

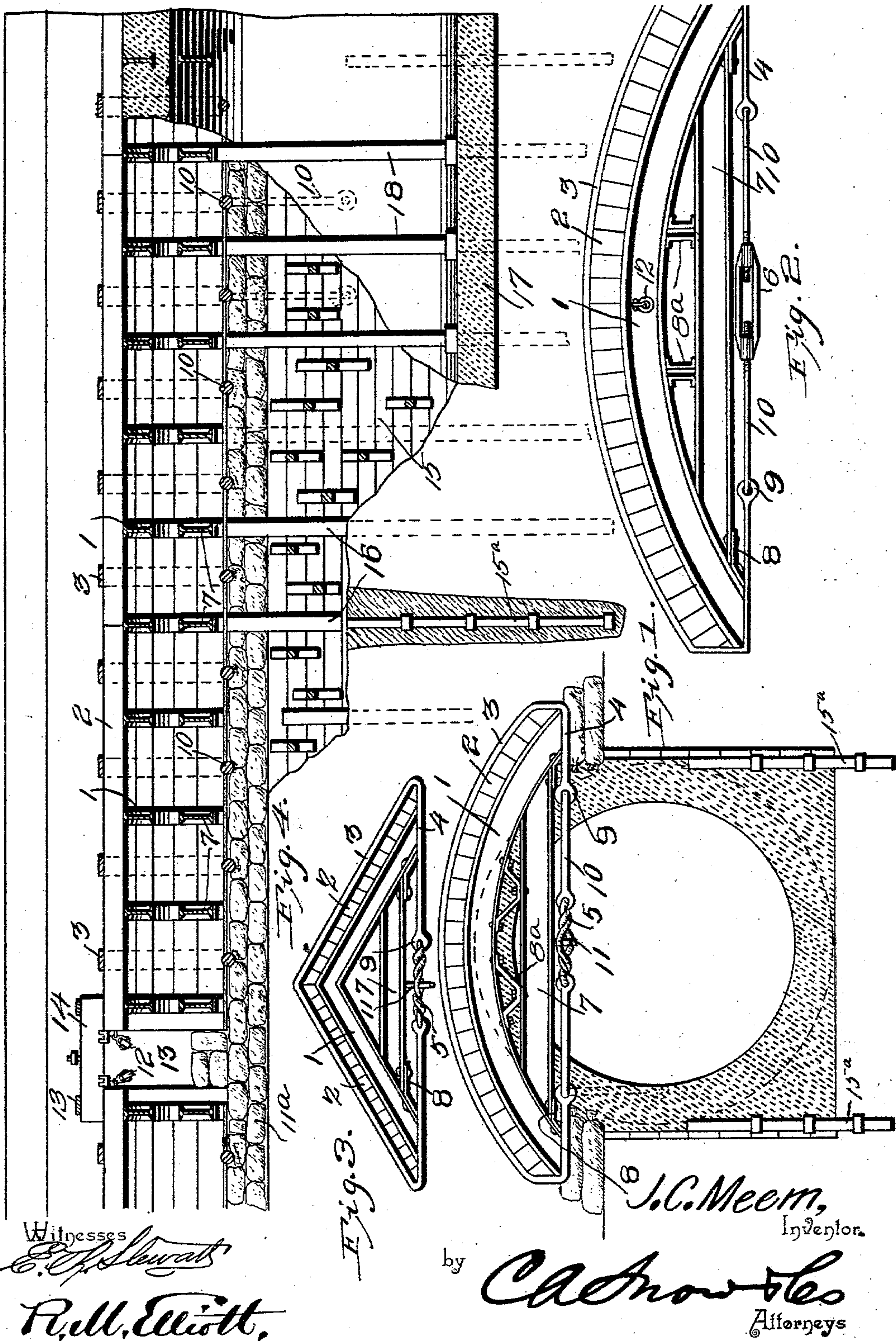
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Patented Dec. 9, 1902.

J. C. MEEM.
TUNNEL ROOF.

(Application filed Apr. 21, 1902.)

(No Model.)



Witnesses

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TUNNEL-ROOF.

SPECIFICATION forming part of Letters Patent No. 715,406, dated December 9, 1902.

Application filed April 21, 1902. Serial No. 103,995. (No model.)

To all whom it may concern:

Be it known that I, JAMES C. MEEM, a citizen of the United States, residing at Brooklyn, in the county of Kings and State of New York, have invented a new and useful Tunnel-Roof, of which the following is a specification.

This invention relates generally to tunnels, and particularly to a shield or roof to be employed in connection therewith.

The object of the invention is in a ready, feasible, and thoroughly practical manner to eliminate the danger of cave-ins attendant upon building tunnels either subaqueous or underground.

With these and other objects in view, as will appear as the nature of the invention is better understood, the same consists in the novel construction and combination of parts of a shield or roof for tunnels, as will be hereinafter fully described and claimed.

In the accompanying drawings, forming a part of this specification, and in which like numerals of reference indicate corresponding parts, there are illustrated three forms of embodiment of the invention capable of carrying the same into practical operation, it being understood that the elements therein exhibited may be varied or changed as to shape, proportion, and exact manner of assemblage without departing from the spirit thereof.

In the drawings, Figure 1 is a view in elevation exhibiting one form of embodiment of the invention as positioned in a tunnel in course of construction. Fig. 2 is a similar view of a modified form of roof or shield. Fig. 3 is a similar view of a still further modified form of roof or shield. Fig. 4 is a view in elevation, partly in section, showing one manner in which a tunnel is constructed when employing the roof or shield of the present invention.

The general idea of this invention is that of a roof or shield for a tunnel which is adapted to be submerged to rest upon a natural or artificial foundation positioned on the natural, dredged, or excavated bottom of any body of water, the structure to have sufficient stability, strength, and stiffness to resist pressure from above or below when supported along its edges only, thereby to permit of ex-

cavations being carried on from beneath, the shield being equally well adapted to be used for tunneling below a surface that is not of mud or water.

The general form of the structure is by preference that of the segment of a circle when viewed in elevation, as shown in Figs. 1, 2, and 4, or a pointed roof-section, as shown in Fig. 3.

In the arrangement shown in Figs. 1, 2, and 4 the structure is exhibited as being composed of ribs or compression members 1, constructed of steel beams spaced apart at suitable intervals and bent on the desired segment of a circle. Upon these ribs are laid longitudinally-disposed wooden arch members 2, which may, if preferred, be spiked or bolted together, the whole being made up into suitable lengths or sections—say of from one to two hundred feet each. The section is bound together laterally by rods or eyebars 3 passing over the arch as bands and underneath as tension chord members 4 and being retained under suitable tension either by tourniquets 5, as shown in Figs. 1 and 3, or by a turnbuckle 6, as shown in Fig. 2. Connecting the terminals of the ribs 1 are chord-stiffeners 7, which may be held associated with the under side thereof by brackets and hangers 8 and 8^a, respectively, as clearly shown in Figs. 1 and 2. The ribs 1 are by preference made of I-beams, as shown in Fig. 4, and are thus capable of withstanding great strain without yielding. While it is generally preferred to make the ribs of I-beams, they may be made of plate-girder or timber, and the arch-pieces or voussoirs may be made of steel plate, cast-iron, or concrete, and the bands or chords may be made of wire or other rope or of straps.

As clearly shown in Figs. 1, 2, and 3, the terminals of the tension chord members 4 are provided with eyes 9, with which are connected draft-bars 10, constituting a continuation of the said members, and in the construction shown in Figs. 1 and 2 the inner ends of these draft-bars are provided with eyes, to be engaged by a length of rope or chain constituting the tourniquet 5, the twisting member 11 of which is held against turn-

ing when the band has been placed under requisite tension by being brought into engagement with the chord-stiffener. In the construction shown in Fig. 2 the inner ends 5 of the draft-bars are threaded for engagement by the turnbuckle 6 in the usual manner.

In the construction shown in Fig. 3 the brackets or hangers 8 are omitted; but it is 10 to be understood that, if preferred, these may be employed, and in this latter construction the compression members 1 are disposed at an angle to each other instead of being curved.

In all the forms of embodiment of the invention herein illustrated the essential features are the arch or compression members 1, the chord-stiffeners 7, and the bands and chord tension members 3 and 4, respectively.

In order to render clear an understanding 20 of how the roof or shield of the present invention is employed, a description of a proposed method of operation will be given.

The bottom of the river or other body of water is first dredged to a suitable depth, as 25 shown in Fig. 4, and a foundation 11^a, preferably of concrete in bags, is laid to occupy a position beneath the edges of the shield. The shield in sections of suitable length is then floated to position and lowered to approximate line and grade, previous to which, 30 however, pulley-blocks 12 are fastened to the forward end of the shield, by means of which the next section of shield may be guided to position. At intervals of from one hundred 35 to five hundred feet, or as desired, bulkheads 13 are constructed between the abutting ends of two sections, between which when in position sufficient room is left to fill the space with concrete or clay to insure a tight joint 40 in the event of using compressed air, the bulkhead being covered by a mattress 14 of arch-timbers, the other abutting joints being covered with a heavy felt or steel covering, and over the entire shield when thus positioned 45 a covering of clay and sand is deposited to keep out water from above and, if used, to keep in air below. If this covering be shallow, barges loaded with pig-iron may be sunk temporarily across the shield to hold it down 50 while the arch is progressing from beneath. From adjacent shafts connection is then made with each end of the shield and the excavation begins. If the underlying material be rock, the excavation may proceed as an open cut, 55 air being used, if necessary. If the said material be ordinary clay or solid earth, the work may also proceed as an open cut, care being taken to sheath the sides at 15 to hold the supporting-foundations. If, however, the 60 ground be soft or treacherous, compressed air may be used, and the work may proceed as follows: Side drifts will be run out adjacent to the edges of the arch, and at intervals of, say, five feet, casing-pipe 15^a in suitable 65 lengths will be sunk to the required depth and filled with concrete, and the shield will be temporarily blocked up thereon, as at 16.

The central shaft is then run out for a short distance to the full depth, and in the bottom a section 17 of foundation is laid, and from 70 this the shield is again supported by stanchions 18 while the sides are being excavated. As the sides are brought up the draft-bars 10 may be separated, as shown by dotted lines in Figs. 1 and 4, and dropped to be built into 75 the masonry and be made a part thereof, thereby to transmit a part of the weight of the tunnel to the side foundations and also hold the shield in place. If preferred, the chord-stiffeners may be removed. 80

By the employment of the shield of this invention greater security results to the workmen building the arch and opportunity is afforded for examining the character of material 85 and to arrange suitable foundations as the arch progresses. Further, in case of ordinary soil or rock underlying the bottom the tunnel may be built close to the surface, thereby reducing the depth of the tunnel correspondingly inshore. 90

It will be understood that in carrying the invention into practical operation various changes in the location of the different parts and in the manner of their assemblage may be resorted to and still be within the scope of 95 the invention.

Having thus fully described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. A roof or shield for tunnels comprising a 100 plurality of compression members, superposed arch members, chord-stiffeners abutting the compression members, and means for binding the parts together.

2. A roof or shield for tunnels comprising a 105 plurality of compression members, superposed arch members disposed transversely thereof, chord-stiffeners associated with the compression members, and tension devices for holding the parts together. 110

3. A roof or shield for tunnels, comprising a plurality of compression members, superposed arch members disposed transversely thereof, chord-stiffeners depending from the compression members, and assembling-bands 115 having means associated therewith for placing them under the desired tension.

4. A roof or shield for tunnels comprising a plurality of compression members, superposed arch members disposed transversely 120 thereof, chord-stiffeners abutting the compression members, assembling-bands having their terminals disposed beneath the chord-stiffeners, and a tension device associated with the said terminals. 125

5. A roof or shield for tunnels, comprising a plurality of angularly-disposed compression members, superposed arch members, chord-stiffeners associated with the compression members and means for binding the parts to- 130 gether.

6. A roof or shield for tunnels, comprising a plurality of arched compression members composed of I-beams, suitably spaced apart,

superposed arch members, chord-stiffeners
associated with the compression members, as-
sembling-bands encircling the arch members
and having their terminals disposed beneath
5 the chord-stiffeners, and a tension device as-
sociated with the said terminals.

In testimony that I claim the foregoing as

my own I have hereto affixed my signature in
the presence of two witnesses.

JAMES C. MEEM.

Witnesses:

LIZZIE M. MURPHY,

T. J. MURPHY.