Oct. 11, 1966 K. KOSS 3,277,616

ROOF STRUCTURE

Filed Aug. 29, 1962 2 Sheets-Sheet 1

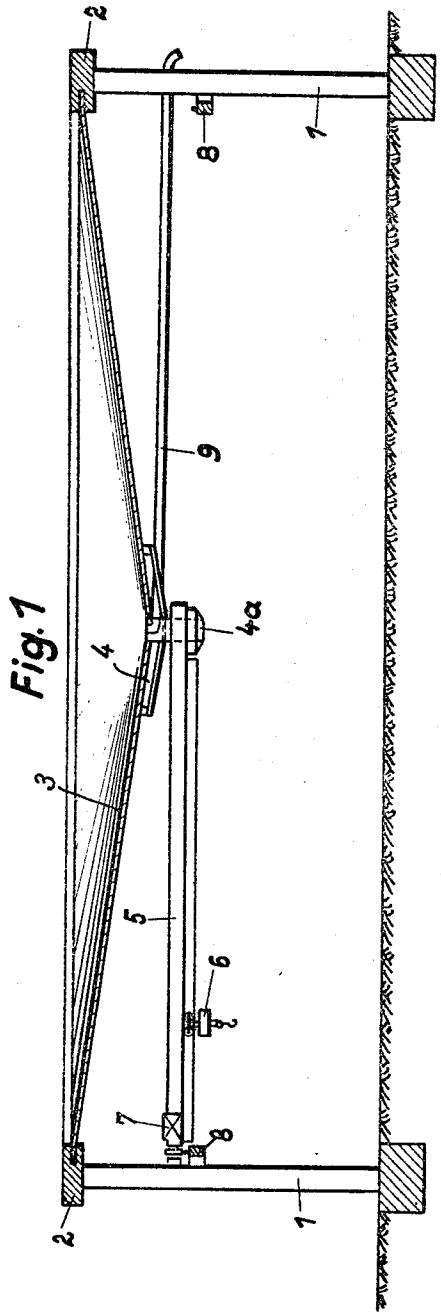

Fig. 1

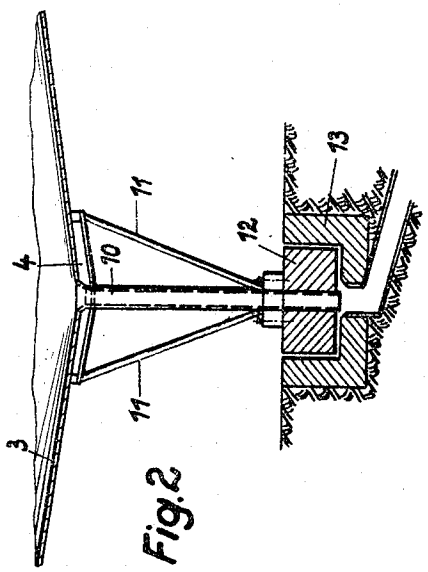

Fig. 2

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Fig. 3a

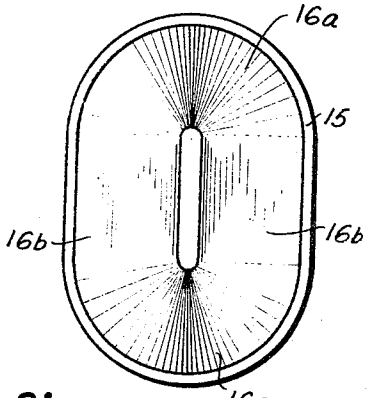


Fig. 3b

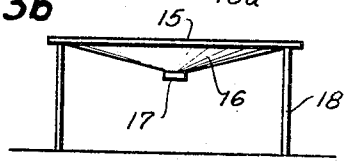


Fig. 5a

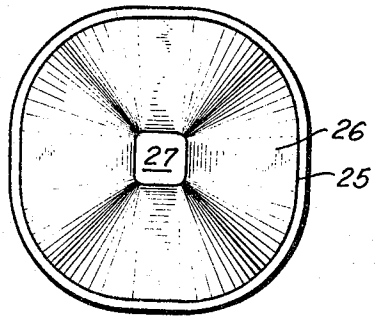


Fig. 5b

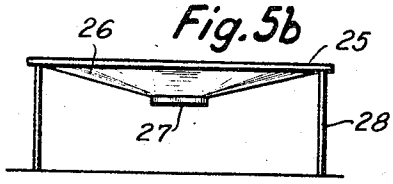


Fig. 4a

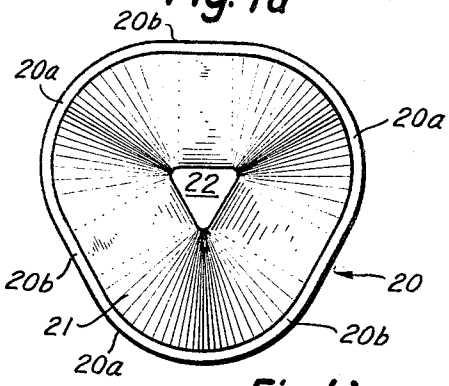
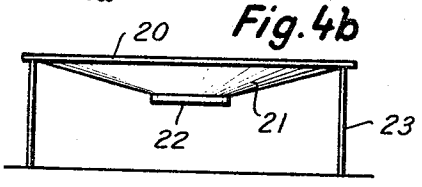


Fig. 4b



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3,277,616

ROOF STRUCTURE

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Claims priority, application Austria, Sept. 4, 1961, 6,742/61
4 Claims. (Cl. 52—31)

This invention relates to suspended roofs. It is an object of the invention to provide large spans with a highly economical consumption of building material. This object is achieved according to the invention in a roof structure having load-carrying sheet member which has a shape between that of a cone and a trough and defines a developable surface, that is, a surface that may be imagined flattened out, without stretching any element, upon a plane (Webster, Unabridged, 2nd ed.). The sheet member is fixedly fastened to a rim structure in conforming engagement on the eaves level of the building and is always under tensile stress in all directions by being loaded in the downward direction at the center of the roof in addition to its own weight. In a particularly advantageous embodiment of the invention, the carrying structure is formed virtually entirely by a conical shell, which is stressed in tension and consists of sheet metal, which may be stiffened, and which forms at the same time the skin of the roof.

The present roof structure provides a suspended roof. With suspended roofs, the most essential problem is to obtain a small weight of the structure while providing for an adequate stability against wind suction forces.

The roof structure according to the invention will be described hereinafter with reference to the accompanying drawings in which FIG. 1 is a fragmentary, elevationally sectional view showing a hall having a round or polygonal plan outline and FIG. 2 is also a sectional view showing a modified construction of the roof center. FIGS. 3*a*, 4*a*, 5*a* are plan views, and FIGS. 3*b*, 4*b*, 5*b* are elevational views of suspended roofs based on the same principle and formed by combinations of conical surfaces and planes.

According to FIG. 1, an appropriate number of supports **1**, of which only two are shown, are disposed around the periphery of a circle and carry an annular rim structure **2**, from which the conical load bearing shell **3** extends inwardly and downwardly. It consists of a sheet metal skin having a central portion from which a carrying structure **4** is suspended whereas the peripheral edge is anchored in a suitable manner in the rim structure to resist tension. The arangement is such that the carrying system is stressed in tension. To obtain a tensile stress having the direction of the generatrices, a loading mass constituted by a crane **5** having a crab **6**, is suspended by means of the carrying structure **4** from the center of the roof. The bridge of the crane is rotatable about a central pivot **4***a* and its other end is guided by running gear **7** on a crane track **8** extending around the hall. A pipeline **9** serves for draining the roof.

It will readily be appreciated that the rim structure **2** stressed mainly in compression need not be exactly circular but the requirements of the invention will also be complied with if this ring is a polygon which approximates a circle. The supports **1** may be spaced any desired distance apart.

The stress obtained at the center of the roof by the weight of the loading mass not only affords protection against wind suction forces but also braces the rim structure in the manner similar to the bracing of the rim of a wheel by spokes. As a result, the rim structure in conjunction with the pre-stressed roof skin can take up

also horizontal stresses in the gutter plane without substantial deformation.

The amount of building material required for such a roof is very small, particularly when the roof consists of sheet metal (sheets having a thickness of a few millimeters may be used for roofs about 50 meters in diameter and may simply be joined by butt-welding). The central draining is an additional advantage because the gutters are eliminated. The access afforded to all parts of a shed having a circular plan outline by means of a crane is much more satisfactory than in sheds having a rectangular cross-section and makes the shed suitable for industrial purposes, storage, workshops, hangers and the like.

Another advantage of the present roof structure resides in the loading of the roof by dead weight, but by an inherently necessary load. This does not mean that the invention can be used only in a shed having a crane or the like, because the weight of the latter may be replaced by another loading mass. An example of such an arrangement is shown in FIG. 2 having a carrying structure **4** and a carrying system **3** stressed in tension as described above. A weight **12** is suspended by means of a tube **10** and braces **11** from the center of the roof and normally rests at least partly in a foundation pit **13**, but is lifted when large wind forces apply suction forces to the roof which is drained through the tube **10**.

Whereas the use of a conical sheet metal shell in the roof structure according to the invention affords particularly great advantages, this invention is applicable to structures of iron, timber, concrete or a combination of materials, and glazed light openings may be provided in the roof surface without difficulty.

Suspended roofs having plan outlines different from a circle may be designed in accordance with the same basic principle, as is shown in FIGS. 3, 4 and 5. FIGS. 3*a* and 3*b* respectively show a modified roof structure of the invention in top plan view and in fragmentary elevation. The rim of the roof is formed by a compression ring **15** of oblong shape having two semicircular portions connected by straight portions. The outer peripheral edge of a sheet-metal member **16** conformingly engages the rim **15** and is fixedly fastened thereto. The rim **15** is held at a fixed level above ground by columns **18** spaced about its circumference, only two columns **18** being shown for the sake of clarity. The inner oblongly annular edge portion of the sheet metal member **16** is parallel and concentric with the outer edge and spaced from the latter in a direction which is downward and toward the upright axis of the loop defined by either edge.

A loading mass **17**, not shown in detail, is suspended from and downwardly biases the inner edge of the sheet-metal member **16**, and thereby holds the latter in a state of tension while its outer edge portion is held at the fixed level of the rim **15** by its engagement with the same.

The sheet-metal member or shell **16** has two conical parts **16***a* in conforming engagement with the arcuate portions of the rim **15**, and two plane portions **16***b* which connect the conical portions **16***a* and depend from the straight portions of the rim. The plane roof portions extending between the conical shell portions in the direction of the generatrices of the cone are prestressed in one direction by a part of the loading mass and in the other direction by the transmission of the annular stresses of the conical shell portions so that the plane portions are also stressed in tension in all directions. The rim **20** of the roof structure shown in FIGS. 4*a*, 4*b* has three equal arcuate portions **20***a*, each extending over 120°, and three equal straight portions **20***b* interposed between the arcuate portions. The sheet-metal member **21** which is attached to the rim **20** as described above has an inner edge hav-

ing the shape of an equilateral triangle with rounded corners, and has a loading mass **22** suspended therefrom, the rim **20** with the sheet metal member **21** and the mass **22** being supported on columns **23**.

The roof structure shown in FIGS. *5a*, *5b* in plan view and elevation respectively has a rim **25** with four 90° arcuate portions, and four straight portions, and a sheet metal member **26** whose outer peripheral edge portion is conformingly engaged by the rim **25**. The inner edge of the sheet metal member **26** is approximately square, and forms the sole support of a loading mass **27**, the roof being supported on columns **28**.

What is claimed is:

1. A roof structure comprising, in combination:

(a) an arcuate rim member defining a closed curve about an upright axis in a substantially horizontal plane;

(b) support means holding said rim member at a predetermined fixed level;

(c) a load bearing sheet member having an annular outer peripheral edge portion conformingly engaging said rim member and fixedly fastened thereto, and an annular inner edge portion spaced from said rim member downwardly and toward said axis, said inner edge portion being concentric with said outer edge portion, and said sheet member being supported solely by the fixed fastening of said outer edge portion to said rim member; and

(d) tensioning means downwardly biasing said inner edge portion and thereby holding said sheet member in a tensioned state while said outer peripheral edge portion thereof is held at said fixed level by said engagement thereof with said rim member, said tensioning means essentially consisting of a loading mass suspended from said inner edge portion, said sheet member defining a developable surface extending between said edge portions thereof when said sheet member is in said tensioned state.

2. A roof structure as set forth in claim **1**, wherein said developable surface is at least partly conical.

3. A roof structure as set forth in claim **1**, wherein said loading mass includes a crane.

4. A roof structure as set forth in claim **1**, further comprising a bridge crane having an elongated bridge member, one end portion of said bridge member being supported on said support means, and the other end portion of said bridge member being supported on said central portion and constituting at least a portion of said loading mass.

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