April 16, 1963 W. H. JAMISON 3,085,366

DOME CONSTRUCTION

Filed July 15, 1959 4 Sheets-Sheet 1

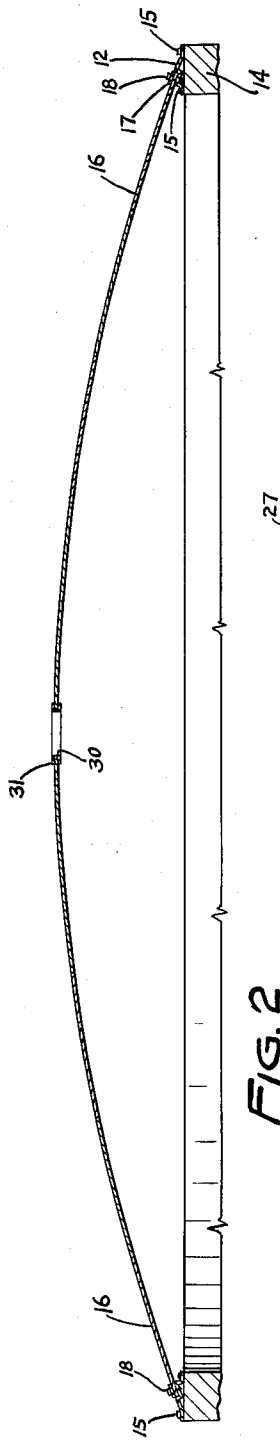


FIG. 2

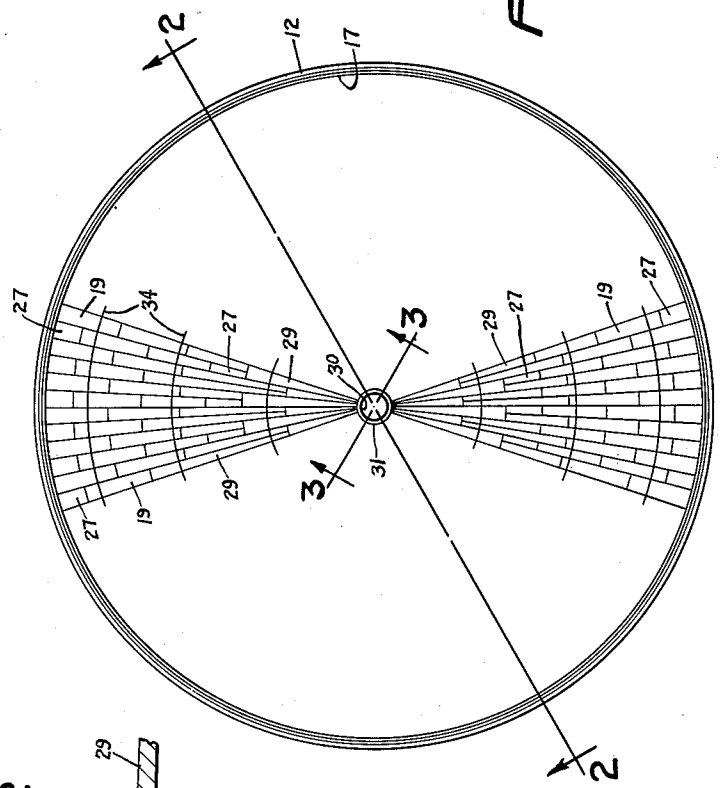


FIG. 1

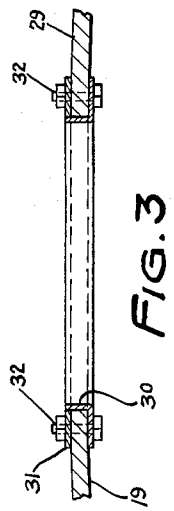


FIG. 3

INVENTOR.
WILLIAM H. JAMISON
BY Moore, White & Bond
ATTORNEYS

April 16, 1963 W. H. JAMISON 3,085,366

DOME CONSTRUCTION

Filed July 15, 1959 4 Sheets-Sheet 2

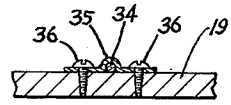


FIG. 5

FIG. 4

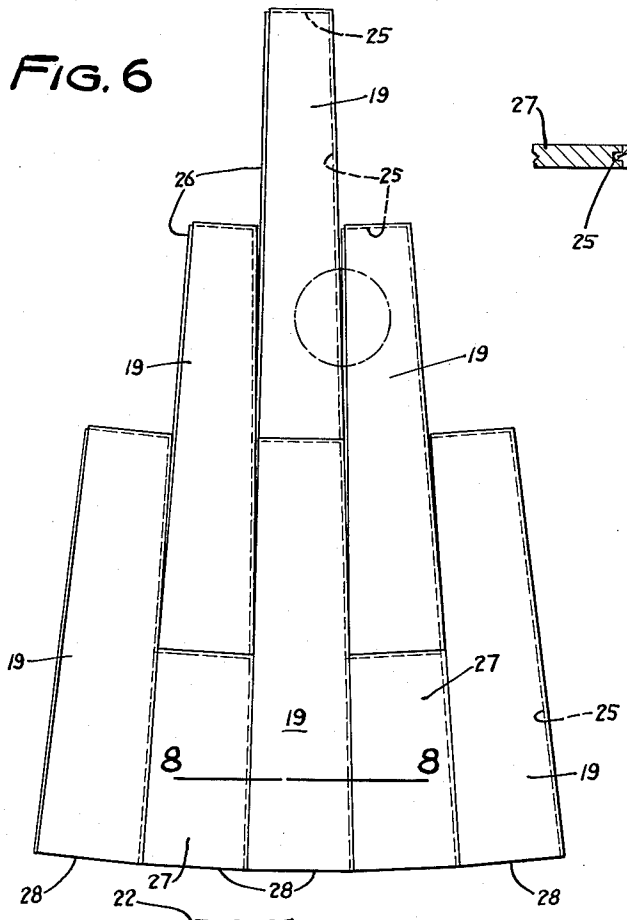
INVENTOR.
WILLIAM H. JAMISON
BY
Moore, White & Bard
ATTORNEYS

April 16, 1963 W. H. JAMISON 3,085,366

DOME CONSTRUCTION

Filed July 15, 1959 4 Sheets-Sheet 3

FIG. 6



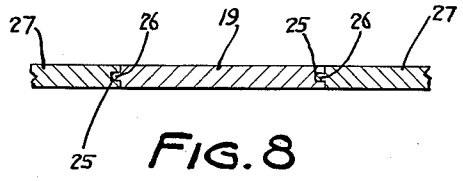


FIG. 8

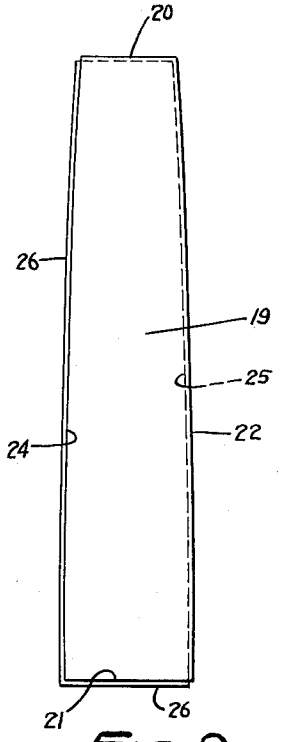


FIG. 9

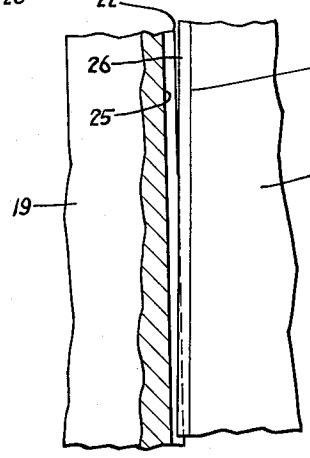


FIG. 7

INVENTOR.
WILLIAM H. JAMISON
BY Moore, White & Burd
ATTORNEYS

April 16, 1963 W. H. JAMISON 3,085,366

DOME CONSTRUCTION

Filed July 15, 1959 4 Sheets-Sheet 4

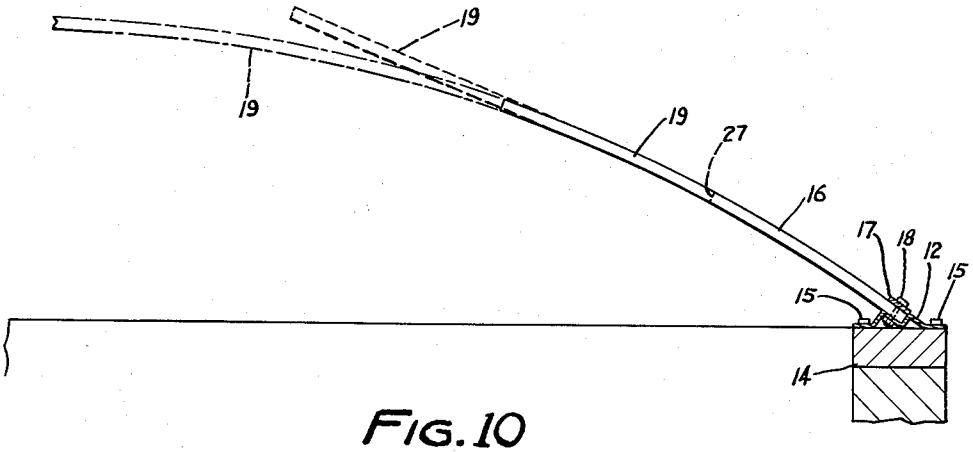


FIG. 10

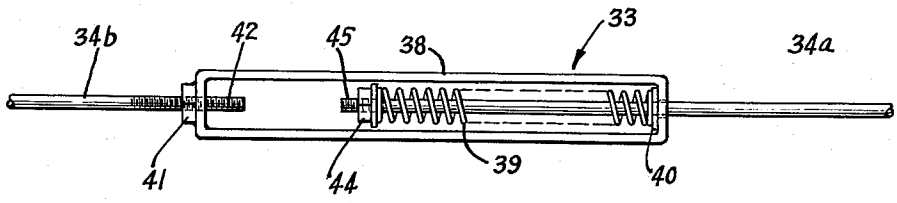


FIG. 11

INVENTOR.
WILLIAM H. JAMISON
BY Moore, White & Burd
ATTORNEYS

United States Patent Office

3,085,366

Patented Apr. 16, 1963

3,085,366

DOME CONSTRUCTION

William H. Jamison, 4700 Urbandale, Des Moines, Iowa

Filed July 15, 1959, Ser. No. 827,210
7 Claims. (Cl. 50—52)

This invention is a dome construction that features a dome made up of a thrust ring to which are secured a plurality of alternately long and short segments making up a square-toothed or castellated bottom row of segments to which are keyed successive rows of segments. All of the segments are made of a flexible material which will bow as a result of the curvature of the sides of the segments and the weight of successive rows of segments. At a point in the dome when the gradually narrowing segments become too narrow to be practical, extra length segments are used to bring adjacent columns of segments to an even end but with adjacent pairs of columns of different heights so that a continued staggered pattern of horizontal joints is made with successive rows thereafter. The dome is held against falling by the resistance of the segments to the compression forces placed thereon. Negative pressures, as when a storm or the like creates a lower pressure area outside the building than in, are resisted by horizontal tension rings secured to the dome. The segment ends at the top of the center of the dome are secured together by a split compression ring.

Prior to the present invention, domes were constructed from masonry or concrete by first erecting a temporary support comprising a solid figure equivalent to the interior of the proposed dome. Masonry formations or reinforced concrete were then placed on top of this temporary structure until the dome was completed. At this stage of the construction the temporary supporting structure could be removed and the dome would stand of its own strength. Generally domes have been applied rather sparingly, at least in the United States recently, because of the relatively high cost of preparing a temporary structure to support the dome until it was completed. A dome is, nevertheless, a very strong and desirable method of providing unobstructed spans over relatively large areas. Thus the failure to use domes flows out of the expense of erecting them rather than their lack of desirability as a structural form.

Personnel required to erect the temporary structures on which to build a masonry or concrete dome are of necessity skilled or semi-skilled construction workers. Furthermore, to support masonry or concrete until it is completely self-supporting requires substantial timbers. Thus the cost, both of the material and labor, particularly of labor, of erecting a purely temporary structure to permit building the final structure is very high. Likewise the personnel required for the final construction are also skilled and highly paid workmen. For these reasons domes have been thought to be too costly for general use in the United States where labor costs are a major factor.

The present invention provides a dome construction that permits domes to be made of relatively inexpensive and available materials and also permits the use of relatively unskilled labor. The present invention also requires no temporary structure to support the materials from which the dome itself is being made.

Accordingly, the principal object of this invention is to provide a dome that can be put together by unskilled labor by reason of it being made of preformed segments that can be fitted together.

Another object of this invention is to provide a dome construction that can be made of any suitable flexible material.

It is still a further object of this invention to provide a dome construction that can employ wood as the material from which it is made.

It is a further object of this invention to provide a dome construction that is self-supporting and requires no temporary supporting structure while it is being constructed.

To the accomplishment of the foregoing and related ends, this invention then comprises the features hereinafter fully described and particularly pointed out in the claims, the following description setting forth in detail certain illustrative embodiments of the invention, these being indicative, however, of but a few of the various ways in which the principles of the invention may be employed.

The invention is illustrated by the accompanying drawings in which the same numerals refer to corresponding parts and in which:

FIG. 1 is a plan view of my dome with so much of the segments shown as established by the repeat pattern which is continued on around the dome;

FIG. 2 is an enlarged vertical section through the dome taken on line 2—2 of FIG. 1;

FIG. 3 is a still further enlarged sectional view of the center ventilating port, terminating ring, and fragments of segments taken on the line 3—3 of FIG. 1;

FIG. 4 is a fragmentary plan view of my dome construction drawn to a scale between those used in FIGS. 2 and 3; portions of the segment are still further broken away to illustrate underlying structure;

FIG. 5 is a sectional view taken on the line 5—5 of FIG. 4 and drawn to a larger scale than that used in FIG. 3;

FIG. 6 is an enlarged fragmentary portion of my dome construction wherein broken lines show hidden parts; the scale used is larger than that of FIG. 4 but smaller than that of FIG. 3;

FIG. 7 is a greatly enlarged fragment of the adjoining portions of two segments taken at the broken line circle in FIG. 6; broken lines show hidden portions; the scale used is larger than that of FIG. 5;

FIG. 8 is a sectional view of the segments taken on the line 8—8 of FIG. 6; the scale is that used in FIG. 5;

FIG. 9 is a plan view of a single segment with broken lines showing the bottom of the groove on the grooved end and side thereof; the scale used is larger than that of FIG. 6 but smaller than that of FIG. 3;

FIG. 10 is a fragmentary vertical section through a dome construction showing in solid lines the configuration of the first segments in place, regular broken lines showing the straight extension of a segment before the additional weight of additional segments is applied, and irregular broken lines illustrating how the regular broken-line showing is modified with the additional weight of additional segments; and

FIG. 11 is a greatly enlarged plan view of one of the tension ring end joining elements.

In the drawings the invention is illustrated as a dome formed from segments made of wood, the outward thrust of which is confined by a thrust ring **12** which is suitably anchored to a foundation or wall **14**. There are three requirements for the thrust ring, one of which being that it should have sufficient tensile strength to balance the outward thrust applied by the dome after it is constructed. The second requirement for the thrust ring is that it must be strong enough to hold any one row of segments at an elevated position until that row of segments is completed whereby leverage forces of the row of segments are translated into outward thrust. A third requirement for the thrust ring is that it must be designed so that the thrust is applied to the center or mass of the ring. Within the foregoing limitations, the thrust ring may be of any configuration to meet architectural requirements, both structural and aesthetic. As best shown in FIG. 10, perhaps, but also apparent in FIG. 2, a suitable thrust ring such as the one **12** of suitable material such as steel

is formed into a shape to receive the ends of the first row of segments. Any suitable means may be used to secure this thrust ring 12 to the foundation or the like 14 such as anchor bolts 15. The first row of segments designated 16 in FIGS. 2 and 10 is secured to the thrust ring by means of bolts 18 extending through the segments, the thrust ring, and auxiliary thrust ring 17 which may add to the mass of the thrust ring for purposes of countering the thrust applied to the thrust ring assembly. The thrust absorbing ring 12 as well as the auxiliary thrust absorbing ring 17 are prefabricated in sections and welded together on location. To the thrust ring are secured the first horizontal row of segments.

The segments generally are best illustrated in FIG. 9, perhaps, where a segment may be seen to be an elongated plank-like member made of any suitable, mildly flexible substance such as wood, generally trapezoidal in shape, having straight parallel ends and convexly curved nonparallel sides. Narrower end 20 may be referred to hereinafter as the top while the broader end 21 may be referred to as the bottom. The two sides are separately designated 22 for the right-hand side and 24 for the left-hand side in order to make easy distinction between them. Top end 20 and side 22 are provided with one portion of a cooperating keying means while side 24 and end 21 are provided with the complementary portion of the same keying means. It is here illustrated, particularly when wood is used, as preferably being a groove 25 in one end and side herein shown as end 20 and side 22, and on side 24 and end 21 a tongue 26. The curve of the sides 22 and 24 is a portion of the convex side of a lune. Illustrated in FIG. 9 is the unit referred to herein as a segment which is of a length that is most widely used in this construction. In the first row of segments there are also employed half segments designated 27. These half segments in the first row of segments are identical to the first row of segments, generally, but, being only half as tall, provide joints that are stepped or broken as a gigantic comb tooth or the like.

When the first row of segments is secured to the thrust ring, allowance should be made for relative expansion of wood and steel under different climatic conditions. For example, wood expands and shrinks in response to humidity change while steel does not. Likewise, wood expands more in response to heat than steel. For this reason a mild spacing of the wood segments in the first row should be made at the thrust ring of the structure. As each segment and half segment has a bolt 18 extending through it, it will be properly located with respect to the other segments in the row. In FIG. 4 only a fragment of all of the bolts 18 are shown to illustrate the general pattern carried out throughout the thrust ring. Succeeding rows of segments above the first one do not require spacing, as contraction and expansion of segments can be absorbed by motion of the dome. After the first row of segments have been secured to the thrust ring and is complete, the leverage forces applied to the thrust ring to hold up individual segments will be largely absorbed by lateral thrust applied one to the other. Bolts 18 are then merely serving as anchors for the ends of the dome segments while most of the force applied by the weight of the segments is absorbed as a thrust applied to the thrust rings through the butt ends of the first row of segments. Succeeding segments are then inserted in the keying tongue and groove structures and independently supported by the first row of segments until the second row is also completed. At this point leverage forces tending to bend the first row of segments down will again be absorbed by the thrust of the second row of segments against the first row of segments and each other and applied as thrusts to the thrust ring. Thus, at any one moment the bolts 18 support only one row of segments. As shown in FIG. 10 each succeeding row of segments as applied causes the preceding flexible row to bend in an arc causing the joints that are slightly open, as illustrated in FIG. 6, at the top of each row of segments to be closed up by forming a portion of a sphere. In the case of a row of segments first applied to the thrust ring, there is no need to have a tongue 26 thereon, as they are bolted to the thrust ring. Ends 28 of the first row of segments, therefore, are free from the tongue 26.

As shown in FIG. 4 this pattern of segments, after the first row, is continued until the top of the dome is approached. At this point segments can become so narrow as to be difficult to tongue and grooves properly. In a large dome construction, this point would be reached someplace relatively near the top of the dome. In the scale in which it is drawn in FIG. 4, the point of excessive narrowing is reached much sooner. Segments aligned in a great arc direction over the surface of the dome are named segmental columns and so referred to hereafter. In the third row of segments of alternate segmental columns beginning with a full segment are the long segments 29. These are substantially like segments except they are half again as long as an ordinary segment. On the other hand, alternate segmental columns beginning with half segments are provided in the fourth horizontal row with half segments 27 that are the same length as the half segments in the first row, but they are provided with the usual tenon 26 bottom so that they may fit into the dome pattern at a point between the top and the bottom. Thus, it will be seen that pairs of segmental columns are joined into single segmental columns near the top of the dome to prevent the final segments from deteriorating to nothingness at the final closure, compression ring 30. It can be seen that long segments also are used alternately with segments to cause all of the segmental columns to terminate in this common circle at compression ring 30.

As seen in FIG. 3, the compression ring 30 has an L-shaped cross section combined with an auxiliary ring designated 31, which, between them clamp the ends of the segments. Suitable means such as bolts 32 hold the ends of the segments to the compression ring and also pull the auxiliary compression ring and the compression ring together on the segment ends. Compression ring 30 also provides a central ventilating port through which any suitable ventilating structure may serve to exhaust stale or hot air from beneath the dome depending on weather conditions and use of the structure. If desired, this port may be closed by suitable structure not material to this invention. While I have shown for purposes of illustration only one of these compression ring port structures, the same structure may be applied at any point in the dome.

Support for the dome is derived from lateral interaction of the dome segments translated into thrust applied to and contained by ring 12. At times, however, the forces applied to the dome are the reverse of those tending to have it fall as, for example, when a storm creates a low pressure area outside of a building. In such cases the building substantially explodes by failing to be provided with sufficient strength to resist differential pressures where the higher pressure is inside the building rather than outside the building. In order to counteract these forces, I apply the tension rings 34 to the dome structure. As shown in FIG. 4, they are applied at various levels throughout the dome in order to counteract differential pressures set out above. I have illustrated the use of three of these tension rings on the dome shown as an example, but obviously, more could be employed in geographical areas where conditions warranted the use of more. As shown in FIG. 5, these tension rings are held to the dome by a series of brackets 35 appropriately secured to the dome material as by the screws 36. It is also possible to place these tension rings on the inside as well as the outside of the dome. In such a case, however, it is desirable to have more brackets to insure application of tension to all members of the

dome. The advantage of having the tension rings inside, when the dome is used in rough structures such as warehouses and the like, is to make the exterior surface more easily covered with roofing material. The final roofing coat is not described or shown as standard materials are used in a conventional manner. As in the case of other repeated structure, only a few of the brackets 35 are shown. Tension ring 34, like the thrust and auxiliary thrust rings, are prefabricated in sections secured together and preloaded on location by suitable means such as tension relieving, tension ring end joining devices 33.

To allow for the greater coefficient of expansion of wood, as compared to steel, means are advisable and in many cases necessary as where there is substantial variation in humidity and/or temperature, to provide for lengthening of tension rings 34 under tensions less than those that would buckle the dome if not relieved. For purposes of illustration there is shown in FIG. 11 a simple spring loaded device generally designated 33. It has a frame 38 that embraces the ends of two portions of a tension ring 34. One end slidably receives the tension ring portion 34A and is yieldingly held extended well into frame 38 by a suitable resilient element such as spring 39. Washer 40 allows smooth turning of frame 38 relative to spring 39 to permit screwing the threaded boss 41 onto the threads 42 of tension ring portion 34B. In this manner tension preload may be imparted to the tension rings 34 and still allow for yielding when the dome expands. A nut 44 on threads 45 provides additional means for adjusting the length of a tension ring.

As is clear from the preceding discussion, this entire dome may be constructed by unskilled personnel directed by a single person understanding the nature of the construction. Furthermore, as the dome is mainly self-supporting during its construction, only a small scaffolding portable to various locations around the dome is necessary to support workers placing segments in the dome construction row upon row and to support a fragment of a row until enough of a row is completed to cause side thrust to partially support the segments. Therefore, it is clear that my dome can be constructed much less expensively than by previously understood methods and techniques.

It is also clear that materials other than wood could be used. I use wood illustratively, however, as it is a relatively abundant material presently. A wood dome 150 feet in diameter would require material approximately three inches thick to provide the necessary margin of safety and strength of material to carry the loads imposed. Such a thickness is considerably greater than is necessary to support the actual calculated load but thought advisable in view of the additional loads imposed by snow, for example. Such a thickness also permits the cutting of the tongue and groove without excessively weakening individual segments.

It is apparent that many modifications and variations of this invention as hereinbefore set forth may be made without departing from the spirit and scope thereof. The specific embodiments described are given by way of example only and the invention is limited only by the terms of the appended claims.

What is claimed is:

1. A dome comprising a thrust ring, a row of alternately shorter and longer segments secured to said thrust ring and extending upward therefrom: succeeding rows of segments equal in length to said longer segments keyed to preceding rows in part and to each other in part; each of said segments comprising a semi-rigid, flexible plate, generally trapezoidal in shape, the parallel portions of which are straight ends and the nonparallel portions of which are outward curving edges; said edges being longer than said ends; bottom ends of succeeding rows of segments engaging top ends of preceding rows of segments and adjacent marginal edge portions engaging each other; and cooperating means on said segments for keying marginal portions of abutting segments together; the upper end of each segment of whatever length being narrower than its lower end; the lower ends of segments in succeeding rows being equal in width to the upper ends of segments in adjacent lower rows, said segments at a point spaced from said thrust ring, forming alternate vertical columns of segments commencing with shorter segments secured to said thrust ring provided with shorter segments; and alternate vertical columns of segments commencing with longer segments provided with extra long segments; whereby adjacent columns of segments have common top planes; segments continuing after said point being equal in width at their lower ends to the tops of two segments in preceding rows, the last row of segments being alternately longer and shorter to cause columns of segments to terminate in a circle; means for securing said segment ends together, and means secured to said segments for resisting internal pressures applied to said dome.

2. The dome of claim 1 in which said means for holding said segment ends together is a compression ring and said means for resisting internal pressures are tension rings.

3. The dome of claim 2 in which said tension rings include tension relieving means.

4. The dome of claim 3 in which said segments are wood and said key means are tongue and groove.

5. The dome of claim 1 in which said segments are wood and said key means are tongue and groove.

6. A dome construction comprising a thrust ring, a plurality of segments comprising shorter, longer and extra long segments, each of said shorter, long and extra long segments comprising a wooden plate, generally trapezoidal in shape, the parallel portions of which are straight ends and the nonparallel portions of which are outward curving edges; said edges being longer than said ends; and cooperating means on said segment for keying marginal portions of abutting segments together, said extra long segments being one and one half times the length of longer segments, all of said shorter, longer and extra long segments being narrower at their tops than at their bottoms and the bottoms of segments in succeeding rows being equal in width to the tops in adjacent longer rows, alternate longer segments and shorter segments secured to said thrust ring and converging therefrom, succeeding rows of segments keyed to said segments and half segments and each other, said segments being arranged also in converging segmental columns, said segmental columns alternately in pairs being provided with longer segments combined with shorter and extra long segments selectively at a substantial distance from said thrust ring, whereby adjacent segmental columns may be continued by a single segment as a double segmental column, said continuing segments having bottoms equal to the width of two tops of said longer segments and extra long segments at the point mentioned, extra long segments completing alternate segmental columns whereby all of said segmental columns terminate at about the same distance from said thrust ring, a compression ring for securing the top ends of said last segments together, and tension rings secured to said dome to resist internal pressures.

7. The dome construction of claim 6 in which said tension rings include tension relieving means forming a part thereof.

References Cited in the file of this patent

UNITED STATES PATENTS

1,093,898	Virtue	Apr. 21, 1914
1,570,311	Maguire	Jan. 19, 1926
2,820,990	Johnson	Jan. 28, 1958

FOREIGN PATENTS

814,505	France	Mar. 22, 1937