

Feb. 16, 1937.

D. VAN HORN

2,071,093

SHEET METAL DOME FOR PLANETARIUM OR THE LIKE

Filed Nov. 7, 1933

2 Sheets-Sheet 1

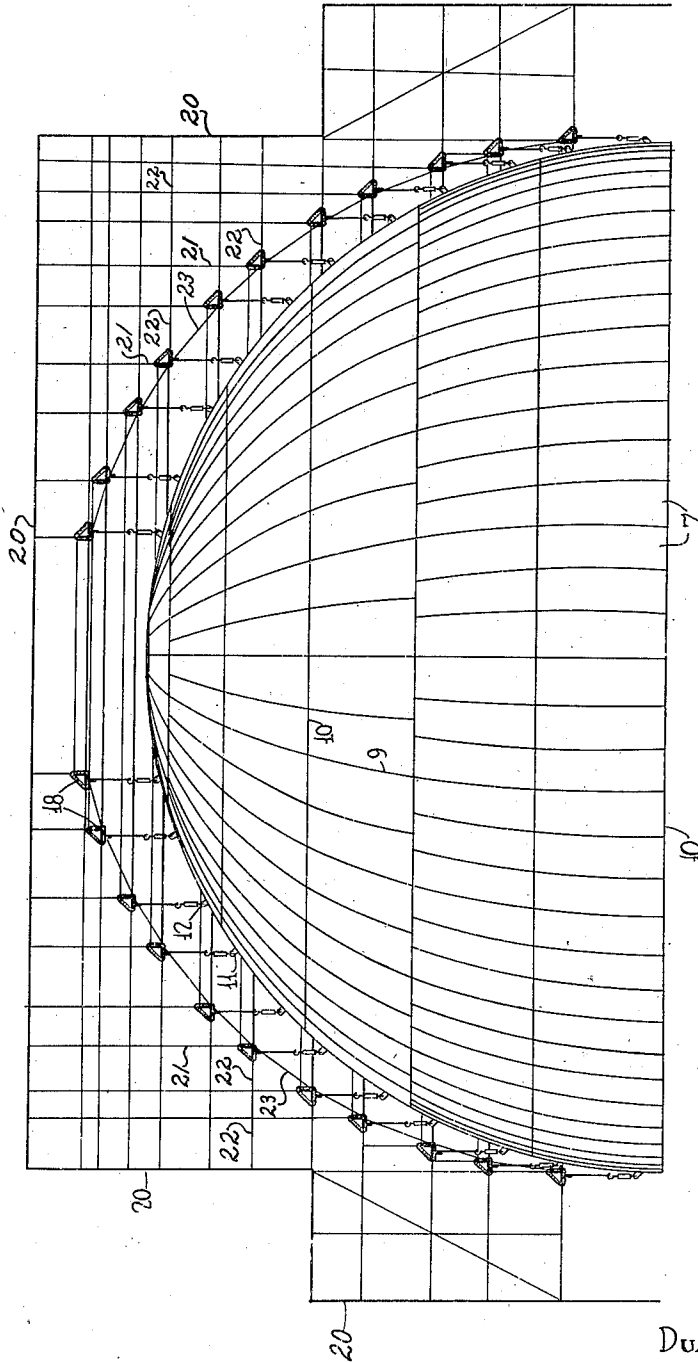


FIG. 1.

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2 Sheets-Sheet 2

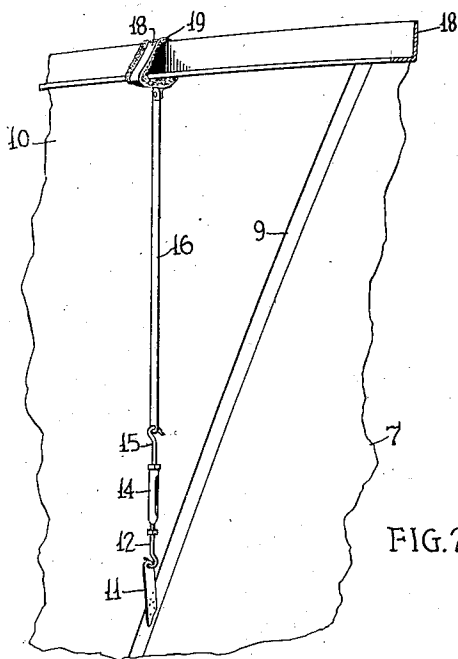


FIG. 2.

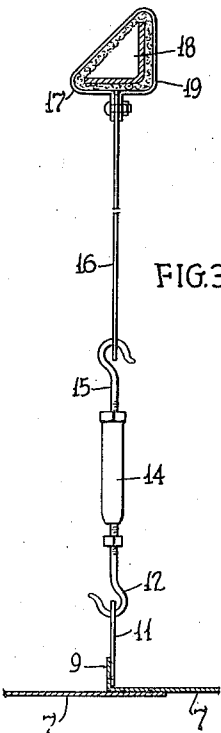


FIG. 3.

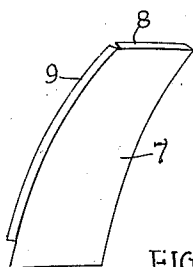


FIG. 5

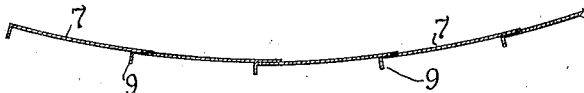


FIG. 4.

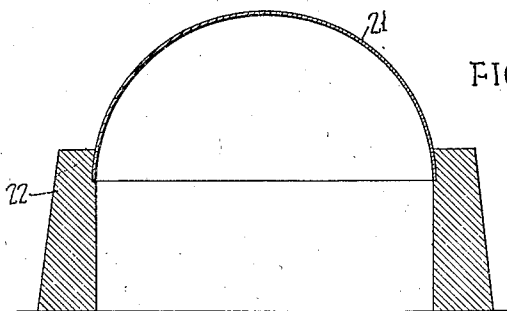


FIG. 6

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2,071,093

SHEET METAL DOME FOR PLANETARIUM
OR THE LIKE

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Application November 7, 1933, Serial No. 696,964

1 Claim. (Cl. 108—4)

My invention relates to sheet metal structures, and particularly to structures of hollow body or shell like character having relatively thin walls. Primarily, the invention is directed toward the provision of a hemispherical dome of a size comparable to those of relatively large public buildings, but, in this instance, it has only one of its surfaces utilized for show, that is, its inner side, with support, adjusting and other elements co-operating with the dome, at its outer side. Being intended, in one use, for the panoramic projection of the images of heavenly bodies onto its concave inner face, by means of stereopticon, motion-picture or like apparatus, to depict their true relative sizes, positions and movements, an essential characteristic of such dome is an obverse display surface that is, not only a true hemisphere, but is also smooth and free from any feature of distortion or deception. Being of large size, it must be of light weight and, since it must also be substantial and permanent, there is no other known material so effective to provide these qualities as sheet metal. Since it should be free from corrosion and not too costly, there is no other sheet metal better suited to it than stainless steel. Since it is of larger size than may be effectually and commercially made in one or a few parts, it is made in a relatively large number of component parts, which in turn, to be commercial and feasible, are made in as few different sizes and shapes as possible. By reason of its size and the thinness of its walls, it is quite rapidly responsive to temperature changes and would fundamentally be relatively unstable of itself were usual practices of construction followed. To compensate for these peculiarities, the invention consists in so forming, joining and supporting the parts and the dome structure as a whole, that the dome may readily be formed as a substantially perfect hemisphere and will move uniformly throughout its parts in response to temperature changes thus preserving its form.

The many component parts render flash welding or other edgewise joining impracticable, so that lapped joints are employed which render extreme accuracy as to size of parts unnecessary; such joints facilitating spot welding to a high degree whereby the operation of assembling is exceedingly easy when permissible variation in the overlap makes it possible to compensate for any variation in size of parts. Compensation for the laps, on the display surface, is effected by so placing them that the exposed lap margin of one component sheet or panel has its edge spaced away from the hidden edge in a direction from

which the surface is to be viewed; this feature, in consideration of the facts that the sheets are thin, the surface large, and the device some distance from the observing position, substantially nullifying any visual effect of the lap edges. Further features reside in rendering the shell incapable of causing the noises of vibration, echo and the like, which might ordinarily be incident thereto.

In a preferred form of the invention, a composite inverted dome or hemisphere, in the form of a hollow sheet metal shell having obverse concave inner and reverse convex outer surfaces, is constructed of component panels or sheets, including those having rearwardly-bent flanges on intersecting edges; the opposite edges being flangeless and lapped over the obverse faces of the flanged edges of adjacent sheets to which they are secured, preferably by spot welding.

The lapped edges aforesaid, are so placed as to avoid looking into them from below; the laps facing away from the audience and, being of extremely thin sheet metal, thus giving, in the assembled object, an appearance of absolute symmetry and freedom from surface interruption.

The dome is made up of horizontal zones or strata each made up of component sheets of the same size, certain of the zones having panels of the same size as the panels of other zones, and differing from those of other zones. Also, the sheets may be, and preferably are, perforated by many small openings distributed over the surfaces thereof, whereby to reduce sound vibration.

The flanges, in the assembled dome, constitute truss braces or a reinforcing rib network opposing collapse of the shell, and are provided at positions, preferably spaced about annular zones perpendicularly offset from one another, with portions to which are attached elongated or tenuous suspension elements or rods for attachment, at the upper ends, to annular beams corresponding in number and diameter to the aforesaid zones, thus rendering the suspension elements perpendicular, although other arrangements are contemplated, as by arranging the elements radially or in other directions. Turnbuckles, or other suitable adjusting means, are preferably provided between sections of the rods whereby the dome or globe may be adjusted accurately to symmetrical shape. Sound-deadening bodies or bands, disposed about the aforesaid beams, afford anchorages for the suspension elements which may, in turn, hold the bodies in position. The weight of the dome may entirely be assumed by the suspension rods or, as is contemplated, only

partially so, or not at all, so far as the adjusting feature and other factors are concerned.

The characteristic features and advantages of the invention will be better understood from the accompanying drawings, illustrating certain embodiments thereof, in which Figure 1 is a side elevation of a planetarium dome, with the near-side supports removed, certain of the immediate supports indicated in elevation and in section, 10 and an adjacent building structure indicated diagrammatically; Figure 2 is an enlarged fragmentary reverse-face perspective of a portion of the dome of Figure 2; Figure 3 is an enlarged detail view of a suspension structure shown in Fig. 2; Figure 4 shows, in section, the arrangement of component panels of the composite dome sheet; Figure 5 is an obverse-face perspective of one of the component panels, and Figure 6 is a diagram illustrating a form of the invention 20 modified from the other figures.

Referring to Figs. 1 to 5 inclusive, sheet metal panels 7, see Fig. 5, are preferably die-stamped from stainless steel blanks to conform to surface increments of the composite globe or dome, of which they constitute components, and have 25 flanges 8 and 9, on intersecting edges thereof, bent rearwardly from obverse front faces of the panels; these panels, being provided in sizes convenient for manufacture and cooperating in assembled relation, as indicated in Fig. 1, to make up the completed dome 10. As indicated in Fig. 1, the panels 7 are arranged in horizontal strata, or horizontal annular sections, in any one, or a greater number of which, the panels are of the 35 same size, different from those of others. Minor variations in adjustment, caused by the hemispherical shape, being taken up in the laps. In assembling the panels, they are laid one upon another, as indicated in Fig. 4, with the flanged 40 edges 8—9 lapping unflanged edges of adjacent panels, thus providing for spot welding and the sheets being extremely thin, thereby rendering the composite sphere surface relatively smooth.

As before mentioned, these laps are arranged 45 to face away from the direction of view, in this case, the lower panels being lapped, at the upper edges, over the lower edges of the panels next above. The idea may be extended to the up-right edges, so that, in any one device, the laps 50 may all extend in one direction, or face differently at different parts, depending on whether the general line of view is from one or from different directions.

In assembled relation, the flanges 8 and 9 constitute a surface reinforcing network or truss 55 structure lending rigidity to the dome surface against inward distortion, and which being of the same material and of the same thickness as the panels have the same coefficient of thermal expansion and rate of temperature response as the panels. Sheet metal attaching elements 11, as better shown in Figs. 2 and 3, are secured, as by spot welding to the flanges 9, and are provided with openings for the reception of attaching 65 means, such as hooks 12, constituting parts of enlarged suspension elements which further comprise turnbuckles 14, top hooks 15, upper extensions 16 and loops 17 embracing beams 18 over bodies 19 of suitable sound-deadening material. These bodies, as shown, are preferably 70 of yieldable material of loop form having wider perimeters than the loops 17, such that the latter, being tightly bound thereto at the centers thereof, depress these centers whereby the edges of 75 the bodies rise above the loops 17; this arrange-

ment holding the loops 18 and 19 against axial displacement.

As indicated in Fig. 1, the attaching elements 11 are preferably arranged in spaced relation in annular zones about the dome 10, which zones 5 are preferably equally offset perpendicularly, whereby the beams lie in, or define, a contour like that of the dome and nested over the same. Also, the beams 18 are preferably circular, of angle section, and provided to number and 10 diameters corresponding to the member and diameters of the aforesaid annular zones; being offset perpendicularly by equal distances so that irrespective of the curvature of the dome, the suspension elements, including the parts 9, 11, 15 12, 14, 15, and 16, are of substantially equal length, with the result that the suspension elements each have substantially the same total lineal expansion and contraction for a given 20 temperature change. This arrangement provides not only for convenience of manufacture in having all of the suspension elements of the same size and shape, but also provides corresponding changes in length in the suspension 25 elements for corresponding changes in temperature. Radial changes in the beams and dome are compensated by the lateral relative movement permitted by the perpendicular suspension elements. The beams 18 are built into any 30 desired building structure 20, by means of suitable structural elements or braces 21 and 22, connecting the annular beams 18 with the tops and sides respectively of the existing building structure 20. Rigid triangular bracing is at- 35 tained through the use of diagonal struts or braces 23 connecting adjacent annular beams in a vertical, diametral plane common with each pair of vertical and horizontal braces 21—22. While the system of braces 21—22—23 are 40 shown in but one diametral plane, it is to be understood that there are a plurality of such systems in different diametral planes, at least two, so as to brace the annular beams in at least two horizontal directions. In mounting 45 the dome, the turnbuckles 14 may be individually manipulated to accurately adjust the globe surface to symmetry, regardless of any of various effects which may tend to have the dome otherwise; this feature being of tremendous facility and advantage in accurately and quickly 50 providing a symmetrical dome of great size and disposed in difficult position.

The device is thus flexible in various aspects, extremely light in weight, easy to assemble by spot welding, proof against the effects of temperature changes, corrosion, shocks, jarring or 55 wind pressure, easy to adjust, of low cost, practically fractureless, and renders the adjacent building parts correspondingly lighter and less expensive, as well as protecting them from in- 60 jury.

As indicated in Fig. 6 by the numeral 21, the dome, as described in the previous figures, may, in certain cases, be entirely supported at its bottom edge, as by a support 22, or so supported 65 and merely shaped or braced by reverse-face supports and turnbuckle elements, or the weight may be divided between such elements and the lower edge base. So far as the specific construction of the dome is concerned, it may be em- 70 ployed in other structures and ways where a similar sheet metal wall is desired and like considerations enter into its support or configuration; it not being intended to limit the invention to the preferred embodiments indicated but to 75

employ them wherever their advantages are of value.

5 The flanges, the thickness of the sheets, the size and shape of the dome and other elements may also vary through a wide range, whereby where the dome is small, it may be entirely self-sustaining and the flanges small and fewer, and where it is large, it may require a greater or less number of the suspension elements or ad-justers, and flanges of various arrangements, all 10 within the purview of the invention as contemplated.

What I claim is:

15 A hemispherical sheet metal dome structure comprising sheet metal sections, each forming a section of a sphere, secured together by spot welds through overlapping marginal edges to

form a substantially continuous inside hemispherical surface, only certain outer overlapping edges being provided with single outwardly extending flanges of the same material as the sheet metal section so as to have the same lineal 5 coefficient of thermal expansion and rate of temperature change as the sheet metal sections, overhead supporting means for the dome structure, and perpendicularly disposed flexible suspension members connecting the dome at differ- 10 ent horizontal zones with the supporting means through said flanges, each suspension member having substantially the same total lineal expansion and contraction for a given temperature change. 15

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