No. 840,224. PATENTED JAN. 1, 1907.

D. B. LUTEN.

ARCH AND ANALOGOUS STRUCTURE.

APPLICATION FILED AUG. 23, 1905.

Fig. 1.

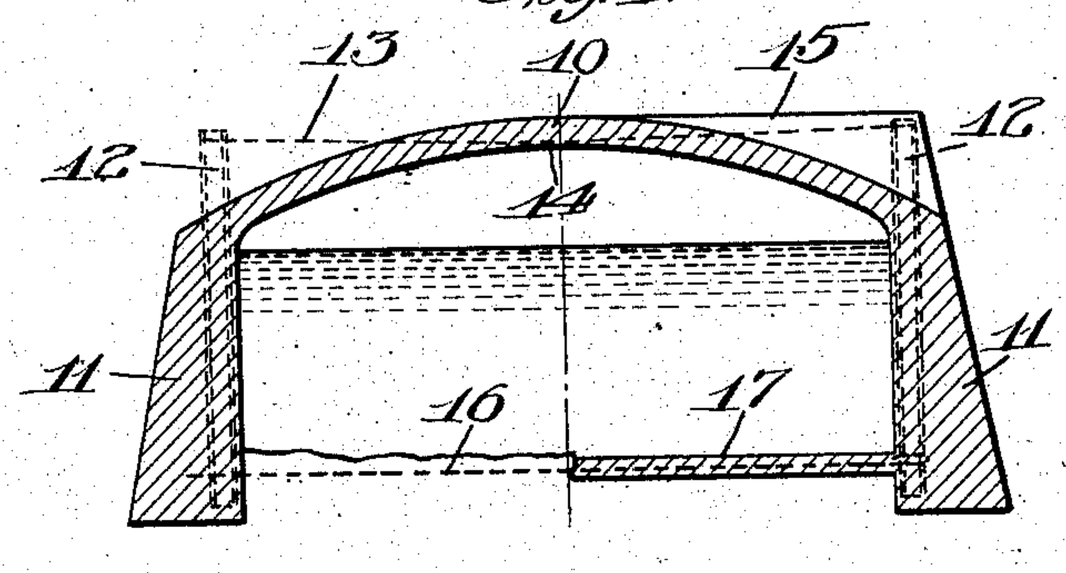


Fig. 2.

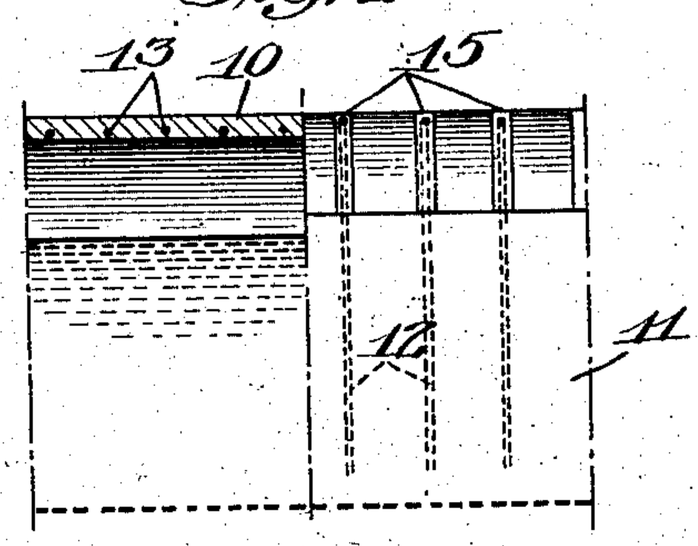


Fig. 3.

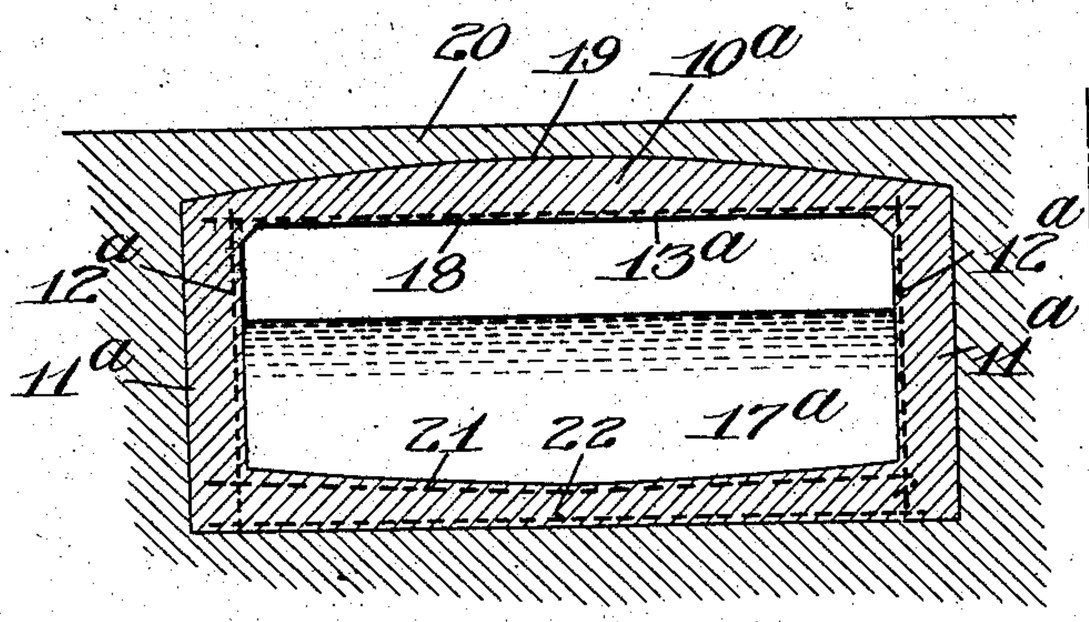


Fig. 4.

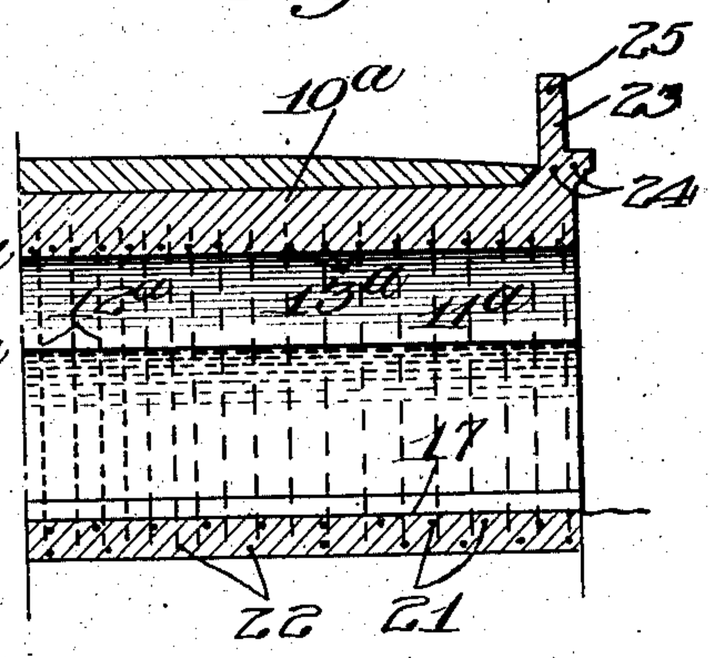


Fig. 5.

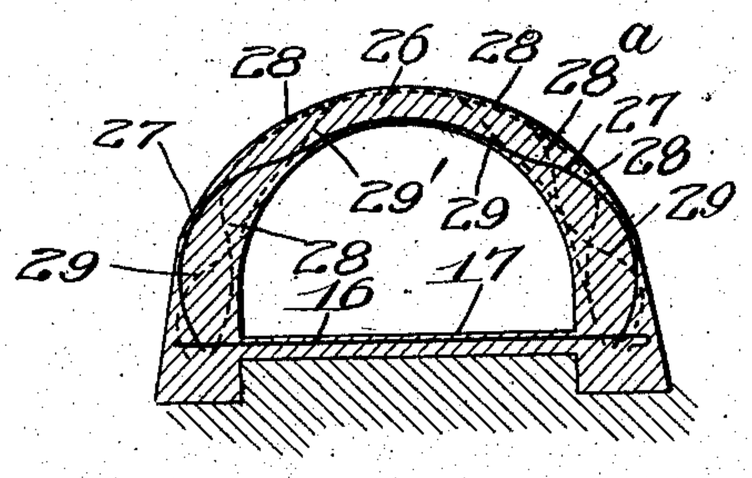
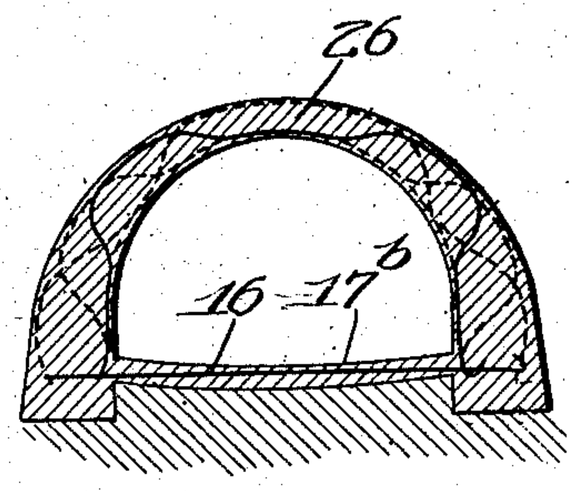


Fig. 6.



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ARCH AND ANALOGOUS STRUCTURE.

No. 340,224. Specification of Letters Patent. Patented Jan. 1, 1907.

Application filed August 23, 1905. Serial No. 275,474.

To all whom it may concern:

Be it known that I, DANIEL B. LUTEN, a citizen of the United States, residing at Indianapolis, in the county of Marion and State of Indiana, have invented new and useful Improvements in Arch and Analogous Structures, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

This invention relates to improvements in arch and analogous structures which are commonly designed to serve as bridges or viaducts across streams, roadways, ravines, &c., and which are usually constructed of concrete, stone, brick, mortar, and other materials; and the invention has for its general object to provide an improved structure of the class described for this and analogous purposes characterized by increased strength and capacity to resist vertical and other strains imposed upon the arch.

Specific objects contemplated by the invention are the provision of strengthening and reinforcing means, especially for masonry structures, employing low or flat crowns to resist vertical strains therein, the reinforcement of abutments, bench-walls, or piers, which may be employed in such or other structures, and the strengthening or reinforcement of pavements that may be employed in structures of the same general class.

In the accompanying drawings I have illustrated several arches or structures embodying my improvements, the same reference characters being employed to designate the same parts throughout the several views and in which—

Figure 1 is a longitudinal sectional view through an arch equipped with my improvements and having as a feature thereof vertical reinforcing members embedded in the piers or abutments thereof or bench-walls as anchors for the suspension members. Fig. 2 is a view, partly in end elevation and partly in cross-section, of the same. Fig. 3 is a view similar to Fig. 1, showing a modified form of arch covered with an earth fill and reinforced in a similar though somewhat different manner. Fig. 4 is a cross-sectional view through the center of the arch and at right angles to Fig. 3. Fig. 5 is a side view of a semicircular arch with reinforcing members embedded in the pavement, and Fig. 6 is a similar view of a similar arch having an inverted-arch pavement also reinforced.

Referring to the drawings, Figs. 1 and 2 show a low or flat arch 10, supported on high bench-walls, abutments, or piers 11. Reinforcing members in the form of beams or posts 12 are embedded upright in the concrete or other material of the bench-walls or abutments 11, and suspension members 13, preferably rods, are hung from the upper ends of said beams or posts and so disposed in the material of the arch-rib as to lie close to the intrados at the crown 14. These members or rods preferably sag slightly, so that the least weight upon the rods will tend to draw the upper ends of the beams together to resist the thrust of the arch. The upper ends of the beams and the outer ends of the rods may be exposed, as shown at the left in Fig. 1, or, as shown at the right, they may be embedded in external protecting-ribs 15, of concrete or the same material as that of the arch. This construction also preferably employs a series of tie-rods 16, connecting the lower ends of the beams 12 across the arch, which tie-rods may simply lie across the bed of the stream, as shown at the left, or may be embedded in a pavement 17, as shown at the right.

Figs. 3 and 4 illustrate a flat arch supported on light abutments or piers, especially suitable for culverts of short span. The arch or beam 10^a has the inner flat or straight side 18 and an upper face 19, which may be either straight or curved. Over this upper surface is filled the earth or gravel of the roadway 20. The flat top of this arch is supported on the end walls or piers or abutments 11^a, between the lower ends of which the pavement 17^a extends. Because of the slight thrust in this form of arch the abutments may be made very light and of sufficient strength only to support the vertical loads and the pressure of the earth behind them. Reinforcing members 13^a, preferably in the form of tension-rods, are embedded adjacent the inner face or intrados of the top 10^a and serve to take up the tension induced in the said lower side by the imposed load. Vertical reinforcing members 12^a, also preferably in the form of rods, are embedded in the piers, walls, or abutments 11^a and are located, as shown, near the inner face to more

effectually resist the pressure from the opposite side, and these may be anchored to the rods 13^a of the top 10^a or be otherwise anchored or simply terminate in straight ends. The pavement 17^a is slightly dished at the center, and a set of rods 21 and 22 are embedded adjacent the inner and outer faces, respectively, and which may be suitably anchored at their ends or secured to the upright reinforcing-rods 12^a. Such an arch, particularly for small spans, has the advantage of simple form, cheapness of construction, and a rectangular waterway, which gives greater water area than in the case of a circular arch. At the right in Fig. 4 a spandrel-wall 23 is indicated, the same being reinforced by tension members 24 and 25 near the lower and upper edges, respectively.

Fig. 5 illustrates an arch having a pavement 17, with embedded tension members 16, such as rods, near the upper face, and therefore near the face in tension. These rods are placed as far apart transversely as may seem desirable, and they may be anchored in any suitable way or simply embedded in the abutment or hooked around the rods passing through the arch-ring.

In Fig. 6 the pavement 17^b is shown dished or inverted-arch shape to better withstand the pressure from below and to assist in supporting the weight and load of the arch. In the arch-ring 26 of each of these arches of Figs. 5 and 6 are shown embedded tension members, so located as to resist tensile stresses adjacent the extrados and intrados in the regions where it is liable to occur. For instance, in Fig. 5 the rods 27 (shown in full lines) pass near the intrados at the crown and near the extrados at the haunches. The rods 28 are similarly arranged with respect to weaving back and forth across the arch-ring, but are inversely or alternately located—that is, they are high at the crown and low at the haunches. Each of these classes of rods (there being a plurality of rods in each class suitably spaced in a transverse row) resist tension in the faces of the structure near which they pass, which is caused by the loading and earth pressures upon the arch. At the right in Fig. 5 the rods 28 are indicated at 28^a as crossing at a different place from other rods 28, this for the purpose of distributing the reinforcement to allow for a variation in the regions of strain. Another set of rods, such as 29, are high at the crown, cross the arch, and low at the haunches, and again cross lower down and pass adjacent the outer face of ring or abutment. In Fig. 6 the rods cross in various ways, as shown, to effectually resist the tensional strains set up in the arch. In this figure the pavement-rods 16^b are so distanced as to better sustain the tensional strains—that is, they are near the inner face of the crown and near the outer face of the haunches.

While I have thus described several specific constructions, it will be apparent that various modifications may be made therein and still come within the spirit and scope of my invention.

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

1. An arch or bridge with reinforcing members embedded in the abutments or piers and tension members across the span below the waterway.

2. An arch having beams set in the abutments or bench-walls, and suspension-rods extending between the upper ends of said beams and passing through the arch, substantially as described.

3. An arch having beams set in the abutments or bench-walls, and suspension-rods extending between the upper ends of said beams and passing through the arch near the intrados, substantially as described.

4. An arch having beams set in the abutments or bench-walls, and suspension-rods sagged at the middle extending between the upper ends of the beams and passing through and embedded in the arch-rib, substantially as described.

5. An arch having beams set in the abutments or bench-walls, and suspension-rods extending between the upper ends of the beams and passing near the intrados of the arch, and an external protecting-rib covering said rod and beams, substantially as described.

6. An arch provided with a pavement and having beams set in the abutments or bench-walls, suspension-rods extending between the upper ends of the beams and passing near the intrados of the arch, and tie-rods passing through said pavement and anchored in the abutments, substantially as described.

7. An arch or bridge having the bed of stream paved with a reinforced concrete pavement.

8. An arch or bridge having the bed of stream paved with concrete reinforced with members from abutment to abutment and extending well into the abutments.

9. An arch or bridge having the bed of stream paved with concrete with tension members embedded transverse to the course of the stream.

10. An arch or bridge with a concrete pavement in the bed of the stream and tension members embedded near its upper surface.

11. An arch or bridge having the bed of stream paved with concrete with concave upper surface and tension members embedded passing near the upper surface at the middle of the span and near the lower surface at the ends.

12. An arch or bridge with reinforced concrete pavement in bed of stream, the rein-

forcing members extending into the abutments and connected to other members embedded in the abutments.

13. In a bridge a pavement in bed of stream with reinforcing members embedded near upper and lower surfaces.

14. An arch or bridge having a pavement in the bed of stream from abutment to abutment, and a tension member embedded in the abutment.

15. An arch or bridge having a strut embedded in the bed of the stream from abutment to abutment, and a reinforcing member in the abutment transverse to the strut.

In witness whereof I have hereunto subscribed my name in the presence of two witnesses.

DANIEL B. LUTEN.

Witnesses:
W. L. LUTEN,
RUSSELL T. MACFALL.