Linville & Piper,

Iron Truss Bridges,

Sheet 1
2 Sheets

No. 50,723. Patented Oct. 31, 1865.

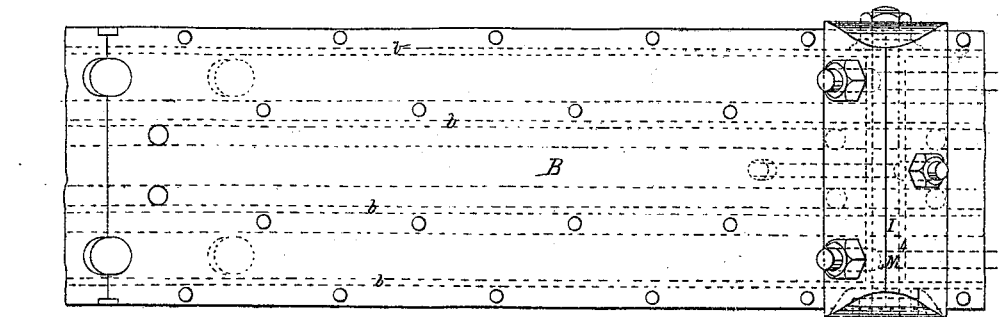

Fig. 4

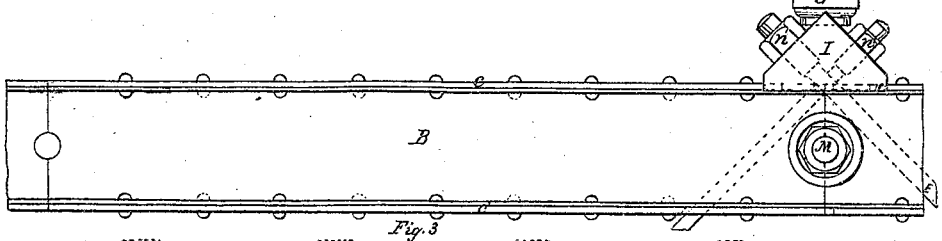

Fig. 3

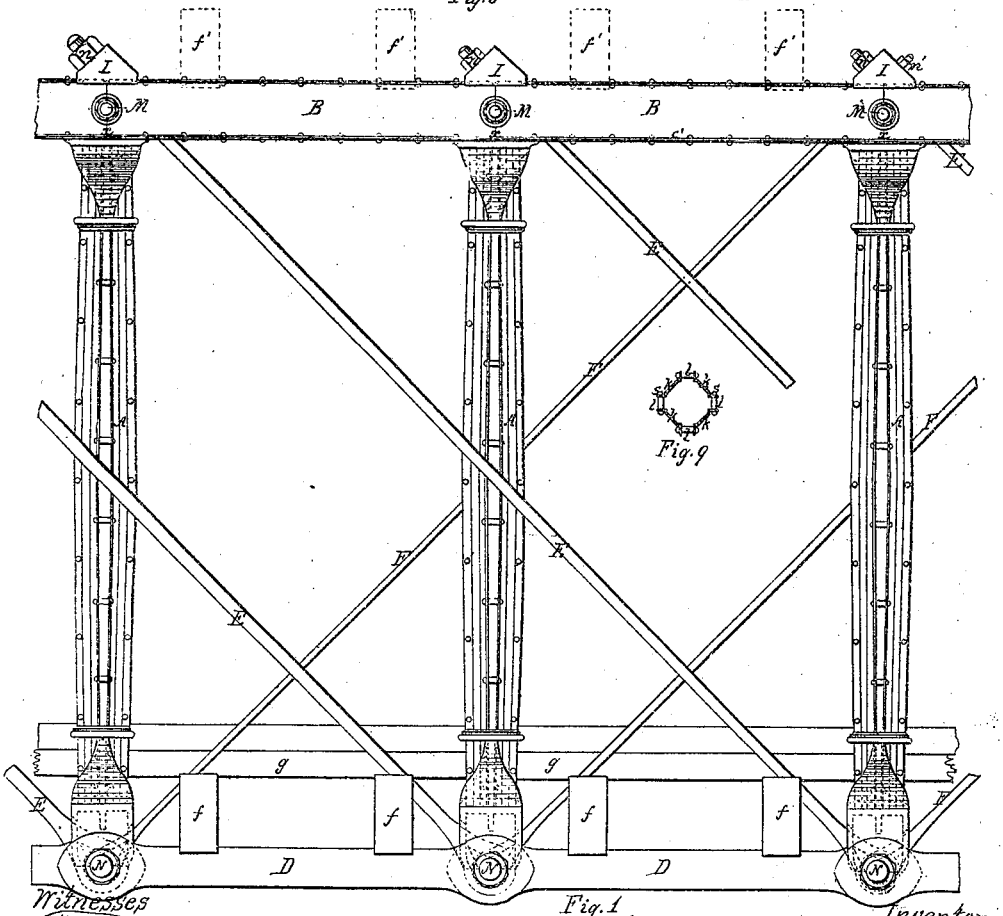

Fig. 1

Fig. 9

Witnesses
Henry Aubrey
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Sheet 2.
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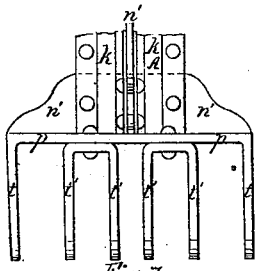

Fig. 7

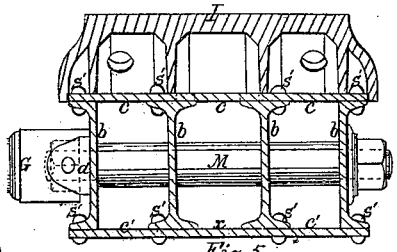

Fig. 5

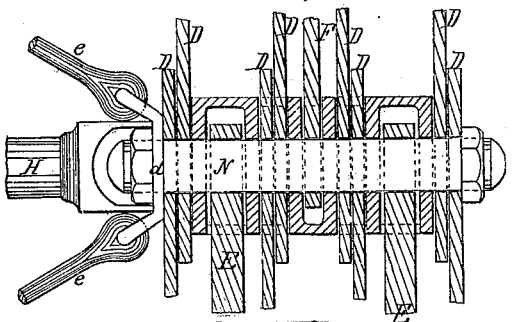

Fig. 6

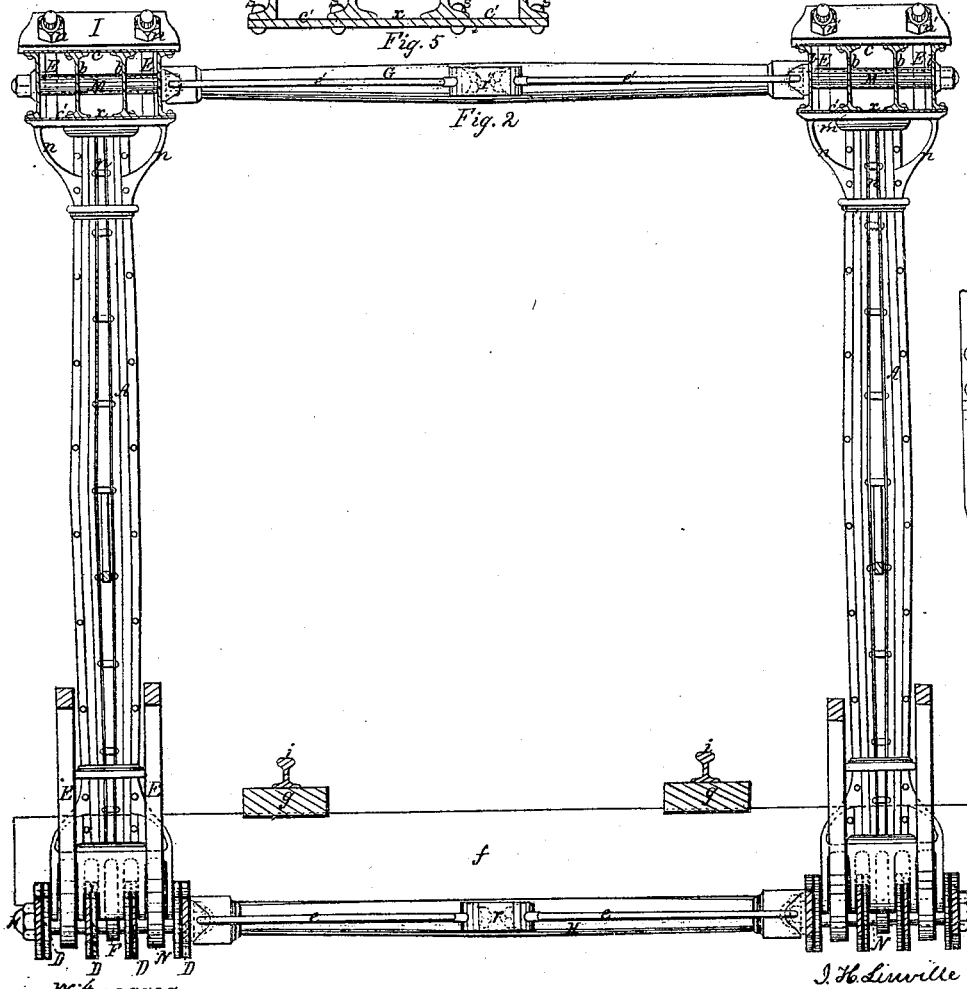

Fig. 2

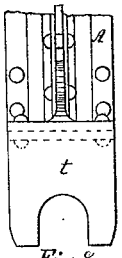

Fig. 8

Witnesses

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UNITED STATES PATENT OFFICE.

JACOB H. LINVILLE, OF PITTSBURG, AND JOHN L. PIPER, OF ALTOONA, PENNSYLVANIA.

IMPROVEMENT IN WROUGHT-IRON BRIDGES.

Specification forming part of Letters Patent No. **50,723**, dated October 31, 1865.

To all whom it may concern:

Be it known that we, JACOB H. LINVILLE, of Pittsburg, in the county of Allegheny and State of Pennsylvania, and JOHN L. PIPER, of Altoona, in the county of Blair and State of Pennsylvania, have invented a new and useful Improvement in Wrought-Iron Bridges or Other Truss-Frames; and we do hereby declare the following to be a full, clear, and exact description thereof, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1 is a side elevation of two panels of a wrought-iron truss-bridge with double intersecting diagonal tension-bars. Fig. 2 is a transverse section of the same. Fig. 3 is a side elevation of the wrought-iron upper chord. Fig. 4 is a top view of the same. Fig. 5 is a transverse section of the upper chord through the center of the angle-block in the plane of the center of the post. Fig. 6 is a horizontal section through the base of the post and lower chord-bars. Fig. 7 is an end view of the wrought-iron base of the post. Fig. 8 is a side view of the base of the post. Fig. 9 a cross-section through the center of a post.

The same letters are used in the several figures to indicate similar parts of the bridge.

Our invention consists of certain improvements in the construction of the wrought-iron truss-bridge for which Letters Patent of the United States were granted to us on the 14th January, 1862.

In the truss-bridge shown in the accompanying drawings, the general arrangement of the parts is similar to that shown in our previous patent just referred to, the improvements forming the subject-matter of this invention relating to the following particulars: First, the posts, instead of being made of two rolled plates of iron of semi-polygonal transverse section united by rivets passed through the center of the polygon and sprung apart by distance-plates, are made of two or more plates of wrought-iron with flanges at the edge, the plates being so united as to make hollow posts by rivets passed through the flanges, and each plate being arched longitudinally by means of ferrules placed at intervals between the flanges and around the rivets, and instead of casting the bases and capitals onto the ends of the posts we use bases and capitals connected by rivets to the post; second, instead of making the upper chords of hollow cast-iron sections or short tubes, we construct our upper chords of a combination of wrought-iron I-shaped beams or channel-bars, or both, connected by wrought-iron plates, so as to form cellular chords of great strength and capacity of resisting either transverse strain or longitudinal compression; third, the use of bottom chords of thin wrought-iron plates, the eye of which, at each end, instead of being cut out of a rolled plate and drilled or forged into shape, is upset under strong compression, so as to give at the eye of the bar a degree of strength equal or superior to that of the bar at any point between the eyes.

To enable others skilled in the art to construct and use our improvements, we will proceed to describe them more particularly.

In our bridge the upright posts A A are placed at regular intervals in each span, and opposite to each other on each side, so that the transverse struts G may be placed across and at right angles to the roadway, between the upper chords immediately above the capitals of the opposite posts, and transverse struts H similarly placed between the bases of the opposite posts, the ends of the struts G and H being attached to the connecting-pins M and N, which pass through the upper chords immediately above the capitals and through the bases of the posts respectively, as shown in Fig. 2.

To a plate, *d*, on the inner end of the connecting-pin M, is attached the end of a diagonal brace, *e'*, of which there are four in each panel of the bridge on a level with the upper chords meeting in a ring, *r'*, in the center, to which they are screwed, and four similar braces, *e*, are attached to the connecting-pins N at the bottom of the posts A in each panel, and meet in a ring, *r*, in the center, to which they are screwed in the same manner. The bases of the posts A are connected at their bases longitudinally by the lower chords, D, of which four may be placed parallel to each other on each side of each panel. They are made of thin bars of rolled iron of sufficient depth and placed on edge, so as to support the roadway, and are attached to the bases of the posts by the connecting-pins N, which pass through the hole or eye near the end of these bars.

The top chords, B, composed of wrought-iron beams and plates, riveted together, as hereinafter described, are made in sections or lengths reaching from center to center of the posts A lengthwise of the bridge, and are placed on the capitals of the posts and are held in position by projections or pins on the capital of the post which enter holes *c* in the lower surface or plate, *c'*, of the chords.

On top of the upper chords, B, and just over each post A, and covering the joint or meeting-point of the ends of the chords, is an angle-block, I, which may be made hollow and of cast-iron, as seen in section in Fig. 5. These angle-blocks form the upper bearing of the nuts n^2, at the ends of the tension-braces E and the counter tension-braces F, which support the bridge. Each tension-brace E starts from the angle-block I at top of one post, passes through the upper chord and downward diagonally, passing outside of the next post, crossing it at midway from its top and bottom, and thence extends to the bottom of the third post, where a loop or eye at the end of the brace E receives the connecting-pin N, two such braces E being used side by side, one passing on each side of the posts A. The counter-tension braces F (which run diagonally in the opposite direction to the braces E) start from the angle-block I at top of each post A, pass through the upper chord, B, and thence through the center of the next or second post, and thence to the bottom of the third post, where the connecting-pin N passes through the eye or loop at the lower extremity of the counter-brace F.

The roadway is composed of sills *f*, placed transversely on top of the lower chord-bars, D, and the string-pieces *g*, which sustain the rails *i*, are placed longitudinally on the sills, as shown in Fig. 1; or, if a deck-bridge is required, the sills *f* are placed on top of the upper chords, B, as shown by dotted lines in Fig. 1.

Having thus described the general construction and arrangement of our bridge, we will proceed to explain more minutely the peculiar features of the posts, upper chords, and lower chords.

The posts consist of three principal parts, the shaft, the base, and the capital. The shaft is made of pieces of rolled iron *k*, of sufficient length to extend from the top of the capital to the base. In the drawings these posts are represented as made of four such pieces of iron; but the number is not material, as two would suffice if they are bent or curved so as to form a hollow post. The edges of these pieces *k* are turned outward, so as to form a flange on each edge. Instead of uniting these pieces or plates *k* by bringing the flanges together, they are separated by ferrules *l* or small tubes of sufficient diameter to receive the rivets *s*. These ferrules are placed between the opposite flanges of the plates *k*, and then a rivet, *s*, passed through the flanges and ferrule and fastened in the usual manner, by upsetting, unites them firmly. The length of the ferrules *l* determines the distance between the opposite faces of the flanges, this distance being greatest at the center of the post and gradually diminishing toward each end, thus making the post A thickest in the middle.

The capital and base may be made of wrought or cast iron, but we prefer the former, as less liable to fracture. The capital consists of a cap-plate, *m*, placed on top and riveted to the post, and supported by brackets *n*, of wrought-iron, placed between the flanges of the plates *k* composing the post, in place of the ferrules, and also riveted to the flanges of the plate *k*. The bases are made in the same manner, a base-plate, *p*, (see Fig. 7,) being united to the plates *k* of the post by brackets *n'*, passing between the flanges of the plates and riveted thereto. The ends of the base-plate *p* (which may also be made of wrought-iron) are turned down, forming ribs *t* (see Fig. 7) and intermediate or mid ribs, *t' t'*, are added between the ribs *t t* by riveting to the under side of the base-plate. These ribs *t* and mid-ribs, *t'*, have semicircular notches cut in them, as seen in Fig. 8, so as to straddle the connecting-pin N, and they serve to separate and keep in place the diagonal tension-braces E, the counter-braces F, and the eye-bars or lower chords, D, as seen in Figs. 1 and 6.

The cap-plate *m* of the post may be turned up at the edges, so as to keep in place the top chords; or this may be effected by pins in the cap-plate entering the holes *x* in the under side of the lower plate, *c'*, of the upper chords.

It is obvious that the shape of the cross-section of the posts may be varied from that shown in Fig. 9 by adding to or reducing the number of plates *k*, so as to make a circular or polygonal post of any number of sides.

The top chords are made by uniting by rivets *s'* any convenient number of **I**-shaped beams, *b*, of rolled iron, to an upper plate, *c*, and lower plate, *c'*, both also of rolled iron. The outside beams may be channel-bars instead of **I** beams, as in Fig. 5; or either channel-bars or **I**-beams may be used, if desired. These top chords are made in lengths equal to the distance between the post A from center to center, and are framed together at the shop before being built into the bridge. The semicircular holes at the abutting ends of these upper chords formed in the ends of the channel-bars and **I**-beams admit of the passage of the connecting-pin M, to which the lateral eye-plate *d* and lateral diagonal braces *c'* are attached. (See Fig. 2.) The rolled **I**-beams and channel-bars afford transverse strength to sustain the floor-timbers *f f* (when a deck-bridge is to be built) without the use of auxiliary beams, and they also prevent the vertical strain caused by the diagonal tension-braces E from crushing the chords over the posts, and by reason of their peculiar cellular construction the sectional area of these combined chords can be graduated in each panel of the bridge in proportion to the compressive strain to be resisted. The width of the top

and bottom plates, combined as described, affords great lateral stiffness and the cellular form is most effective in resisting forces of compression.

The lower chords, D, consist of wide, thin rolled iron bars, with enlarged ends, which are made by upsetting the rolled bars by compressing them into the desired shape in molds, into which the heated iron is forced under immense pressure, thereby increasing the density, toughness, and strength of the enlarged ends, and permitting the holes or eyes for the connecting-pins N to be cut out without rendering the transverse section at the eye less than that of other parts of the bar or diminishing the transverse or longitudinal strength of the chord-bar.

We do not claim the upsetting of iron bars in the manner described nor any peculiar mode of performing the operation, but merely the use of chord-bars for bridges, the ties of which are thus formed so as to give additional strength to the bar where it is so much needed.

Having thus described our improvements in wrought-iron truss-bridges, which are applicable also to truss-frames for other purposes, what we claim as our invention, and desire to secure by Letters Patent, is—

1. The use of posts for wrought-iron truss-frames having a curved or polygonal sections composed of two or more plates of rolled or wrought iron with flanged edges, secured together by means of rivets passing through such flanges and through ferrules interposed between them to give any desired enlargement to the posts and leave space for the passage of counter-braces without cutting away or weakening the post, such posts being completed by bases and capitals of wrought or cast iron riveted thereto, substantially as and for the purposes hereinbefore described.

2. The use of upper chords or compression-beams, formed by a combination of **I**-shaped rolled beams or channel-bars, or both, riveted at top and bottom to plates of wrought-iron, so as to form in each chord or beam a series of rectangular tubes or cells, for the purpose of affording great transverse strength to support the weight of passing trains in railroad or other bridges, combined with great resistance to compressive force, substantially as hereinbefore described.

3. The use for the lower chords of truss-frames of wide and thin rolled bars with enlarged ends, formed by upsetting the iron, when heated, by compression into molds of the required shape for the purpose of increasing the density, toughness, and strength of the eye of the rod, and enlarging the eye without diminishing its transverse section, substantially as hereinbefore described.

In testimony whereof we, the said JACOB H. LINVILLE and JOHN L. PIPER, have hereunto set our hands.

JACOB H. LINVILLE.
JOHN L. PIPER.

In presence of—
A. S. NICHOLSON,
W. D. LEWIS.