Nov. 19, 1935. L. DAVIDSON 2,021,480

ARCH CONSTRUCTION

Filed Dec. 14, 1931

Fig. 1.

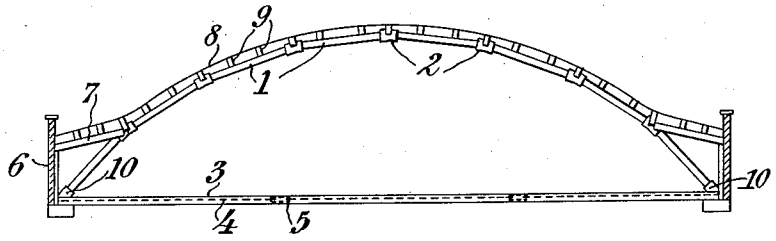


Fig. 2.

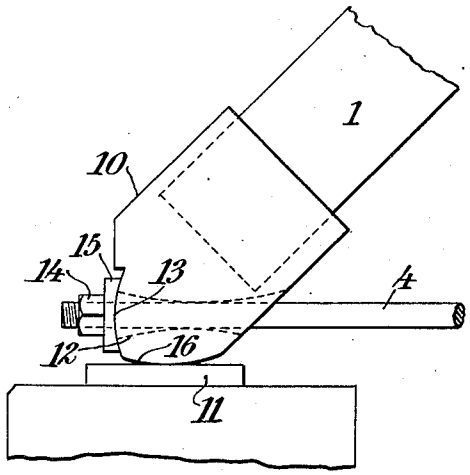


Fig. 3.

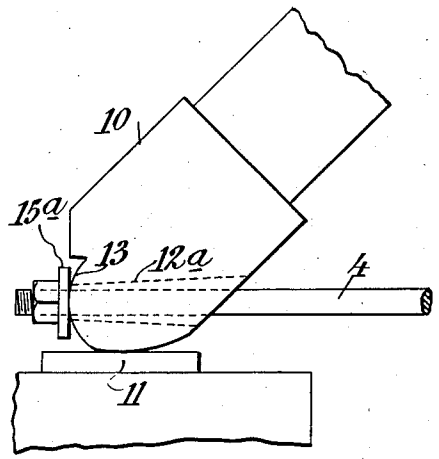


Fig. 4.

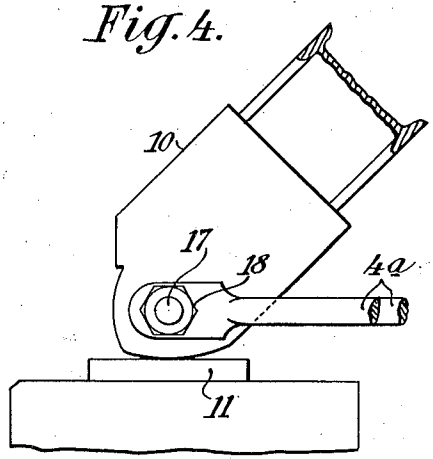
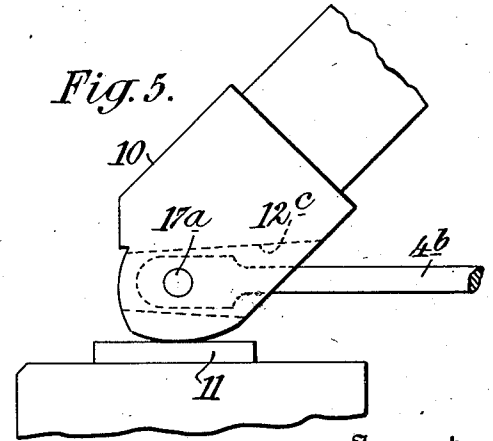


Fig. 5.



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ARCH CONSTRUCTION

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Application December 14, 1931, Serial No. 580,926

8 Claims. (Cl. 108—23)

The present invention relates to improvements in long span arch constructions, to buildings comprising such arches and to the arch or truss shoes adapted for use in constructing such arches, and aims to provide certain improvements therein. More especially it relates to the mounting and construction of the terminal elements at the end or spring line of the arches.

The present invention constitutes a continuation in part of the invention disclosed in my Patent No. 1,891,346, dated December 20, 1932.

Among the objects of the present invention may be enumerated the following: (1) to build roof arches economically; (2) to eliminate expensive shop and field work incidental to fabricating and constructing arches; (3) to use standardized parts of simple design and construction so that ease and rapid assembly of the arches in the field can be successfully carried out by unskilled labor; (4) to provide arch constructions which may be used for permanent or temporary buildings with equal facility; and (5) to eliminate from arches of the type described during their erection, the introduction of secondary strains into the horizontal thrust-resisting means and in the arches through their ends.

The foregoing and other objects of my invention I accomplish by providing in long span arch constructions elements or shoes at the spring line of the arches which are adapted for limited rocking action, so that failure of the arch when erected to assume the theoretical curvature due to slight differences in the sizes of the arch members and connecting means, the connections therebetween, temperature variations, etc., the arch will inherently assume its natural curvature without introducing any secondary strains in the tie-rods which connect the ends of the arch together or in the arches through the end supports.

Several embodiments of my invention are illustrated in the accompanying drawing, wherein

Figure 1 is a transverse section of a building employing an arch construction according to my invention.

Figs. 2, 3, 4 and 5 are enlarged fractional elevations showing arch ends and the manner in which the arches are mounted according to my present invention.

Referring first to Fig. 1 of the drawing, the arch roof building construction illustrated therein may be said to comprise a plurality of longitudinally spaced, long span arches, of which only one is shown, each comprising a plurality of arch segments 1 connected together by rigid arch or truss shoes 2, the ends of the arches terminating at substantially the floor 3 of the building and being connected together by tie-rods 4 which function to resist the horizontal thrust of the arches, the tie-rods being connected together by turnbuckles 5. At the ends of the arches the building is provided with side walls 6 and arch sub-segments 7, the ends of which are supported respectively by the arches and the side walls. A suitable roof 8 may be mounted over the arches and supported by roof beams 9 which extend transversely of the arches. The arch or truss shoes 2 may be of any preferred or desired transverse cross-sectional contour, depending upon the cross-section of the arch segments 1 which the shoes are adapted to support in connecting relation to one another, said arch segments 1 being formed either of timber or steel rolled sections of any desired cross-section. The general construction of long span arches and buildings embodying the same, as thus described, constitutes the subject-matter of my aforementioned Patent No. 1,891,346.

The present invention is primarily directed to the construction and mounting of the terminal means of the arch, herein shown as shoes 10, which are disposed at the spring line of the arch and which are adapted for connection with the tie-rods 4. As aforementioned, in actual construction, due to slight variations or imperfections in the connections or shoes 2 and the ends of the segments 1, it is not always possible to bring the terminal shoes 10 upon their seats 11 at points such that the arch will assume its precise theoretical curvature, and any attempt to force said terminal shoes and segments into their theoretical position would introduce secondary or bending stresses in the tie-rods 4. To overcome this and thus avoid the introduction of secondary or bending stresses in the tie-rods 4, the bottom faces of the shoes are curved as indicated at 16 to permit motion in the plane of the arch and the openings 12 in the terminal shoes 10 through which the tie-rods extend are preferably cored out so as to taper inwardly from the outer surfaces of the shoe, as best shown in Fig. 2. This double taper allows for rocking movement of the shoe 10 independently of any movement in the tie-rod 4, and to facilitate this rocking action the outer face of the shoe 10 whereat the tie-rod extends therethrough, is curved or made spherical, as indicated at 13. The outer ends of the tie-rods 4 are screw-threaded and equipped with a nut 14 and a washer 15, which latter pro-

vides a reaction surface for the shoe **10** at the surface **13**. To accommodate the aforementioned rocking action without interfering with the engagement of the surface of the shoe **10** with the reaction surface of the washer **15**, whereby the secondary strains would be introduced into the tie-rod, the inner surface of the washer **15** is curved in complemental relation to the spherical surface **13**.

An alternate construction of the shoe **10** for accomplishing the same ends may be obtained by coring the shoe outwardly from the curved bearing face **13**, as indicated at **12***a* in Fig. 3. In this modification it will also be noted that a flat washer **15***a* may be employed for providing the reaction face on the tie-rod **4** for the shoe **10**.

In the modifications illustrated in Figs. 4 and 5 I have shown how clevis rods may be used for tying in the ends of the arches. In Fig. 4 the clevis rods **4***a* are connected to the exterior of the shoe **10** by means of a pivot pin **17** and secured by suitable nuts **18**, the rocking action being thus permitted around the pivot pin **17**. In Fig. 5 the shoe may be cored out, as indicated at **12***c*, in a manner similar to that shown in Fig. 3 and a single clevis rod **4***b* mounted therein upon a pivot pin **17***a*, which may be held in place in any suitable manner.

In the various modifications the shoe **10** is shown as provided with a socket into which the terminal segment **1** is disposed and connected. It is obvious, however, that this connection may be made in any manner approved by engineering practice, depending upon the character and cross-sectional form of the terminal segment and the stresses that it is obliged to sustain.

While I have shown and described certain preferred embodiments of my invention I do not wish to be limited to the details of construction disclosed, since the same may be varied without departing from the spirit of the invention.

What I claim is:

1. A long span arch construction comprising means for resisting the horizontal thrust of the arch, flat bearing surfaces for the ends of the arch and rocking means at the ends of the arch bearing upon said flat surfaces for avoiding the introduction of secondary strains into the horizontal thrust-resisting means and into the ends of the arch.

2. A long span arch construction comprising a tie-rod connecting the arch ends together, flat bearing surfaces for the ends of the arch, and rocking means at the ends of the arch bearing upon said flat surfaces for avoiding the introduction of secondary strains into the tie-rod and into the ends of the arch.

3. A long span arch construction comprising a plurality of straight segments, means connecting the segment ends together for transmitting the longitudinal thrust of the arch throughout the segments, a tie-rod connecting the ends of the arch together, a shoe at each end of the arch having an opening therein larger than the tie-rod and through which the tie-rod extends, said shoe on its outer face having a curved surface whereat the tie-rod extends therethrough, and means on said tie-rod bearing against said curved surfaces and permitting a limited rocking of the shoes without introducing secondary strains into the tie-rod.

4. A long span arch according to claim 3, wherein the openings in the shoes through which the tie-rod extends taper inwardly from the outer surfaces of the shoes.

5. A long span arch according to claim 3, wherein the openings in the shoes through which the tie-rod extends taper outwardly from the curved bearing surfaces through the shoes.

6. A long span arch according to claim 3, wherein the bearing surface on the tie-rod is of complemental form to the curved surface on the shoe.

7. A long span arch according to claim 3, wherein the shoes are formed on their bottom or bearing faces with surfaces which are curved to permit motion in the plane of the arch.

8. In a long span arch construction, a tie rod connecting the ends of the arch together, means at each end of the arch having an opening therein larger than the tie rod and through which the tie rod extends, said means on its outer face having a curved surface whereat the tie rod extends therethrough, and means on the tie rod bearing against said curved surfaces and permitting a limited rocking of the means at the ends of the arch without introducing secondary strains into the tie rod.

LOUIS DAVIDSON.