. 5c. The reason for this is that the plate 52 is no longer flat but has been formed into the conical construction. However, there is only a single bend which the building board is required to accommodate in the conical construction rather than a double bend, since the edge 56, for example, is merely bent or curved in a single plane. It is because of this property, i. e., that the material in the conical configuration is subjected only to a single bend, which makes it possible to utilize material such as building board for the purpose herein described. At the same time because of the thickness of the material it is possible to develop considerable stress resisting qualities because of the arched configuration.

It will be obvious that there is a limit to the area of the roof section made in accordance with the present invention where with a given thickness of building board, the roof structure is satisfactorily self-supporting. That is, where the material is relatively thin and the diameter is relatively great such as 15 to 20 ft., it may be desirable to provide some reenforcing. However, when the present invention is employed it is unnecessary to provide a complicated and expensive support or reenforcing structure as will now be apparent.

In Figure 6a there is shown a rectangular sheet 60 which may be a single sheet or made up of several sheets as desired and which may be, for example, 20 ft. square. A circle 61 is scribed on the sheet 60 and the circular plate 62, Figure 6c, is cut out. The central opening 63 is provided to relieve the stress at the center when the plate 62 is deformed to the conical configuration. In order to reenforce the construction, strips 64 can be suitably secured to the under side of the plate 62 when it is flat. The number and size of the strips 64 will be determined by the degree of rigidity required. The strips 64 can be secured to

the plate 62 in any suitable manner such as by screws, bolts, nails, etc. The plate 62 is then radially cut along the lines 65 to remove a wedge-shaped section. The central portion of the plate 62 is then deformed relative to the periphery as shown in Figure 6b of the drawings and the juxtaposed edges are joined by a furring strip 66.

It is important to note that the strips 64 can be placed in position while the plate 62 is in the flat condition. This is possible since, in the final cone shape as shown in Figure 6c, the roof structure is straight rather than curved along its slant height. The strips then are not required to bend to conform to the cone shape. It is a relatively simple matter to apply the reenforcing strips 64 to the plate 62 when it is flat. Obviously the strips 64 can be applied at the factory and the plate 62 can be shipped to the installation point in assembled condition.

It will be understood that the various embodiments of roof construction disclosed herein can be prefabricated in the factory. They can be shipped flat in a compact bundle and readily assembled on the job as and where desired. Further they can be dismantled and restored to the flat condition for storage and subsequent reconstruction.

Instead of employing strips 64 as shown in Figures 6b and 6c, one or more reenforcing rings can be applied to the underside of the roof structure in the cone form. Such ring or rings can be suitably bolted or otherwise secured to the roof structure as desired.

Instead of providing an opening at the center of the sheet for relieving the stress, this end can be accomplished by other means. As shown in Figure 7a of the drawings, a sheet 69 of building material is provided and a circle 70 is scribed thereon. The circular plate 71 is cut out as shown in Figure 7b.

At the center of the plate 71 a number of radial slots 72 is cut, the slots extending, as shown, relatively short distances from the center of the plate 71. The plate 71 is also cut along the radial lines 73 to remove the wedge shaped section. The central portion of the plate 71 is then deformed relative to its periphery to provide the conical construction as shown in Figure 7c of the drawings. The generally sector shaped portions provided by the cuts 72 at the center generally rearrange themselves in somewhat overlapping position. If desired a coating of tar or other suitable weatherproofing material can be given to the overlapping portions for completely weatherproofing the roof structure. In Figure 7c of the drawings it will be noted that the juxtaposed edges of the plate 71 are secured by a lap joint. If desired a butt joint could be used.

In Figures 8a, 8b and 8c there is illustrated the manner in which a roof construction in accordance with the present invention can be made using relatively small sheets of building board. In Figure 8a of the drawings there is shown a sheet 75 which, for example, may be 4 ft. wide and 8 ft. long. It is cut along a diagonal to provide two portions 76 and 77 which, it will be observed, are right triangles. The portions 76 and 77 are then assembled back to back, as shown in Figure 8b, so that together they provide an isosceles triangle. Furring strips 78 can be used for joining the juxtaposed edges of the right triangular portions 76 and 77. The desired number of isosceles triangular portions are assembled and the juxtaposed edges are secured together by furring strips 79. The resulting configuration is

generally polygonal but one or more of the triangular sections is omitted, as shown in Figure 8b, to permit the deformation to the conical construction. A circle 80 is scribed on the upper surface of the composite sheet and the circular plate 81, as shown in Figure 8b, is then cut out. If desired the central portion of the plate 81 can be cut out as indicated at 82 or the construction shown in Figure 7b can be followed, if it is not desired to provide a central opening. The central portion of the plate 81 is then deformed with respect to its periphery and the juxtaposed edges are held together by a furring strip 83.

In Figure 9 of the drawings there is shown a construction embodying the present invention that is heat insulated. For example, two conical members 86 and 87 can be formed in accordance with any of the embodiments previously described. They are stacked one above the other in spaced relation and a layer 88 of suitable insulating material is provided therebetween. This construction makes it possible to prefabricate a heat insulated roof construction in a simple and efficient manner.

Since many changes can be made in the foregoing construction and method without departing from the spirit and scope thereof, it is intended that all matter shown in the accompanying drawings and described hereinbefore shall be interpreted as illustrative and not in a limiting sense.

I claim as my invention:

1. A roof structure comprising a relatively thin single sheet of building board so stressed that it forms substantially a right circular cone whereby the roof structure is self supporting and capable by itself of withstanding a substantial load.

2. A roof structure comprising a relatively thin single sheet of weather proofed building board so stressed that it forms substantially a right circular cone characterized in that the roof structure requires no weather proof covering or support frame but is inherently weather resisting and self supporting and is capable of withstanding a substantial load.

3. A roof structure comprising a plurality of relatively thin sheets of building board with their edges secured together to form a single composite sheet, said composite sheet being so stressed that it forms substantially a right circular cone whereby the roof structure is self supporting and capable by itself of withstanding a substantial load.

4. A roof structure comprising a plurality of relatively thin sheets of weather proofed building board with their edges secured together in abutting relation to form a single composite sheet, said composite sheet being so stressed that it forms substantially a right circular cone characterized in that the roof structure requires no weather proof covering or support frame but is inherently weather resisting and self supporting and is capable of withstanding a substantial load.

5. A roof structure having a relatively small slope and a relatively large area comprising a relatively thin single sheet of building board so stressed that it forms substantially a right circular cone, and reinforcing strips secured to and extending radially of said cone.

6. A roof structure comprising a relatively thin single sheet of building board so stressed that it forms substantially a right circular cone, the apex of said cone being formed by overlapping portions of said board provided by radially slitting the central portion thereof.

7. A roof structure comprising a pair of relatively thin sheets of building board stacked one above the other in spaced relation and each so stressed that each forms substantially a right circular cone, and a layer of heat insulating material filling the space between said sheets.

8. Method of making a self supporting roof structure from a sheet of relatively thin building board which comprises: radially slitting the sheet to remove a wedge shaped section, deforming the central portion of the sheet with respect to its periphery so as to close the opening left by removal of said wedge shaped section and form substantially a right circular cone, and joining the juxtaposed portions of said sheet to hold the same under stress in the cone shape.

9. Method of making a self supporting roof structure from two sheets of relatively thin building board which comprises: securing the edges of said sheets in juxtaposed relation along a portion of their respective lengths, removing a circular portion from the center portion of said sheets, radially slitting the sheets along their unjoined juxtaposed portions to remove a wedge shaped section, deforming the central portion of said sheets with respect to the periphery thereof so as to close the opening left by the removal of said wedge shaped section and form substantially a right circular cone, and joining the juxtaposed remaining portions of said sheets to hold the same under stress in the cone shape.

10. Method of making a self supporting roof structure from a sheet of relatively thin building board which comprises: radially slitting the sheet to remove a wedge shaped section, radially slitting the sheet along a plurality of lines extending relatively short distances from the center, deforming the central portion of the sheet with respect to its periphery so as to close the opening left by removal of said wedge shaped section and from substantially a right circular cone, and joining the juxtaposed portions of said sheet to hold the same under stress in the cone shape.

11. Method of making a self supporting roof structure from a plurality of rectangular sheets of relatively thin building board which comprises: slitting each sheet along a diagonal to provide a pair of right triangular portions, disposing the portions of each pair so as to form an isosceles triangular portion and joining the juxtaposed edges thereof, disposing the isosceles triangular portions in juxtaposed relation so as to form a polygonal portion with one or more of the right triangular portions being omitted and joining the juxtaposed edges thereof, deforming the central portion of the polygonal portion with respect to the periphery thereof so as to close the space left by omitting said one or more triangular portion and form substantially a right circular cone, and joining the remaining juxtaposed edges to hold the resulting construction under stress in the cone shape.

12. A building construction comprising, in combination, a support structure and a roof structure carried by and covering the upper end thereof, said roof structure comprising a single relatively thin sheet of building board so stressed that it forms substantially a right circular cone whereby the roof structure is self supporting and is capable by itself of withstanding a substantial load and provides a slope for draining off water that may fall thereon.

13. A building construction comprising, in combination, a generally circular support structure adapted to be positioned so that its longitudinal

axis is vertical, and a roof structure carried by and covering the upper end of said support structure, said roof structure comprising a relatively thin sheet of weather proofed building board so stressed that it forms substantially a right circular cone characterized in that the roof structure requires no weather proof covering or support frame but is self supporting and is capable of withstanding a substantial load.

14. Method of making a self-supporting roof structure from a sheet of relatively thin building board which comprises: cutting the sheet to form a circular plate, radially slitting the plate to remove a wedge shaped section, securing reinforcing strips to the plate along radial lines, deforming the central portion of the plate with respect to its periphery so as to close the opening left by removal of said wedge shaped section and form substantially a right circular cone, and joining the juxtaposed portions of said plate to hold the same in the cone shape.

15. Method of making a self-supporting substantially conical shaped roof structure from a relatively thin building board which comprises forming the board into a substantially circular sheet, removing a portion of the sheet at the center to relieve stresses when the sheet is deformed into the conical shape, securing reinforcing strips to the face of the sheet, said strips extending radially from points short of the center to substantially the periphery of the circular sheet, radially slitting the circular sheet to remove a wedge shaped section, deforming the central portion of the sheet with respect to the periphery thereof so as to close the opening left by the removal of said wedge shaped section and form a substantially right circular cone, and joining the juxtaposed remaining portions of said sheet to hold the same under stress in the cone shape.

AARON A. LADON.