J. B. EADS.

Bridges.

No. 144,519. Patented Nov. 11, 1873.

Fig. 1.

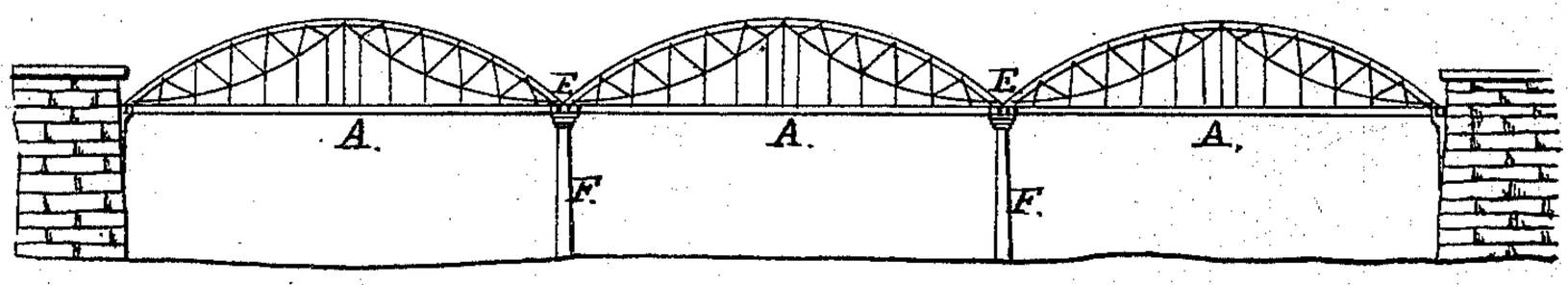


Fig. 2.

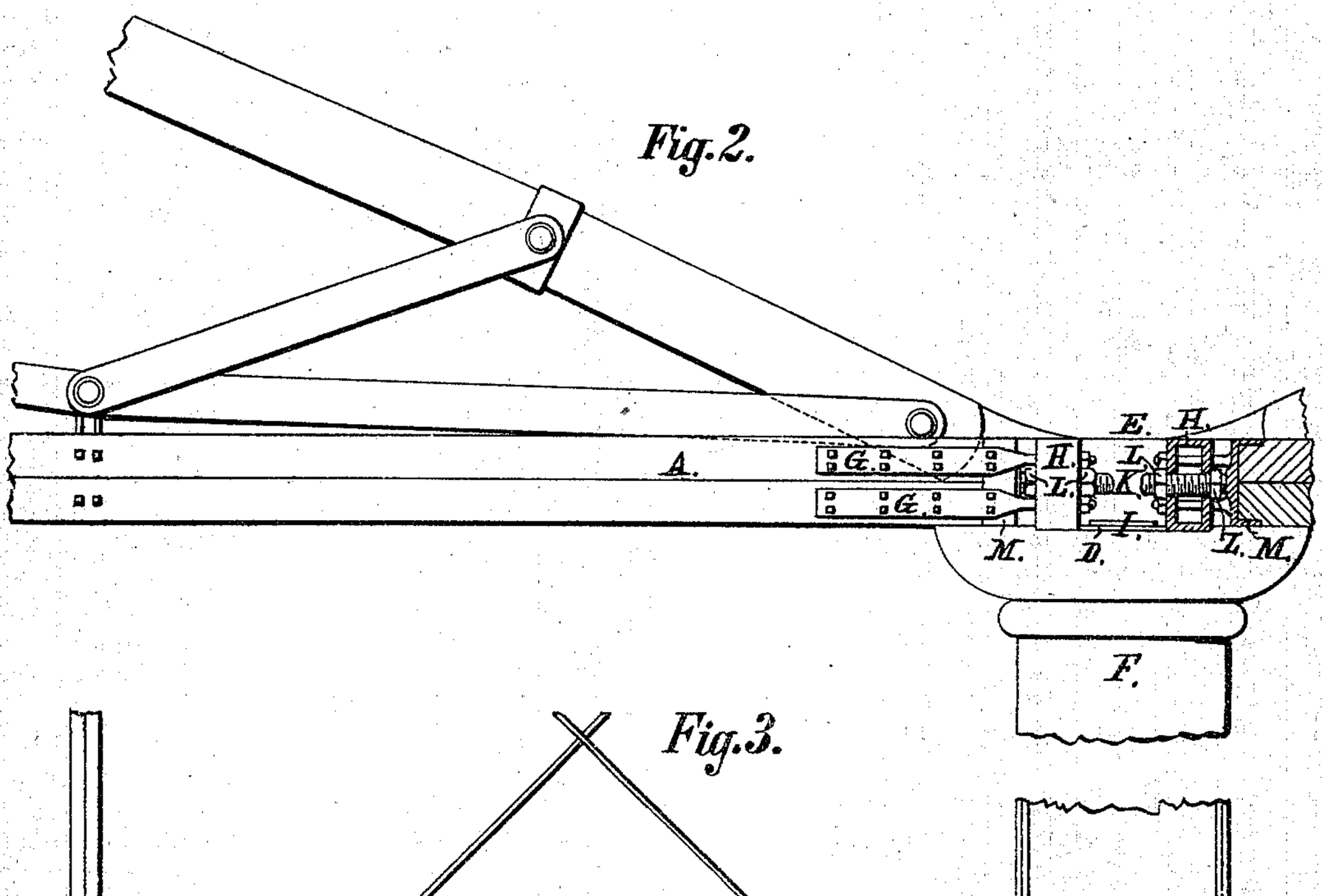
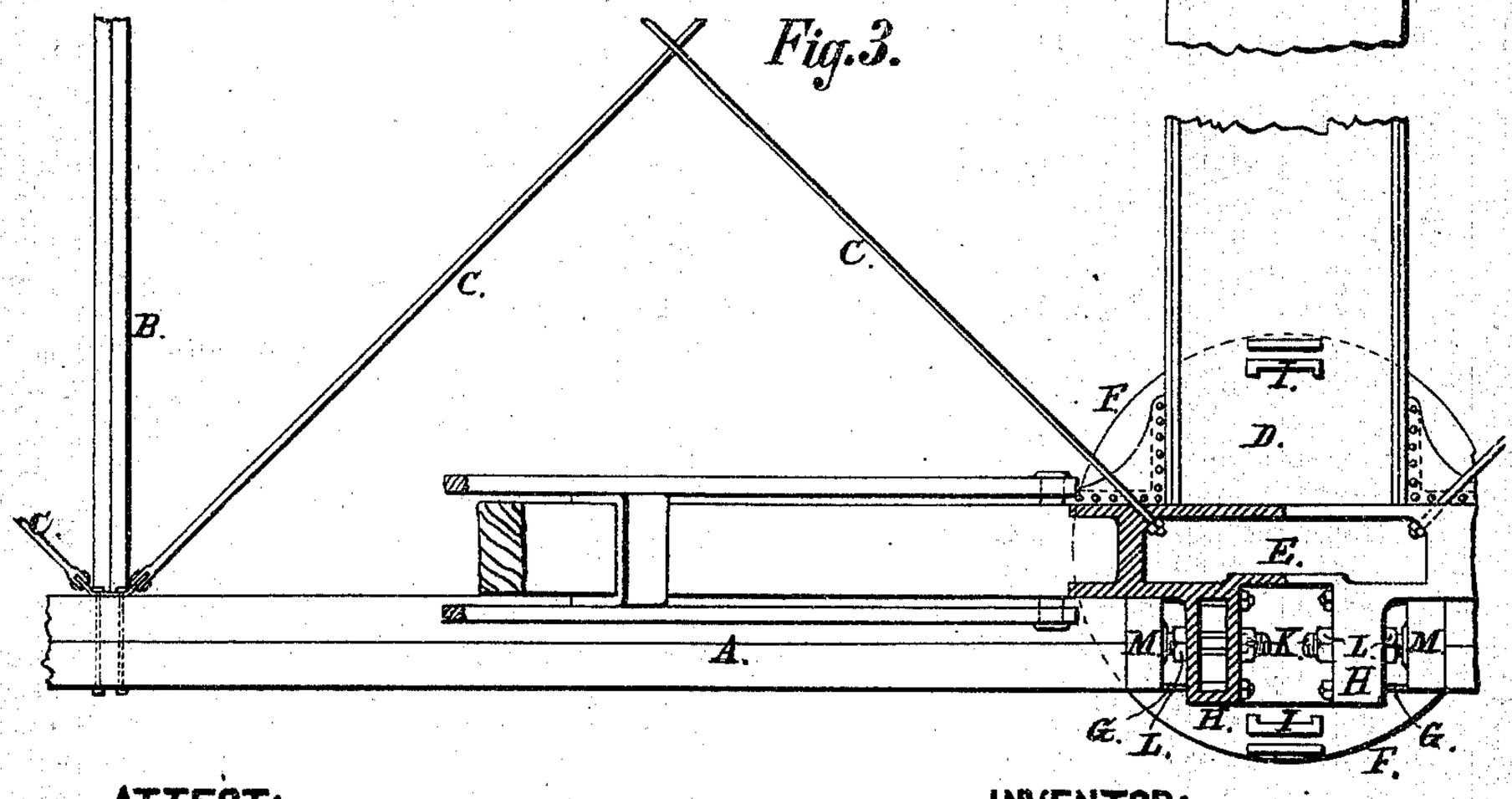


Fig. 3.



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JAMES B. EADS, OF ST. LOUIS, MISSOURI.

IMPROVEMENT IN BRIDGES.

Specification forming part of Letters Patent No. **144,519**, dated November 11, 1873; application filed August 27, 1873.

To all whom it may concern:

Be it known that I, JAMES B. EADS, of St. Louis, St. Louis county, Missouri, have invented a certain Improvement in Bridges, of which the following is a specification:

This invention relates to improvements in the superstructure of bridges consisting of a number of arches; and the improvement consists in a method of relieving the central piers of such bridges from the unequal thrust of the arches caused by the unequal loading of the same. I effect this by making the roadway substantially continuous against compressive strain from the abutment on one end of the bridge to the abutment on the other end of the bridge, so as to bring the horizontal strain of all the arches ultimately on the said abutments. The roadway may also be made continuous in such manner as to resist tensional strains from pier to pier or abutment, and thus lessen the compressive strains that would otherwise come against the abutments, the horizontal resistance or chords being provided as near the extreme sides of the roadway as possible.

In the drawings, Figure 1 is a side view of a bridge with three arches, illustrating my improvement. Eig. 2 is a side view enlarged of one end of an arch, part being in longitudinal section to show the compressive screw between the skew-back and chord or distance piece. Fig. 3 is a horizontal section of one end of the arch, looking downward.

Suppose two spans constitute a bridge, and the shore-abutments alone are constructed of sufficient strength to resist the thrust of the arches with their loads. If the loads on both arches be equal, and the arches of the same form and weight, the thrust of one span against the central pier will be balanced by the thrust of the other, and a pier or column simply calculated to sustain the vertical pressure, as in ordinary trusses, would be sufficient to insure stability; but if the load be removed from one span, the pier may be overturned by the thrust of the loaded one. To prevent this overthrow of the piers thus designed, by such horizontal force, without the expense of increasing the size and weight of the piers, I propose forming the chords of the wind-trussing of the roadway, and such other longitudinal members of the roadway as may be necessary, of some non-expansible material, (wood, for instance,) and so abut these chords and longitudinal members against the abutments and piers, in or about the line of the springing of the arches, as to cause the chords and members aforesaid, in the unloaded arches, to resist, by their compressive strength, the horizontal force resulting from the loading of any arch in the system. These distance pieces or chords in any one arch will not be in compression at the time the load is borne by that particular arch, except when initial compression is produced in them, as hereinafter stated; but if they were firmly secured to the piers, or pier and abutments supporting the arch, so as to resist tension, and were constructed throughout their length so as to resist tension, it will be seen at once that the compressive strain thrown on the chords in the other unloaded arches would be lessened by the amount of tension borne by the chords in the loaded arch.

The objection to combining timber with metal in the supporting members of a truss does not apply in this method. In the truss one chord (usually the top or compressive member) is sometimes made of timber; but when this becomes decayed or injured it is scarcely possible to replace it, save at the expense of constructing scaffolding, &c., to sustain the entire truss during repair.

In the proposed method any chord or part of a chord may be readily removed without disturbing the arches, piers, or other portion of the structure; for it will be seen that if an equivalent weight were put on the floor-beams of any one arch its chords could be removed, and the stability of the arch would not be at all affected so long as the chords remained intact in the other spans of the series. It is only when the spans are unequally loaded that any strain at all is upon the proposed distance pieces or chords, (except as hereinafter stated,) whereas, in all forms of trusses whatever, the chords are constantly under strain, and hence repairs in them are almost impossible, except at great inconvenience and expense.

In the drawings, A A A represent three chords or distance pieces, which will likewise serve as chords for the wind-trussing. B B are transverse floor-beams, and with the diag-

onals C C and the chords A A constitute the system of wind-bracing. D is a strong flat plate supporting the skew-backs E E and connecting the columns F, which stand in transverse couples or series, and constitute the piers supporting the ends of the two arches. G G are iron screw-straps joining the wooden chords to the brackets H H on the skew-backs. I I represent lugs or brackets on the plate D, to which may be secured stays, to secure the lower part of the arch against lateral movement, where the wind-bracing is omitted, to give head room for the roadway. K K are compression-screws, which pass through the brackets H H, and are provided with nuts L L, which bear against the sides of the bracket, and by which the screw can be caused to press with greater or less force against the metallic cap M at the ends of the distance piece, for a purpose hereinafter fully explained.

When an arch is loaded the distance pieces in the other arches will be compressed, and consequently slightly shortened. This will have the effect of slightly changing the position of the tops of the piers, and if this change be so great as to endanger the stability of the piers, the longitudinal movement of the bases of the arches may be accommodated by arranging the skew-backs and plates D (or other plates upon those D) to slide on the tops of the piers or plates D in the manner of ordinary trusses, in which case the distance pieces would abut against the skew-backs.

Where several arches constitute a series of spans, and the load be on one span, the extent of shortening in all of the chords of the unloaded spans from the horizontal force of the load may cause the bases of the loaded arch to move so far apart as to cause objectionable deflection in that arch. To prevent this, stronger abutments are provided, and the adjusting-screws K K, placed at the skew-backs of each arch, are made to act against the ends of the distance pieces in such manner as to produce a compressive strain throughout the entire line of chords from abutment to abutment when the bridge is unloaded. This initial compressive strain may be produced to such an extent (as determined by calculation) as to be just sufficient to relieve the chords of an arch entirely of compressive strain, when bearing the maximum load, and yet not produce tension in it. In such case the deflection of the arch will be limited by the compression in the arch itself, (due to the load,) and by the separation of the arch bases to the extent of the initial compression in its own chords or distance pieces. In a series, for instance, of five arches of, say, five hundred feet span, where the maximum horizontal force produced by the load on one arch equals five hundred tons, if an initial compressive strain of four hundred tons be produced in the entire system of chords from abutment to abutment, by the screws, when the bridge is unloaded, then this initial strain will be taken out of the chords of an arch next the abutment so soon as it bears its maximum load, while the compressive strain in the remaining chords will be proportionately increased. When all the arches are loaded the strain on the abutments will be five hundred tons, plus four hundred tons, plus the horizontal force of the unloaded arches—say, three hundred tons—making a total of twelve hundred tons. This system is applicable to all of the ordinary forms of truss-bridges, also; and by it the usual iron chords or tension members of a series of trusses may be dispensed with, and wooden compression members or chords substituted, thus effecting an important saving in cost.

It must be borne in mind that as each arch, in a uniform system, balances the thrust of its neighbor, the horizontal force against the abutments remains the same, whether there be one arch or any greater number of arches in the same series. The same remark applies to trusses also.

Owing to the expense and difficulty of joining a long series of timbers in such manner as to bear the tensile strain throughout the length of the series, I prefer the method proposed of increasing the strength of the abutments, and producing by screws, or their equivalents, as described, an initial compressive strain, and thus avoiding tensile strains in these chords. It may, however, be deemed desirable to have provision in them for a small degree of tension, as in case of tornadoes, where they act as chords to the system of wind or horizontal bracing between them; and to this end the timbers are joined to the skew-backs by bolts and nuts, as shown in Figs. 2 and 3, to resist tensile strains. Where these fastenings are necessary the timbers forming the chords must be secured also throughout the length of the chords to each other by splicing or breaking joints, or other usual means for similar purposes.

I claim herein as new and of my invention—

1. The described method of relieving the central piers of bridges from the unequal thrust of the arches, or equivalent members of truss-bridges, caused by moving loads, by making the roadway or longitudinal members supporting the same substantially continuous against compressive strains from the abutment at one end of the bridge to the abutment at the other end of the bridge, substantially in the manner and for the purpose set forth.

2. In combination with the chords or distance pieces A A, the compression and tensional screws K and G, substantially as and for the purpose set forth.

JAS. B. EADS.

Witnesses:
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GEO. C. FABIAN.