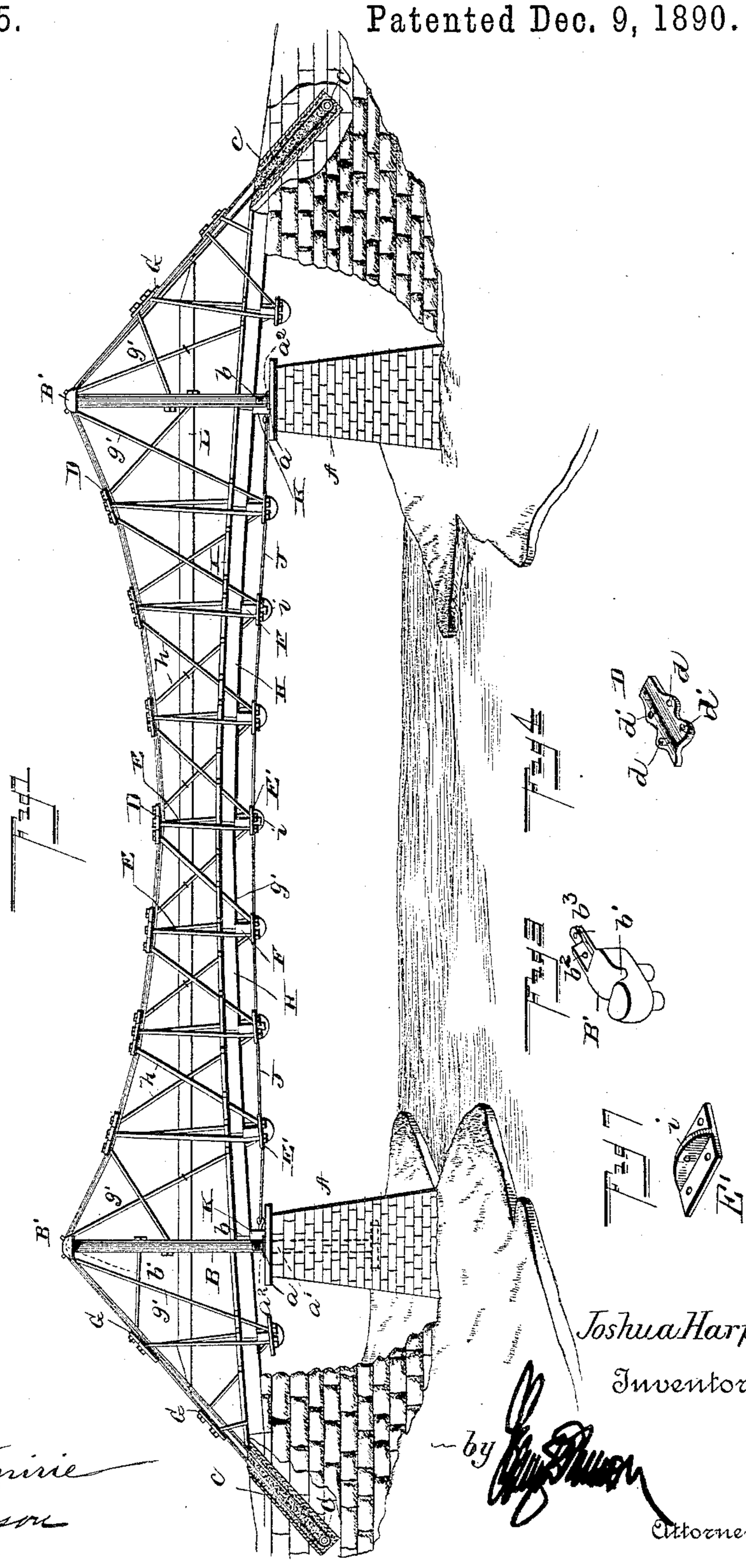
(No Model.) 2 Sheets—Sheet 1.

J. HARPER.

SUSPENSION BRIDGE.

No. 442,435. Patented Dec. 9, 1890.



Witnesses
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(No Model.)

2 Sheets—Sheet 2.

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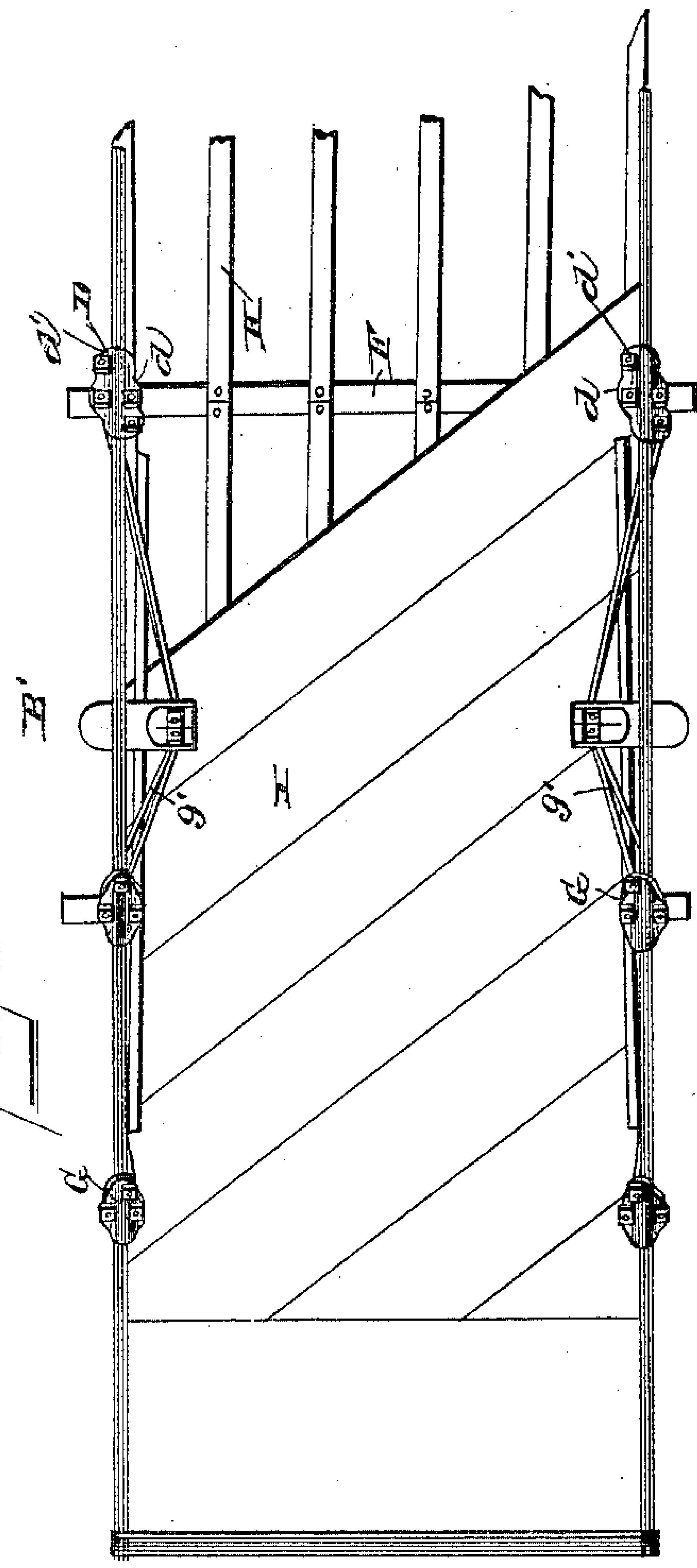

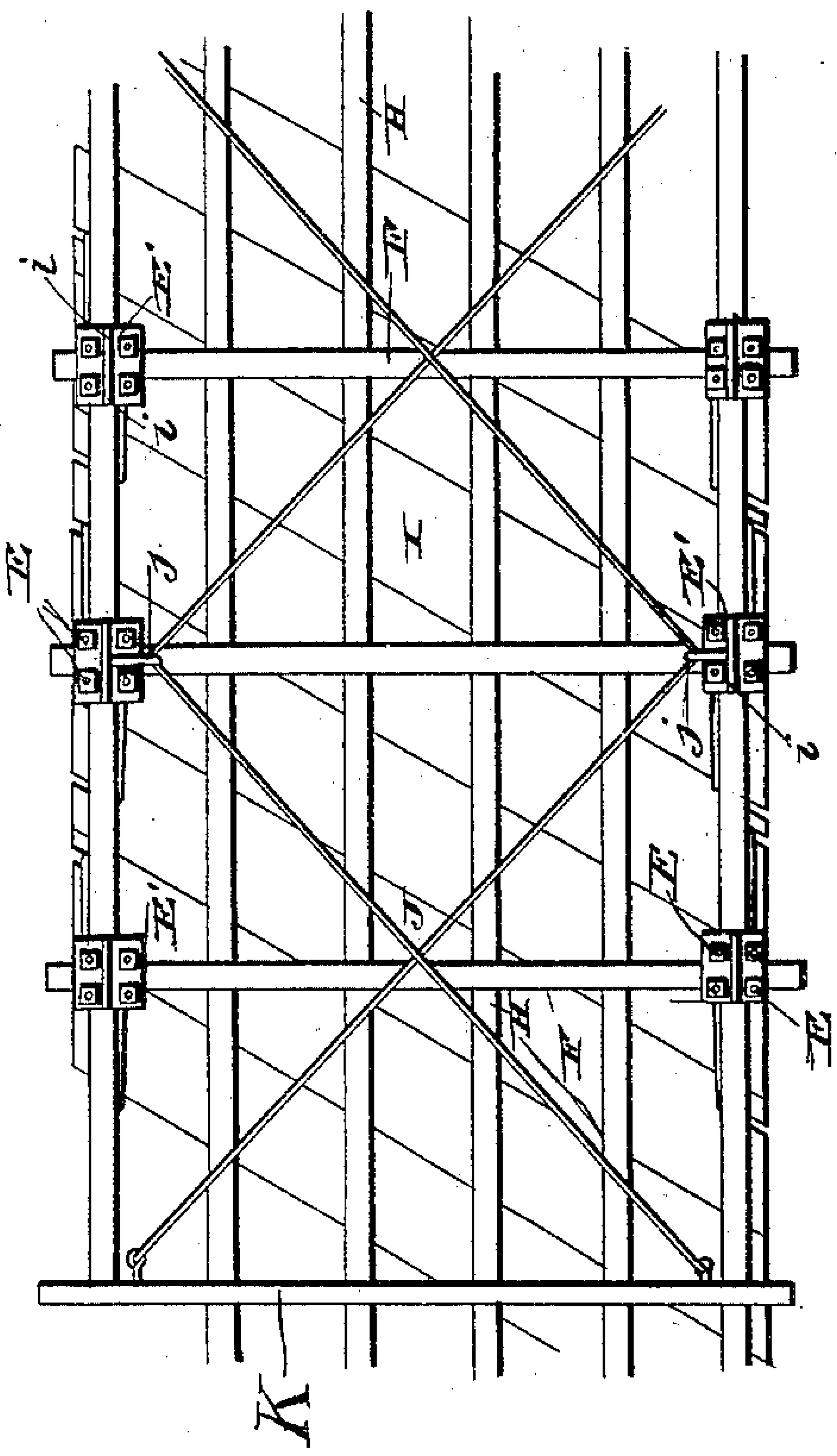

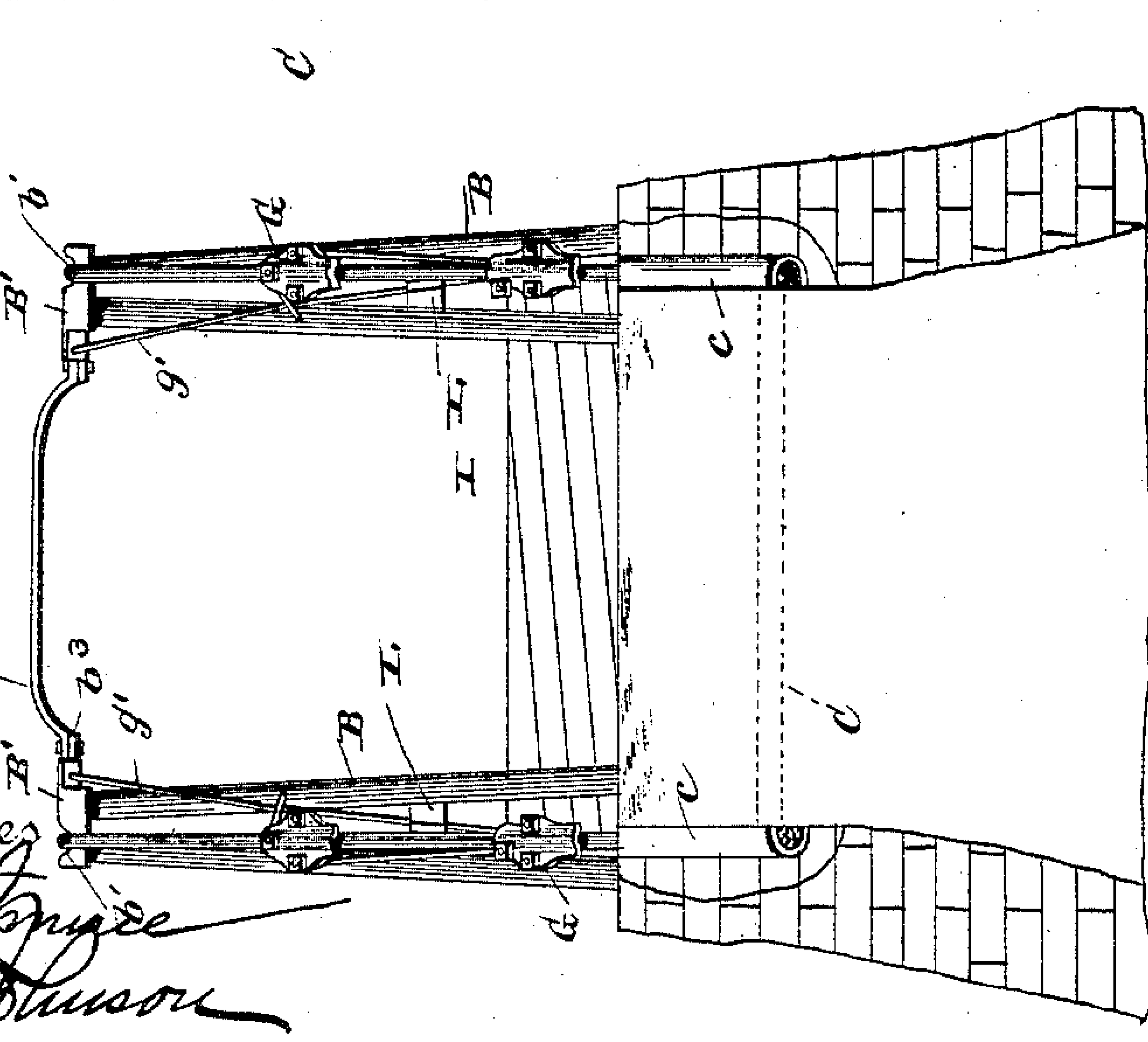

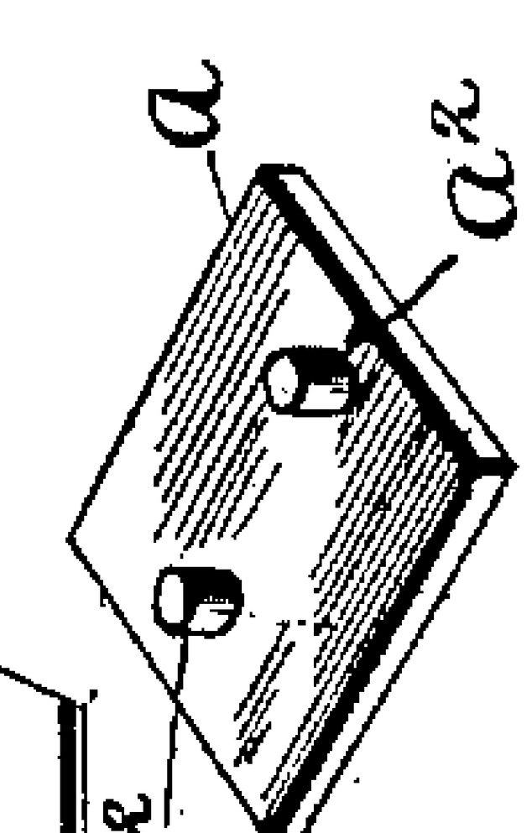

Witnesses

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UNITED STATES PATENT OFFICE.

JOSHUA HARPER, OF MELVERN, KANSAS.

SUSPENSION-BRIDGE.

SPECIFICATION forming part of Letters Patent No. 442,435, dated December 9, 1890.

Application filed May 29, 1890. Serial No. 353,629. (No model.)

To all whom it may concern:

Be it known that I, JOSHUA HARPER, a citizen of the United States of America, residing at Melvern, in the county of Osage and State of Kansas, have invented certain new and useful Improvements in Bridges; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to letters of reference marked thereon, which form a part of this specification.

This invention relates to suspension-bridges; and it consists in the improvements herein described and set forth, whereby a light, strong, and efficient structure is provided that will be comparatively inexpensive.

In the accompanying drawings, forming a part of this specification, Figure 1 is a side view of a bridge embodying my improvements. Fig. 2 is an end view of the same. Figs. 3 and 4 are detail views. Fig. 5 is a plan view of the bridge; Fig. 6, an inverted plan. Fig. 7 is a detail view of one of the lower plates in an inverted position, and Fig. 8 is a detail view of one of the plates for supporting the tubular standards.

On each side of the stream or chasm and adjacent to the bridge approaches is located a pier A, and upon each of these is secured a plate a, preferably secured in position by being bolted to a vertical rod a', secured to a base embedded in the masonry of the pier. Each plate a is provided on its upper side with two lugs a^2, each of which enters the lower open end of a vertical column or standard B, two of such standards being located upon each pier and converging at their upper ends. Adjacent to their bases these standards are transversely perforated for the passage of a securing-rod b, the ends of which are engaged by nuts to rigidly and relatively brace said standards. A casting B′ forms a cap for said standards, and is provided upon its lower side with depending lugs, which enter the upper open ends of the standards. Each cap has a longitudinal groove or depression b' formed therein, and on its inner side the said cap is provided with two diagonal openings b^2, intermediate of which is a vertical perforation b^3. A curved or arched tie-rod extends transversely to connect the inner standards of the adjacent piers, and is secured to each of said inner standards by a bolt passing through the vertical perforations in the cap thereof. These tie-rods not only connect and brace the adjacent pairs of standards, but furnish a medium upon which may be suspended any suitable notice required by the law of the locality in which the bridge may be located and announcing regulations for the bridge travel.

In constructing my improved bridge I discard the employment of the ordinary twisted compound cable, and use in lieu thereof a cable composed of a series of untwisted strands of wire, which rest and are retained longitudinally in the groove of the cap-plate, and in applying such cable I make use at each end of the bridge approach of an anchor device comprising a transverse horizontal cylinder C, seated in any suitable arrangement of embedded masonry, and to one of the ends of said cylinder is permanently secured the wire comprising the strand forming part of the cable, and said strand is then led to the opposite side of the bridge approach, where it is looped around, or, if necessary, connected with, a similar cylinder located thereat, is then led back and forth until a suspension means of the desired size is secured.

In order to protect the embedded anchor device and portions of the cable adjacent to the same, I coat the same with tar or other equivalent compositions to prevent corrosion by water and dampness, and in applying the same prefer to employ a box c, which embraces the cable beneath the bed of the roadway and partially embraces the anchor device, and is thereafter filled with tar, as stated.

The arrangement of the main or body portion of the bridge is such that the necessity of using chords or stringers is entirely obviated. To such end the cable between the standards B B has adjusted thereon at equidistant points a series of saddle-plates D, each of which has a longitudinal depression on its under side to form a bearing for the cable, and is provided at each side with vertically-perforated lugs d d'. It will be noted that the perforations in the lug d are substantially

vertical; but those in the lugs *d'* are oblique. Vertically-depending rods E are secured to said lugs *d d* by having their upper projected threaded ends engaged by nuts, and at their lower ends these rods E are slightly separated, in order to pass through openings therefor located diagonally in a lower plate E', which is also provided with an additional pair of diagonal openings. It will be understood that the saddle-plates at one side of the bridge are arranged to register transversely with the corresponding plates on the other side, so that the lower plates supported by each pair of rods E will be so disposed as to sustain a transverse timber F.

Saddle-plates G, similar to those previously described, are alsc mounted on the cable where it inclines toward the anchor, in order that those portions of the structure adjacent to the approaches may be also properly braced and connected. To contribute to the former purpose, the inner standard of each pair has horizontal perforations formed therein, in which are secured by means of nuts the ends of braces, the other ends of which pass through and are secured in the diagonal openings of the adjacent saddle-plates.

Brace-rods *g' g'* are secured in the diagonal openings in the cap-plates, and each engages one of the diagonal perforations in the lower plates supporting the timbers next adjacent on each side. The lower plates and upper saddle-plates are braced in series by the diagonal braces *h*, which pass through the diagonal openings, respectively, of the saddle and base plates and connect each lower plate with the saddle-plates next adjacent and correspondingly connect the saddle with the base-plates next adjacent, and so on. By this arrangement a durable and efficient structure is secured, that will readily withstand all the jars and vibrations a bridge is incident to and will at the same time sustain all its parts positively and strongly. It will also be noted that the supporting frame-work of the bridge is formed entirely by the cable saddles and lower plates, brace-rods, and transverse timbers, and that therefore the necessity of the employment of chords or stringers is entirely overcome. It will therefore be seen that in order to secure proper provision for the flooring it will only be necessary to employ a series of parallel beams H, extending longitudinally over and supported upon the timbers, and that each of these beams is made up of a series of short lengths of timbers, each of which need only be of a length sufficient to span the distance between two of the timbers and abut against the end of the continuing section.

In applying the flooring I prefer to lay the boards I in diagonal lengths, as shown in Fig. 3, as this arrangement will not only prevent the ends of the boards from being sprung loose in the path of travel, but permit shorter sections to be used, and, what is most important, will contribute to the rigidity of the structure and assist in resisting torsional strain.

Each lower plate is provided on its under side with a longitudinal web or rib *i*, perforated for the connection thereto of a short link *j*, extending inwardly, as shown in Fig. 6, for engagement therewith of one or two or more chords or cables J, which diagonally connect the links of alternate plates on opposite sides, as shown in Fig 6, and are finally secured to the standards B B or to a cross-timber K, spanning each pair of piers and securely lashed or connected to the standards. While of course all of the lower plates may have the link-and-cable connection above explained, it will be sufficient in some instances to so connect only each alternate pair of plates, as shown in Fig. 6. A bar L extends longitudinally along each side of the bridge and is bolted at its ends to the inclined portion of the cable, and is intermediately secured to the inner standard of each pier and to the inner diagonal braces, as shown in Fig. 1, and the relative height of such bar is such that it will serve as a guard for the metal work of the structure against injuries that might be sustained by the contact therewith of hubs of vehicles passing over the bridge.

The advantage of employing a series of independent strands to form the cable, as explained, will be obvious, for should one of the strands become injured or broken it can be readily repaired or spliced without difficulty and without the necessity of unwinding a considerable portion of the cable, as would be the case were the ordinary form employed.

It will be seen that the tubular form of the standards not only confers great strength upon the bridge at the points where they are located, but that they will yield to a greater or less extent to give a moderate amount of elasticity to the structure. The slightly-arched form of the transverse tie-rod, in addition to its function as a suspending medium and brace, will by reason of its curved form allow a greater or less relative yield of the parts without straining their connections.

As will be quite obvious, the plate A may be entirely dispensed with, and in lieu thereof the lower ends of the standards B may bear in recesses therefor in the upper portions of the piers.

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

1. The combination, in a bridge, of the supporting-standards therefor, having removable caps longitudinally channeled, together with cables, each consisting of a continuous length wrapped back and forth from one pier to the other to form parallel untwisted strands and bearing in the channel of the caps, grooved saddle-plates mounted on said cables, and connections suspending the intermediate frame-work of the bridge, substantially as set forth.

2. The combination, with a bridge-pier, of tubular standards thereon and converging at

their upper ends, as described, a tie-brace piercing the lower portions of said standards, and a cap-plate having depending lugs seated in the upper ends of said standards, substantially as set forth.

3. The combination, in a bridge, of tubular standards located adjacent to one of the approaches of the same at each side thereof, cap-plates mounted on said standards and having lugs to engage the upper end of the same, and provided with an inwardly-projecting portion vertically perforated, together with a transverse curved spring-brace or tie-rod having its ends bolted to said vertically-perforated portions, as and for the purpose specified.

4. The combination, in a bridge, of the suspending-cables, supported as described, saddle-plates mounted on said cables, rods depending from said plates and connected at their lower ends to plates, transverse timbers supported by the latter, short lengths of longitudinal beams having their adjacent ends resting on said transverse timbers, and a flooring secured on said beams, substantially as set forth.

5. The combination, in a bridge, of the cables suitably supported, saddle-plates having depressions in which said cables bear and provided with vertical and diagonal perforations, together with depending rods connected at their lower ends to plates, timbers supported by the latter, and short lengths of longitudinal beams having their adjacent ends resting on said transverse timbers, the said plates also having diagonal perforations, and diagonally-arranged braces which connect each of the saddles with a plate beneath each of the two adjacent saddles on each side, substantially as set forth.

6. The combination, in a bridge, of the cables suitably supported, lower plates suspended therefrom and each provided on its under side with a perforated web, links connected to said webs, and cables alternately engaging said links and connected to the end portions of the structure, substantially as set forth.

7. The combination, in a bridge, of the pier and tubular standard mounted thereon, a cable supported thereby and suspending intermediate portions of the bridge, saddles mounted on said cable on both sides of said standard, and brace-rods connecting the standard with said saddles, substantially as set forth.

In testimony whereof I affix my signature in presence of two witnesses.

JOSHUA HARPER.

Witnesses:
PETER CHEVALIER,
R. J. HARPER.