No. 853,203. PATENTED MAY 7, 1907.

D. B. LUTEN.

ARCH.

APPLICATION FILED JULY 25, 1904.

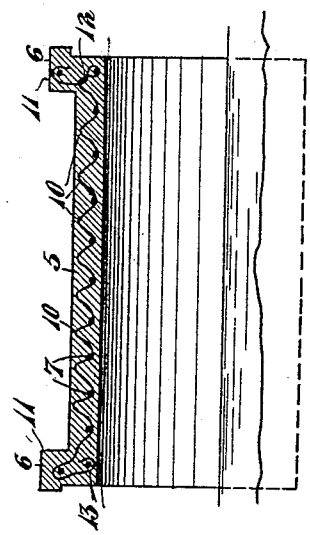

Fig. 2.

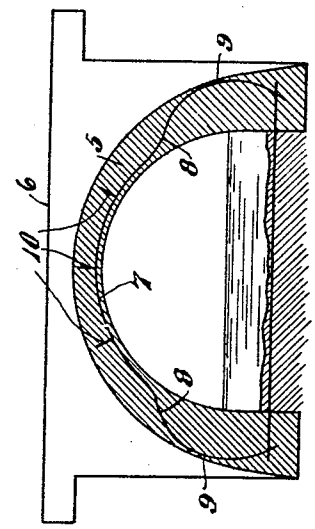

Fig. 1.

Witnesses.
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UNITED STATES PATENT OFFICE.

DANIEL B. LUTEN, OF INDIANAPOLIS, INDIANA.

ARCH.

No. 853,203. Specification of Letters Patent. Patented May 7, 1907.

Original application filed May 17, 1902, Serial No. 107,812. Divided and this application filed July 25, 1904. Serial No. 217,937.

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 a certain new and useful Improvement in Arches, 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.

My invention relates to arches, culverts, and similar bridge structures which are commonly constructed of masonry from concrete, stone, brick, cement, mortar, and other similar materials; and the invention has for its general object to provide an improved structure of this class which shall combine increased strength and efficiency with superior economy of materials and labor as compared with structures of this class now in general use.

It has been heretofore proposed to reinforce arch structures by tension members embedded in the rib or barrel of the arch and passing alternately from side to side of the rib through the portions in tension. I have found that in some arches in which this principle is applied where the tension members lie close to the intrados not only at the crown but for a considerable distance downwardly on either side thereof, when strains are applied normally to the arch at and adjacent to the crown there is sometimes a tendency on the part of the tension rods to break through the underlying portion of the rib, thus weakening the latter and putting it in danger of breaking through longitudinally of the arch.

My present invention is designed to provide a means whereby the beneficial effect of the tension rods may be preserved without subjecting the arch to the danger above referred to; and in its preferred form this means consists of one or more wires or straps embedded in the material of the arch at or near the crown, running in the direction of the axis of the arch that is, transversely to the span and to the main tension members and woven back and forth crosswise of the material and beneath the tension members to bond the material securely in transverse direction, these bonding members, where the arch is provided with spandrel walls, being preferably extended upwardly into side walls to thereby bond the walls to the arch rib and prevent their cracking or breaking away from the latter.

The present application constitutes a division of an application filed by me on the 17th day of May, 1902, Serial No. 107,812.

An arch having spandrel walls and constructed in accordance with my present invention is illustrated in the accompanying drawing, wherein

Figure 1 is a cross sectional view through the rib or barrel of the arch longitudinally with the span, and Fig. 2 is a central sectional view through the arch body and its spandrel walls transversely of the span.

Referring to the drawing, 5 designates the rib or barrel and 6 the spandrel walls of a typical form of arch constructed of concrete or other masonry. In the rib of the arch are embedded a series of tension rods which extend in a direction transversely of the axis of the arch, these rods lying close to the intrados at the crown and for some distance downwardly on either side thereof, as shown at 7, thence passing across to the outer wall as shown at 8, and following close to the latter down into the abutments as shown at 9, these rods, being thus disposed in the tensional regions of the arch, serving to prevent rupture of the latter at points of tensional strain. In passing from one tension region to the next adjacent tension region, these rods cross the central axis of the arch ring, that is the curved axis midway between the intrados and the extrados of the arch and are thus bonded into the material of the arch ring at the points 8 by their own extensions. I have found in practice that where these rods are extended continuously for a considerable distance through the tensional region at the intrados on either side of the crown, while locally effective for their intended purpose, they nevertheless tend to break the layer of concrete beneath them at and adjacent to the crown away from the remainder of the arch body, and thus permit the latter to crack at the crown and fail. I have found that this tendency may be effectually guarded against by embedding in the material of the arch one or more straps 10 which are woven back and forth between the inner and outer sides, passing beneath the tension rods 7 in the manner clearly shown in Fig. 2. Where the arch has spandrel walls, a tension rod 11 is embedded in the latter also, preferably near the top of the wall at its center, and the

straps 10 are carried up into the material of the wall and anchored around the tension rods of the walls in any suitable manner. An effective way of disposing of the end of the strap in the spandrel wall is shown at the right in Fig. 2 wherein the strap is looped or interlinked at 12 with its end around the outermost tension rod 7 and is then carried up and around the tension rod 11 of the spandrel wall the strap 10 extending in the direction of the axis of the arch overlapping its upright extension at 12, and securely anchored by the loop passing around the main tension member. A clearly effective disposition of the end of the strap is shown at the left of the same figure wherein the strap is carried upwardly and over the tension rod 11 and then brought down and anchored around the outermost tension rod 7, as shown at 13. This arrangement prevents failure of the arch by the longitudinal splitting away of the portion carrying the spandrel wall; or by the tendency of the spandrel wall itself to overturn due to the pressure of earth filling or other material or loading back of it and the straps 10, as already indicated, serve to effectively bond the material both in the direction of the axis of the arch and transversely of the material of its rib against the tendency of the spandrel wall to break away under the earth pressure, and against the tendency of the tension rods to split the rib longitudinally.

I claim:—

1. An arch supported on abutments or piers having tension members embedded near its concave surface, and other tension members passing back and forth through the material of the arch and between the first mentioned tension members and the adjacent surface, substantially as described.

2. An arch of concrete or similar material with a single series of tension members embedded and passing through all the regions of tension, and other reinforcing members bonding the tension members into the body of the arch, substantially as described.

3. An arch having a spandrel wall and straps embedded in the rib of the arch and extended into said wall to bond the wall to the body of the arch, substantially as described.

4. An arch having spandrel walls and tension-rods embedded in both the body of the arch and the walls, and straps woven back and forth between the extrados and intrados of the body and beneath said tension-rods and at their ends extending into said walls and anchored to the tension-rods of the latter, substantially as described.

5. In a concrete bridge, a spandrel, railing or retaining wall reinforced with a longitudinal member embedded and with upright members embedded near both faces.

6. A concrete bridge having a roadway bordered by a concrete wall, a longitudinal reinforcing member embedded in the wall, and transverse reinforcing members embedded in the wall and extending into the bridge under the roadway.

7. A bridge of concrete or similar material, with reinforcing members transverse to the roadway and extending upward into a wall or spandrel near its back face.

8. A concrete bridge consisting of a floor with walls at each side and reinforcing members embedded transversely of the floor and extending upward into the walls.

9. A bridge of concrete or similar material with reinforcing members embedded transverse to the roadway, in combination with a wall or spandrel with upright reinforcing members embedded.

10. A bridge of concrete or similar material with reinforcing members embedded transverse to the roadway and extending upward into a wall or spandrel.

11. A bridge of concrete or similar material with reinforcing members embedded transverse to the roadway, overlapping other reinforcing members embedded in a wall or railing.

12. A concrete arch with reinforcing members transverse to the axis and passing near intrados and near extrados and other members extending in the direction of the axis of the arch and overlapping upright members embedded in the spandrel, which in turn overlap a longitudinal member embedded in the spandrel.

13. An arch and spandrel with tension members embedded in the arch and extending into the spandrel and attached to longitudinal members in the spandrel, substantially as described.

14. A concrete arch with reinforcing members transverse to the axis and passing near intrados, and near extrados, and other reinforcing members extending in the direction of the axis of the arch and overlapping upright members embedded in the spandrel.

15. A concrete arch and spandrel wall with a longitudinal member and a transverse member embedded in the spandrel and overlapping, and a member embedded in the arch in the general direction of its axis.

16. A concrete arch with embedded tension members passing near the intrados and other transverse reinforcing members passing near the intrados and extending toward the extrados and anchored in the concrete without attachment to other members.

17. A concrete arch with rods or bars embedded crossing the central axis of the arch ring and other rods or bars passing close to the intrados adjacent to the aforesaid rods or bars and extending away from the intrados.

18. A concrete arch with rods or bars embedded transverse to the axis and crossing

the central axis of the arch ring, and longitudinal rods or bars passing between the said rods or bars and the intrados.

19. A concrete arch having embedded two tension members transverse to each other and each crossing from near the intrados to near the extrados of the arch.

20. A concrete arch with rods or bars embedded crossing the central axis of the arch ring and other similar rods or bars transverse thereto.

21. An arched structure of concrete or similar material with walls transverse to the axis of the arch and bonded to the arch by reinforcing members embedded in the arch in a direction transverse to the walls.

22. A curved structural member with tension members embedded passing from side to side of the structural member in longitudinal and transverse directions.

Signed by me at Indianapolis, county of Marion, State of Indiana, in the presence of two witnesses.

DANIEL B. LUTEN.

Witnesses:
B. C. RINEHART,
A. C. BROWN.