J. B. EADS.

Bridges.

No. 142,378. Patented September 2, 1873.

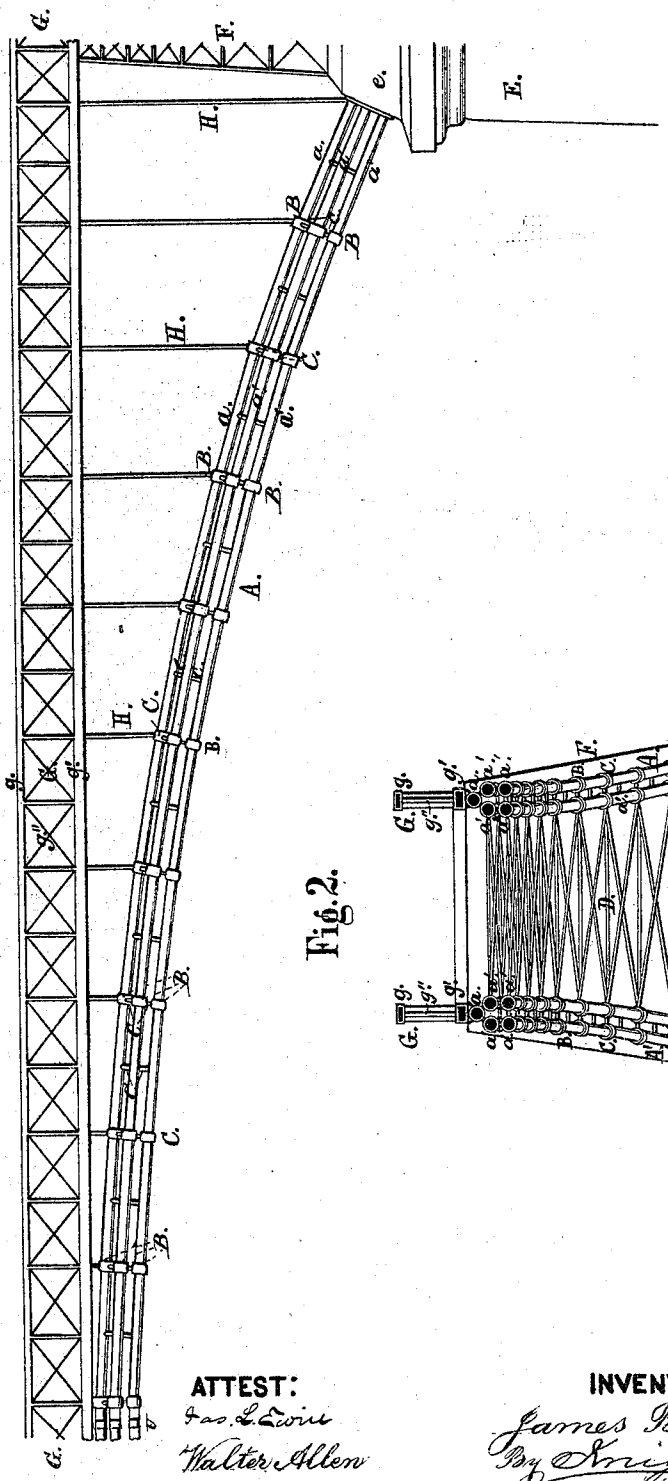

Fig. 1.

Fig. 2.

ATTEST:

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

IMPROVEMENT IN BRIDGES.

Specification forming part of Letters Patent No. **142,378**, dated September 2, 1873; application filed March 19, 1873.

CASE A.

To all whom it may concern:

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

My invention consists in the combination of an arch and girder, substantially as hereinafter set forth. My invention also consists in inclining the arches (of which the compound arch is composed) inward toward the middle, so as to brace the bridge against wind-pressure, the sides of the girder being parallel with each other, but the arches approaching each other nearer at the crown than at the abutments, thus giving the arches a broader base.

It is known to engineers that the rigidity or resistance to deflection is given to a suspended arch (or suspension-bridge) with a very light girder, because the center of the cables presents a central support to the girder, which thus virtually forms two continuous girders of half the length. If this girder were divided into two independent beams they would be deflected only one-eighth as much with a given load distributed over them as they would if they formed one single girder without the support at the middle; but when joined as a continuous girder and supported about the middle by the arch, if one-half have its part of the load imposed, it will only deflect one-sixteenth as much as without the support at the center, or one-half as much as if it were not continuous, for to bend that half down necessitates the bending of the other half up, and this takes an equal additional force.

My invention secures an equal degree of stiffness to an upright arch, otherwise flexible, through the same principle, and dispenses with spandrel bracing and the ribbed arch. It also dispenses with the building of high towers and heavy anchorages used in suspension-bridges, and likewise the large amount of materials in the back chains or cables of such bridges, for if any given suspended arch were inverted with all its weights and the curve of the arch could be preserved the tensile strains on it before would be converted into compressive ones of the same intensity exactly, and as these would be received at the abutments or bases of the towers there would be no need of extending the arch material beyond these points to any more distant anchorage, as in suspension-bridges, and so no need of towers. The method proposed by me insures the construction of long-span bridges at less cost, therefore, than is possible with suspension-bridges, which are usually considered the cheapest of all bridges.

Figure 1 is a side elevation of one-half of a bridge, exhibiting my improvement. Fig. 2 is an end view of same, the crown being shown in transverse section.

a a' represent straight tubes, forming sections or lengths of the arches, which are combined to form the compound arches A A', the sections being jointed together by collars B, and secured in relative position by stays and struts, shown at C and D. E is the pier or abutment, *e* the skew-back, and F a tower or upward extension of the pier or abutment for the support of the girder G, which latter may consist of upper and lower chords *g g'* and intermediate brace-work *g''*. H are struts or uprights connecting the arches A A' and girder G. The arches do not stand in a vertical plane, but are inclined inward at top, as shown in Fig. 2, the ends of the arches inclining outward at the abutments and secured to them, so as to brace the bridge against transverse strain or lateral vibration. Where the span is not great, or where two or more rail or road ways are carried, the spreading of the arches at the abutments will not probably be requisite for stability against lateral strains. It will frequently be found desirable for the arches to rise as high as the top chord of the girder, or even above it. In such cases the girder must possess extra lateral stiffness to secure the arches against lateral flexure, if the horizontal bracing between the arches be omitted through the girder on account of the passage of traffic.

To prevent inconvenience from expansion and contraction of the material in the arches and girder, no rigid connection between them

will be made, which interferes with horizontal longitudinal movements of the two systems, except at the center of the arches. Thus the expansion of the girder will be horizontal and relieved at each end of it, and that of the arches will simply cause a proportionate rise at the middle. By having the ends of the girder rest on iron struts or towers the expansion of the latter will aid in preserving the straight form of the girder under such changes. The parts of the arches between the joints B where the vertical attachments are made to the girder, should be formed of straight lengths or sections of tubes, or other forms of material calculated to give the requisite degree of resistance to crushing strains.

I am well aware that arches and girders have been combined for many years in bridges by engineers, and that as ordinarily used such combination is not novel. I have devised a reversal of the suspension-bridge construction, wherein flexible suspended arches or cables are made to form a practicably rigid point of support for the center of a girder, whereby the power of said girder to resist deflection is increased sixteen fold; and by means of vertical attachments to the joints of flexible arches the latter are rendered practically inflexible against vertical strains.

I claim herein as new and of my invention—

1. The combination of the horizontal girder G with an upright flexible-jointed arch, giving mutual support, substantially in the manner and for the purpose set forth.

2. The bridge-arch consisting of arches A A′, expanding toward the abutments, substantially as and for the purpose set forth.

JAS. B. EADS.

Witnesses:

SAML. KNIGHT,

GEO. C. FABIAN.