J. B. MARSH.

ARCH BRIDGE CONSTRUCTION.

APPLICATION FILED APR. 11, 1918.

**1,388,584.**

**Patented Aug. 23, 1921.**

2 SHEETS—SHEET 1.

Fig. 1.

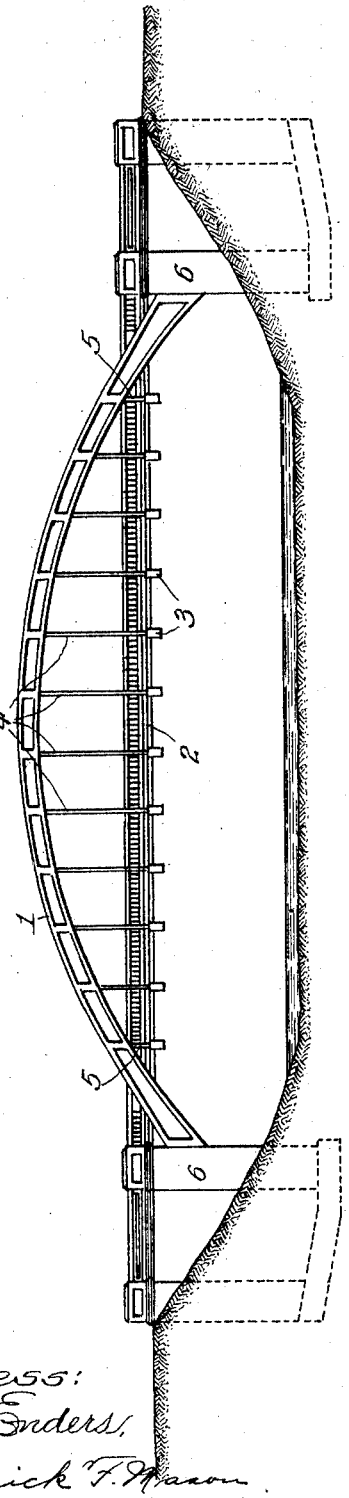



Fig. 4.

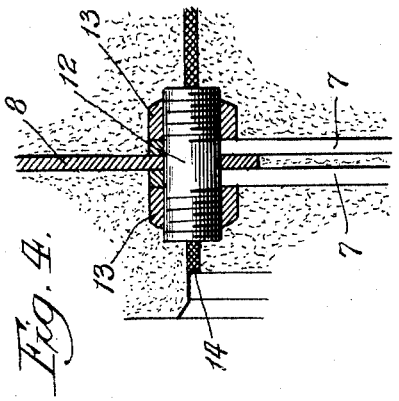
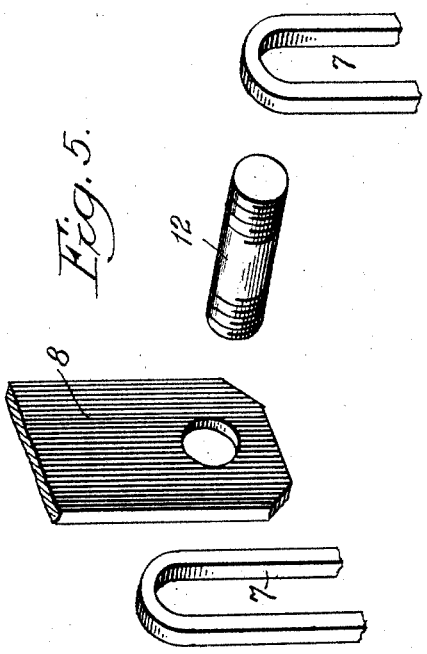



Fig. 5.




Witness:
John Enders.
Frederick F. Mason.

Inventor:
James B. Marsh
by Wallace R. Lane
Atty.

J. B. MARSH.

ARCH BRIDGE CONSTRUCTION.

APPLICATION FILED APR. 11, 1918.

**1,388,584.** **Patented Aug. 23, 1921.**

2 SHEETS—SHEET 2.

Fig. 3.

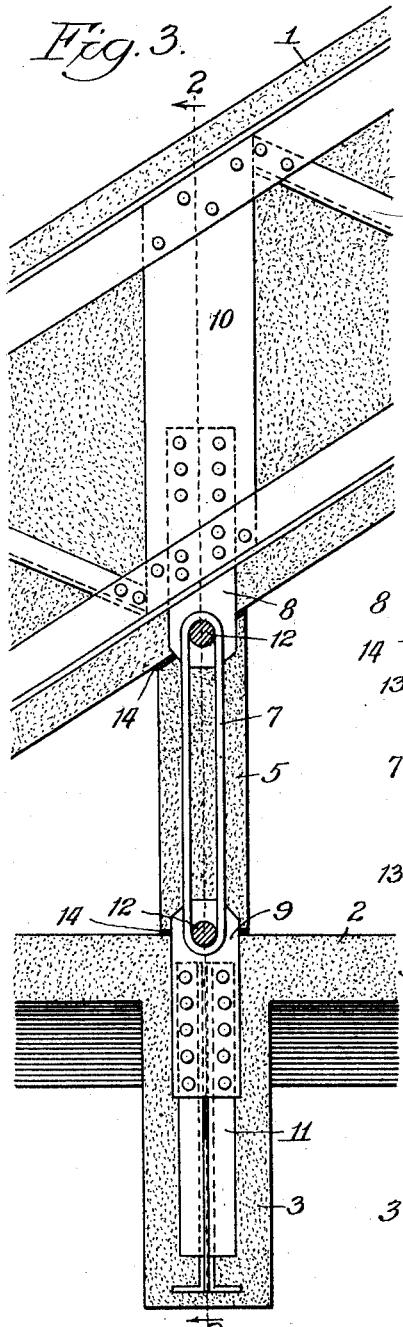
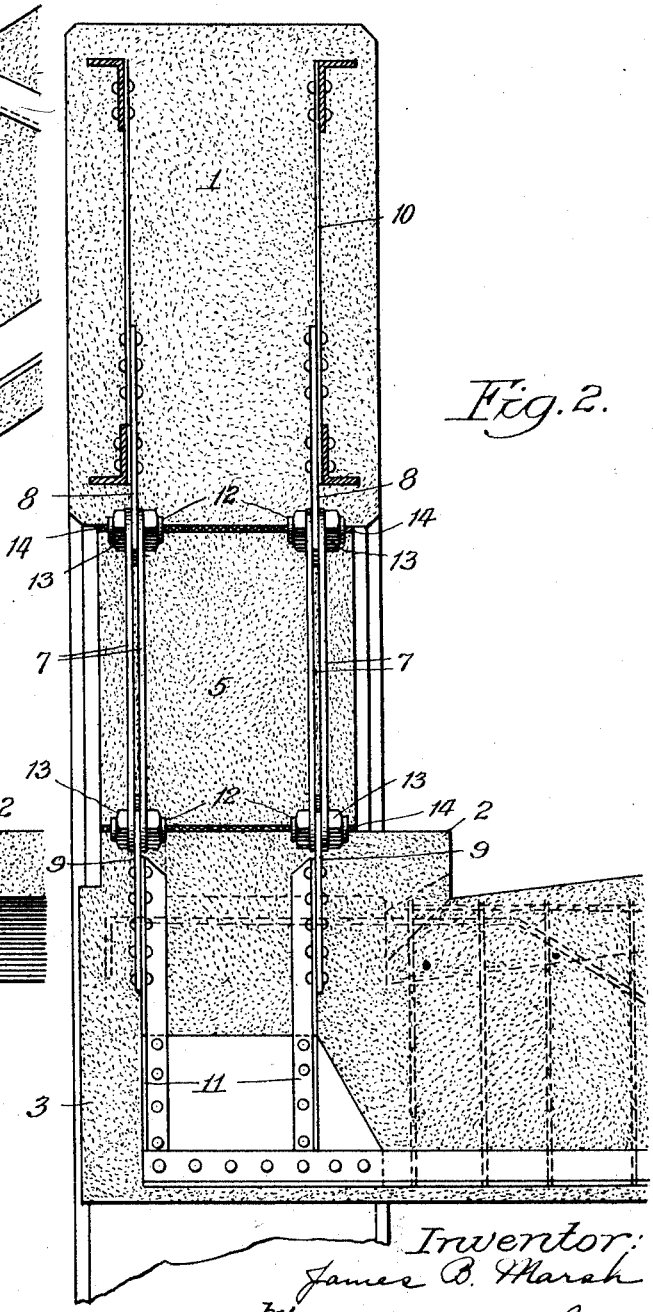



Fig. 2.




Witness:
John Enders.
Frederick F. Mason.

Inventor:
James B. Marsh
by
Wallace R. Lane
Atty.

# UNITED STATES PATENT OFFICE.

JAMES B. MARSH, OF DES MOINES, IOWA.

## ARCH-BRIDGE CONSTRUCTION.

1,388,584. Specification of Letters Patent. Patented Aug. 23, 1921.

Application filed April 11, 1918. Serial No. 227,860.

*To all whom it may concern:*

Be it known that I, JAMES B. MARSH, a citizen of the United States, residing at Des Moines, in the county of Polk and State of Iowa, have invented certain new and useful Improvements in Arch-Bridge Construction, of which the following is the specification.

This invention relates to certain improvements in bridge construction and more especially to the prevention in reinforced concrete arch bridges of rupture of certain of the parts from expansion and contraction.

One of the great deficiencies and sources of failure in reinforced concrete bridge construction as heretofore conducted is the improper and inadequate provision made for contraction and expansion due to temperature changes. This fault alone (aside from failures caused by faulty foundations) has wrecked more concrete bridges than any other one feature of faulty and incorrect design.

In reinforced concrete bridges such as shown in my Patent No. 1,035,026 granted Aug. 6, 1912, and which are known as the rainbow arch type, it will be seen that the floor supporting hangers decrease in length from the center of the bridge toward its ends. It will also be appreciated that the movement of the floor system due to changes in temperature, would naturally occur from the center of the span and travel each way to the end of the floor; this movement being accumulative from the center toward the ends. The hangers at or near the center of the arch span will take care of the movements of the floor, since because of their greater length and flexure per unit of length is so slight it will not injure the concrete or reinforcing metal in these hangers. The reverse however is true when considering the shorter hangers at or near the ends of the floor, since they are located at the greater distance from the center of the span, at which greater distance the maximum movement of the floor occurs. The present invention contemplates means whereby any injury to the concrete or reinforcing elements of these shorter hangers will be entirely obviated.

Among the objects of my invention is primarily to make provision, in reinforced concrete arch bridge construction, for expansion and contraction so as to prevent from this cause any rupture or failure of the shorter hangers or similar parts; further to provide an articulated joint for the shorter hangers or similar parts to permit a movement thereof without rupture of or injury to the concrete or reinforcing elements; further to interpose between the ends of these hangers and the adjacent parts an elastic filler to seal the joints but yet permit movement of the hanger with relation thereto; further to so arrange the reinforcing elements that they will be continuous from within the arch member, through the hanger, and into the floor cross beam, but of such nature as to provide a hinged joint at each end of the hanger; further to combine with such movable hanger simplicity and economy in construction and efficiency in operation; and such further objects, advantages and capabilities as will later more fully appear.

My invention further resides in the combination, construction and arrangement of parts illustrated in the accompanying drawings. While I have illustrated in the drawings a preferred embodiment I do not wish to be limited to this particular structure since it is obvious that the same is susceptible of modification and change without departing from my inventive idea.

In the drawings:

Figure 1 is an elevation of a reinforced concrete rainbow arch bridge embodying my invention.

Fig. 2 is a fragmentary vertical section through the end hanger and floor cross beam taken on the line 2—2 of Fig. 3 and showing the vertical reinforcing elements in elevation.

Fig. 3 is a vertical section through the end hanger, arch rib and floor and is taken at right angles to Fig. 2.

Fig. 4 is a sectional detail view showing the articulated joint of the end hangers.

Fig. 5 is a perspective view of the parts forming the articulated joint just prior to their being assembled.

Referring to the drawings and especially to Fig. 1, it will be seen that I have illustrated my invention as embodied in a reinforced concrete rainbow arch bridge comprising the arch members 1, the floor system 2 resting upon the cross beams 3 which are in turn supported by the vertical central hangers 4 and the shorter end hangers 5. Suitable abutments 6 are provided at each end of the span, but as these form no part of the present invention, a description of the

same will not be entered into. A general description of this bridge, exclusive of the present invention, will be found in my above mentioned patent.

As is obvious, the movement of the floor system due to changes in temperature will naturally occur from the center of the span and travel each way to the end of the floor, and which movement will be cumulative from the center toward the ends. The longer hangers 4 near the center of the span, due to their length, are capable of sufficient flexure to accommodate the small amount of movement produced by the contraction or expansion at the center of the span without the occurrence of any rupture in the concrete or in the reinforcements of these hangers, the flexure per unit of length for these hangers being small. The reverse however, is true when considering the shorter hangers at or near the ends of the span since they are at a greater distance from the center of the span and where maximum movement of the floor occurs. The present invention contemplates such a construction and arrangement of these shorter end hangers whereby to eliminate any danger of rupture therein, but at the same time fully accommodate any movements caused by expansion or contraction in the floor or arch members, or both. This result I accomplished by the provision of an articulated or hinged joint located at each end of the shorter hangers and which will now be described.

Referring now to Fig. 3, it will be seen that the rigid vertical reinforcement described in my above mentioned patent in connection with the vertical hangers has been replaced by a set of suitably spaced looped bars 7, these bars being arranged in pairs and located one on each side of the vertical plates 8 and 9, the plate 8 being rigidly secured by rivets or otherwise to the reinforcing elements 10 of the arch member 1, and the plate 9 being similarly securely fastened to the reinforcing elements 11 of the cross beams 3 in the floor system. These plates 8 and 9 are each provided with a perforation through which passes a pin 12, which pin also extends through the loop at the end of each of the bars 7. The pin 12, as shown in Figs. 4 and 5, is threaded at each end to accommodate the nuts 13, whereby these parts may be fastened in place in such manner as to permit a pivotal movement of the bar 7 upon the pins 12. While I have shown these bars 7 in the form of loops, it is obvious that they may assume various other shapes if desired, the primary idea being to secure a pivotal connection between the ends of the elements 7 and the plates 8 and 9 respectively.

The joints between the ends of the short hangers 5 and the inner surface of the rib 1, and upper surface of the floor 2 are filled with an elastic filling 14, which may be of such material as tarred felt or the like, the function of this filling being to keep the weather, dirt and the like out of these joints, but yet permit a pivotal movement of the hangers 5 about the pin 12 to accommodate any expansion and contraction. It will be noted in the drawings that the pins 12 are located in the plane of intersection between the ends of the short hangers 5, and the arch member 1, and the floor member 2 respectively, thus giving the maximum of movement between these parts. While I have shown in Fig. 2 two pairs of the loop bar 7 in each short hanger, it is obvious that any other desired number sufficient for strength may be used.

Since the flexibility of hangers varies inversely as their lengths it will be readily apparent that, due to their short length and their great distance from the center of the span, the end hangers in taking care of movements of the floor, due to temperature expansion and contraction, would have in the absence of provisions to take care of the same set up therein, bending moments sufficient to crack or disrupt the concrete at points where the hanger intersects the arch or floor, or at intermediate points along the length of the hanger, and which would also cause injury to the vertical reinforcing metal therein. This danger of rupture of these end hangers is entirely eliminated by the present invention, by which they are permitted to have a free and easy movement for accommodation of such expansion and contraction.

Having now described my invention—

I claim:

1. In a bridge construction a hanger formed of reinforced concrete, and means in the plane of intersection of said hanger with the adjacent parts of said bridge connecting said hanger to said adjacent parts in such manner as to permit movement of the hanger with relation to said parts to prevent rupture of the concrete.

2. In a reinforced concrete bridge construction a concrete arch member, a concrete floor, and a concrete hanger, each of said elements having reinforcing elements therein, said hanger being connected at each end in slightly spaced relation to said arch member and said floor respectively by means of a pivoted joint whereby to accommodate for expansion and contraction.

3. In a bridge construction a reinforced concrete arch member, a reinforced concrete floor, and a reinforced concrete hanger, the reinforcement of said hanger being pivotally connected at each end of the hanger to the reinforcement of the arch member

and floor respectively in the plane of intersection of said hanger with the adjacent parts of said bridge.

4. In a structure of the class described, an upper reinforced concrete member, a lower reinforced concrete member, and a supporting reinforced concrete hanger pivotally connected to said members in the plane of intersection of said hanger with the adjacent parts of said bridge to permit movement of said parts without rupture of the concrete thereof.

5. In a bridge construction, an upper member, a hanger hingedly connected to said upper member, and a floor hingedly connected to the lower end of the hanger, all of said parts being formed of reinforced concrete, and an elastic filler between the ends of the hanger and the upper member and floor respectively.

6. In a bridge construction an arch member, a floor system, hangers supporting said floor from said arch, all of said parts being formed of reinforced concrete, the shorter hangers at or near each end of said floor system having their reinforcing elements pivotally connected at the ends to the reinforcing elements of the arch and floor respectively in the plane of intersection of said hangers and the adjacent members whereby said shorter hangers may have a swinging movement with relation to said arch and floor when movement is produced in these parts by expansion or contraction.

7. In a bridge construction a reinforced concrete upper member, the reinforcement of which is provided with a downwardly extending plate, a reinforced concrete floor the reinforcement of which is provided with an upwardly extending plate, a reinforced concrete hanger comprising spaced looped bars, and pins passing through said loops and said extending plates respectively whereby said hanger may have swinging motion with relation to said upper member and said floor to accommodate expansion and contraction in said bridge without rupture of the concrete hanger.

8. In a reinforced concrete arch bridge construction a concrete arch member having reinforcing elements therein, a concrete floor having reinforcing elements therein, a concrete hanger connecting said arch member and said floor, a reinforcing element in said hanger and extending therethrough, and means pivotally connecting the respective ends of the hanger reinforcing element and the adjacent end of each of said other reinforcing elements substantially in the plane of intersection of said hanger and the adjacent members whereby to permit movement of the hanger without rupture to accommodate contraction and expansion of either said floor or said arch member or both.

9. In a reinforced concrete arch bridge construction a concrete arch member having reinforcing elements therein, a concrete floor having reinforcing elements therein, a concrete hanger connecting said arch member and said floor, a reinforcing element in said hanger and extending therethrough, means pivotally connecting the respective ends of the hanger reinforcing element and the adjacent end of each of said other reinforcing elements whereby to permit movement of the hanger without rupture to accommodate contraction and expansion of either said floor or said arch member or both, and an elastic filler in the joint at each end of the hanger.

10. In a reinforced concrete rainbow-arch bridge construction a concrete arch member, reinforcing elements in said arch member, a concrete floor construction having reinforcing elements therein, a concrete hanger connecting said arch member and floor construction, reinforcing elements in said hanger, said last mentioned reinforcing elements comprising spaced apertured members, the ends of said apertured members being arranged one on each side of the adjacent end of the said reinforcing elements in the arch member and floor construction respectively, a pin passing through each of the ends of the said apertured members and through said respective adjacent ends, means to secure said pin in such position and permit pivotal movement of the parts therearound, and an elastic filler in the joint between the respective ends of the hanger and the arch member and floor construction; whereby to permit movement of short bridge hangers to accommodate without rupture the expansion and contraction of the bridge.

11. In a structure of the class described, an upper reinforced concrete member, a lower reinforced concrete member, and a supporting reinforced concrete hanger pivotally connected to said members, the ends of said hanger being slightly spaced from the said members to permit movement of said parts without rupture of the concrete of said parts.

12. In a reinforced concrete construction an upper member, a lower member, and a supporting hanger pivotally connected to said members to permit movement of said parts without rupture of said hanger, and a layer of tarred felt between the ends of said hanger and the adjacent parts.

13. In a structure of the class described, an upper reinforced concrete member, a lower reinforced concrete member, and a supporting reinforced concrete hanger pivotally connected to said members at the

planes of intersection of its ends therewith respectively, said ends being slightly spaced from said members whereby to permit of movement between said parts to accommodate expansion and contraction without rupture of the concrete of said parts.

In witness whereof I hereunto subscribe my name to this specification in the presence of two witnesses.

JAMES B. MARSH.

Witnesses:
GEORGE F. HIGBIE,
WM. P. NEMMERS.