Nov. 26, 1946. W. D. DARBY 2,411,651

CATENARY ROOFLIKE CONSTRUCTION AND METHOD OF FORMING IT

Filed Jan. 24, 1942 2 Sheets-Sheet 1

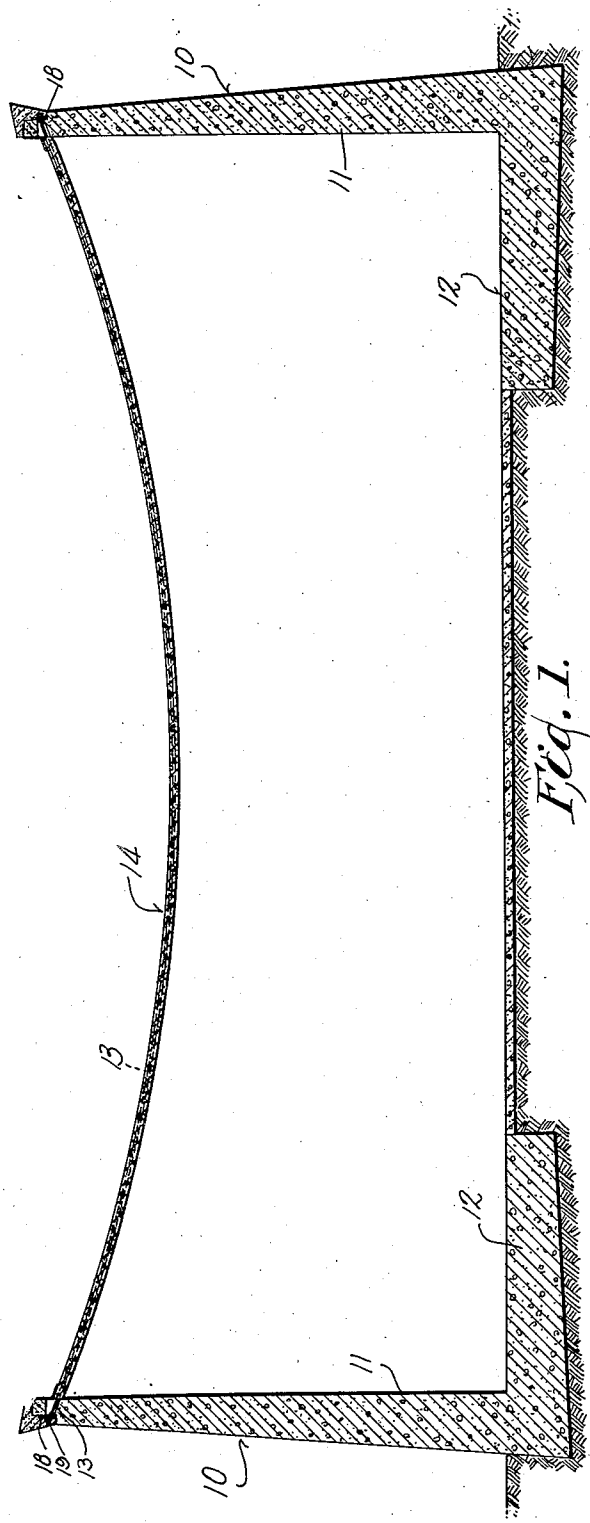


Fig. 1.

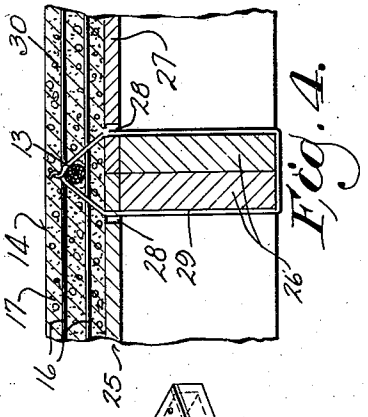


Fig. 4.

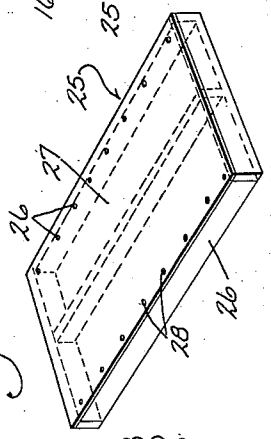


Fig. 3.

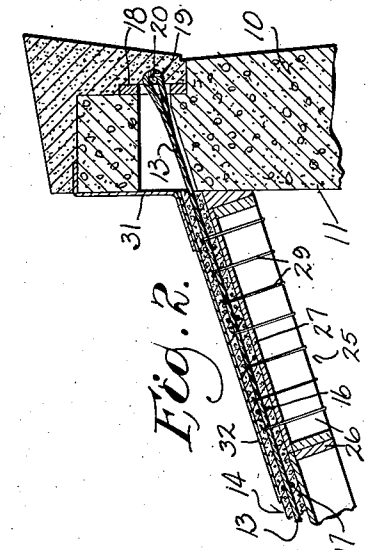


Fig. 2.

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CATENARY ROOFLIKE CONSTRUCTION AND METHOD OF FORMING IT

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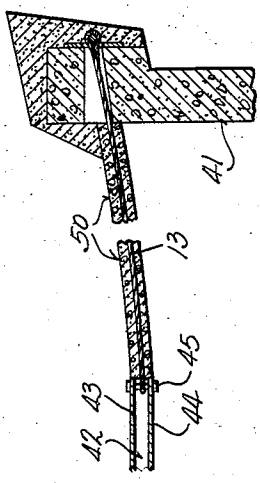


Fig. 7.

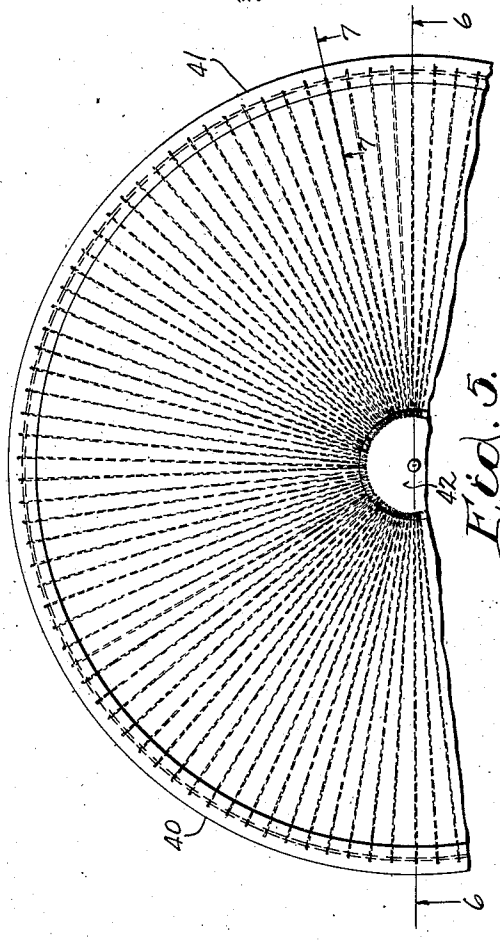


Fig. 5.

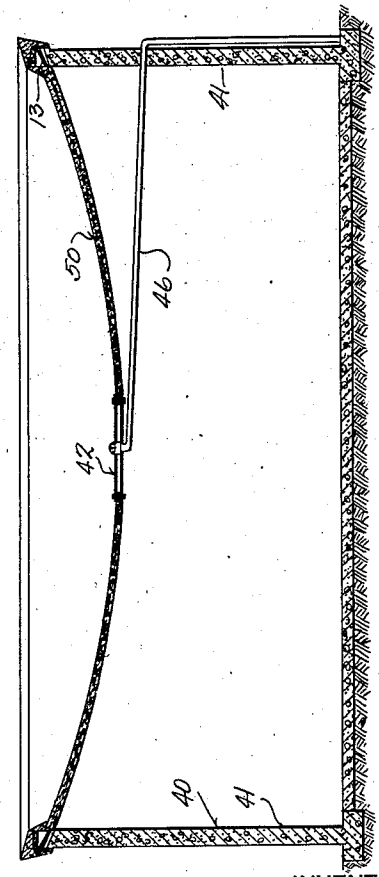


Fig. 6.

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CATENARY ROOFLIKE CONSTRUCTION AND METHOD OF FORMING IT

William D. Darby, West Allis, Wis.

Application January 24, 1942, Serial No. 428,046

9 Claims. (Cl. 108—1)

1

My invention relates to improvements in catenary roof-like constructions and methods of forming them.

My construction and method may be used for other building elements, but are principally useful in building roofs, and the description below will be directed particularly to roofs.

The object of my invention is to provide a roof which may be supported entirely from side walls and without requirement for central supports; to provide a roof which will absorb shock and will not collapse under bomb attack; to provide a roof-like structure in catenary suspension between spaced suspensors; and to provide a method of construction to meet these requirements which will simplify, cheapen and make more satisfactory a roof-like area.

In the drawings:

Fig. 1 is a vertical section through my new catenary roof and showing it suspended between side walls supported upon footings in accord with my invention.

Fig. 2 is a detailed vertical section of a portion of my roof in course of construction with my special forms in place and showing catenary cable suspension of my roof from the top portion of the wall.

Fig. 3 is a perspective of an individual form used in the laying of concrete for my catenary roof.

Fig. 4 is a vertical section through contiguous portions of two forms locked in position and suspended below one of my catenary cables.

Fig. 5 is a plan view of an alternative form of my catenary roof as required for a circular building or other structure or curved end for a building or other structure.

Fig. 6 is a section on line 6—6 of Fig. 5.

Fig. 7 is a section on line 7—7 of Fig. 5.

Like parts are designated by the same reference characters throughout the several views.

My invention is of primary importance in structures where central or intermediately-spaced columns or supporting pillars or arches are detrimental to the uses to which the structure is to be put, and where even the use of supporting structures during the construction period is undesirable or expensive. My catenary roof is subject to my construction method in which even during the period of construction there is no need for the building of scaffolds or temporary columns, pillars, arches, or trusses.

In the following description I have chosen the word "suspensor" to designate the supporting structure for my catenary roof. Such a supporting structure may be the side walls of the building or various spaced supports in many other construction elements from portions of which cables in a catenary array may extend for the purposes of my invention. I term them all suspensors since the cables are in catenary suspension between them. Furthermore, in the following description I use the term "array" to refer to an arrangement of cables in catenary suspension between suspensors, the cables being in such relation that a "sheet" of concrete or other construction material laid as a roof or floor will include the cables within the thickness of the sheet.

2

Applying the above terms to the drawings, it will be seen that I have provided spaced suspensors 10 in Fig. 1 comprising walls 11 and footings 12 in L-shape to sustain the stresses of cables 13 of my catenary roof 14. The permanent structural elements of the roof including the array of cables 13, any suitable reenforcing means such as rods 16, and cementitious material 17 form the continuous slab-like roof or floor element of my invention.

The many catenary cables 13 extending between suspensors 10 are secured by any suitable means, but I have provided continuous-apertured plates 18 bearing upon the outside face of the top of each suspensor and each cable 13 has an eye 19 spliced in the end thereof for insertion through one of the apertures in the plate 18 to receive an anchor pin 20. The pin bearing upon the margins of the aperture prevents the release of the cable, and various cables in the array are of identical length and tensile strength.

The array of catenary cables 13 having been suspended between the suspensors 10, all of the construction work to complete my roof is carried out with the array of cables as the working support. During the laying of concrete or other cementitious or moldable material to complete the roof area light planking may be laid on the array for runways for workmen.

I provide surfaces for the support of the concrete in the form of platforms 25 made up of a suitable framework 26 overlaid by a sheet of plywood 27 or other suitable concrete form material. Along the margins of each platform 25 I provide holes 28; and as adjacent platforms 25 are brought into position beneath the catenary cables 13, I wire the platforms together and wire them in position below the catenary cables as shown most clearly in Fig. 4 where it will be seen that the wire 29 inserted through the holes 28 extends about the adjacent frame members of the adjacent platforms to bind them together and the same length of wire is of sufficient length

to extend about one of the cables 13 to position the platforms approximately an inch and one-half below the cable. Successive platforms 25 are secured together and hung from the cables 13 so that the forms for the entire catenary area are supported from the cables in readiness for the pouring of the roof sheet 30 of concrete.

Any form of reenforcement may be laid upon the catenary cables 13 or beneath them, and the concrete is then poured to any suitable depth, but I have found that about a three inch thickness of concrete of good quality makes a most acceptable catenary roof.

When the concrete has set and is sufficiently cured, the wires 28 may be clipped to release the platforms 25, and it will be found that my catenary roof thus constituted has superior qualities of stability and permanency.

Waterproof characteristics are hardly to be expected of any known forms of concrete or other cementitious or moldable material, and I, therefore, provide the usual flashings 31 and roofing felt 32 to cover the concrete or molded slab of my catenary roof.

Where buildings or other structures have curved or circular ends 40 or where buildings or other structures are circular in their general configuration as indicated in Figs. 5, 6, and 7, the walls thereof provide suspensors 41, and I provide central catenary plate 42 which is laminated as shown in Fig. 7 to provide upper lamination 43 and lower lamination 44 between which an anchor bolt 45 is extended so as to pass through an eye of catenary cable 13 thus completing a catenary-"dished" roof 50 following the practices of my invention. Obviously, the platform forms such as those shown at 25 in Fig. 3 must be shaped to conform to the requirements of the curves of the catenary array of cables, but in all other respects the principles of my invention as shown in Figs. 1 to 4, inclusive, are followed in the construction of the roof for a circular building. Centrally of the building a conductor pipe 46 for rain water may be included.

Thus, it will be seen that I have provided a floor or roof construction in slab form without the use of staging or supporting elements other than the suspensors which may form the permanent walls of the building and that the entire construction operation is carried on through the use of catenary cables.

I claim:

1. A catenary area construction including peripheral catenary supports, a central catenary plate, flexible catenary members extending between the plate and said peripheral support whereby to constitute an array of catenary members, and cementitious material formed upon and about said catenary members whereby to form a continuous rigid surface, said surface, plate, and members being substantially wholly suspended at the ends of said members from said supports.

2. The process of forming a roof-like construction in building operations, said process including the erection of spaced catenary supports, suspension of a plurality of flexible catenary tension members throughout the area and preserving the catenary curve of each flexible member adjacent one another in roof-like configuration, supporting forms from said tension members; and pouring thereon cementitious substance whereby to encase the catenary members and form a rigid roof-like structure in true catenary curve.

3. The process of forming a continuous, rigid, catenary curved slab in building construction, said process including the placement of catenary supports, suspension of an array of flexible catenary members between said supports, placing beneath said array a plurality of forms in contiguity and connecting said forms suspensarily to said catenary members whereby to preserve the catenary curve, and depositing cementitious substance on the forms in sufficient quantity to embed said catenary members, and permitting the cementitious substance to harden thereabout in a curved form, wherein said catenary members are maintained in catenary curvature and tension.

4. In a building structure, the combination with supporting walls, of a roof entirely free of support between said walls and comprising a series of tension elements connected at their respective ends to said walls and in catenary suspension therebetween, the several elements being sufficiently flexible to assume a catenary curve under their weight and the weight of any uniformly applied load imposed thereon, and having an embedding sheet in which a number of such elements are embedded, said sheet comprising a cementitious substance molded upon said elements while soft, said sheet being rigidified in setting, whereby to fix said elements in their normal catenary curves.

5. The structure of claim 4, in which said walls have integral floor sections extending toward each other beneath said tension elements sufficiently to hold said walls upright, said floor sections being spaced from each other.

6. A building construction comprising heavy floor sections spaced at opposite sides of the building, supporting walls integrally connected with said floor sections at points remote from the inner margins of said floor sections whereby said walls are braced against tilting movement toward each other, a plurality of initially flexible tension elements connected with said walls and suspended in catenary curves substantially unsupported between said walls, and a cementitious sheet in which the several elements are embedded and whereby they are rigidified in their natural catenary curve assumed while flexible and prior to their fixation by said sheet.

7. The process of building a roof which comprises supporting flexible reenforcing elements at their ends while allowing such elements freely to assume natural catenary curves between the points of support, embedding the flexible reenforcing elements in a cementitious roofing substance while said substance is soft and supporting the weight of the cementitious substance on the reenforcing elements prior to the setting of such substance, whereby the reenforcing elements may automatically achieve their respective catenary curves according to the disposition of such weight thereon, and allowing the cementitious substance to set about the reenforcing elements and substantially continuously therebetween, whereby to constitute a roof wherein said elements are fixed in a natural catenary configuration freely assumed by the respective elements as loaded.

8. In a building structure, the combination with exterior vertical supporting walls apertured near their upper margins and provided with metal plates bearing against the outer surfaces of said walls and provided with apertures registering with those in the walls, cable-like tension members spanning the space between said walls and extending through said apertured plates, an-

choring devices engaged with said tensioning members and bearing against said plates, and a rigid cementitious roof in which the tension members are embedded and having marginal contact with said vertical walls, said tension members being fixed by the embedding cementitious roof in their natural catenary curves under the load of said roof.

9. In a circular building structure having vertical walls and cable-like tension members anchored to said walls and converging in catenary

curves to the central portion of said structure, a metal plate connecting the convergent inner ends of said tension members across the central vertical axis of the building structure, and a rigid cementitious roof in which said tension members are embedded in mutually reenforcing relation, the outer margins of said rigid roof being supported by said vertical walls and the extended ends of the tension members anchored thereto.

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