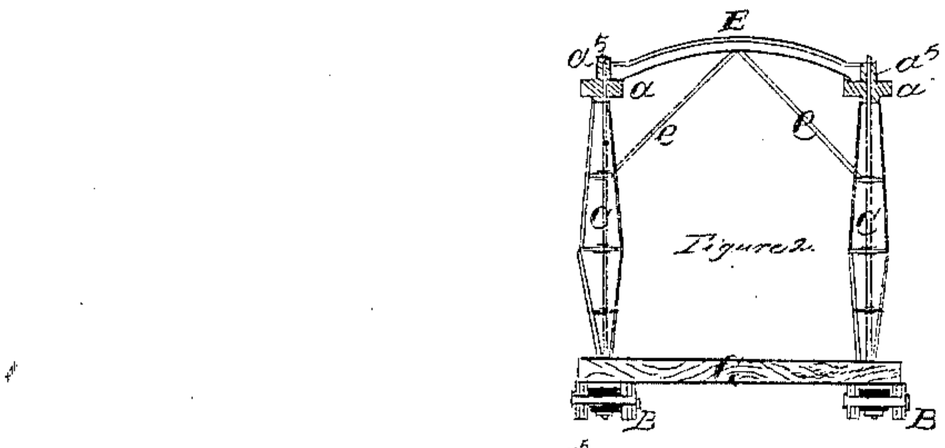
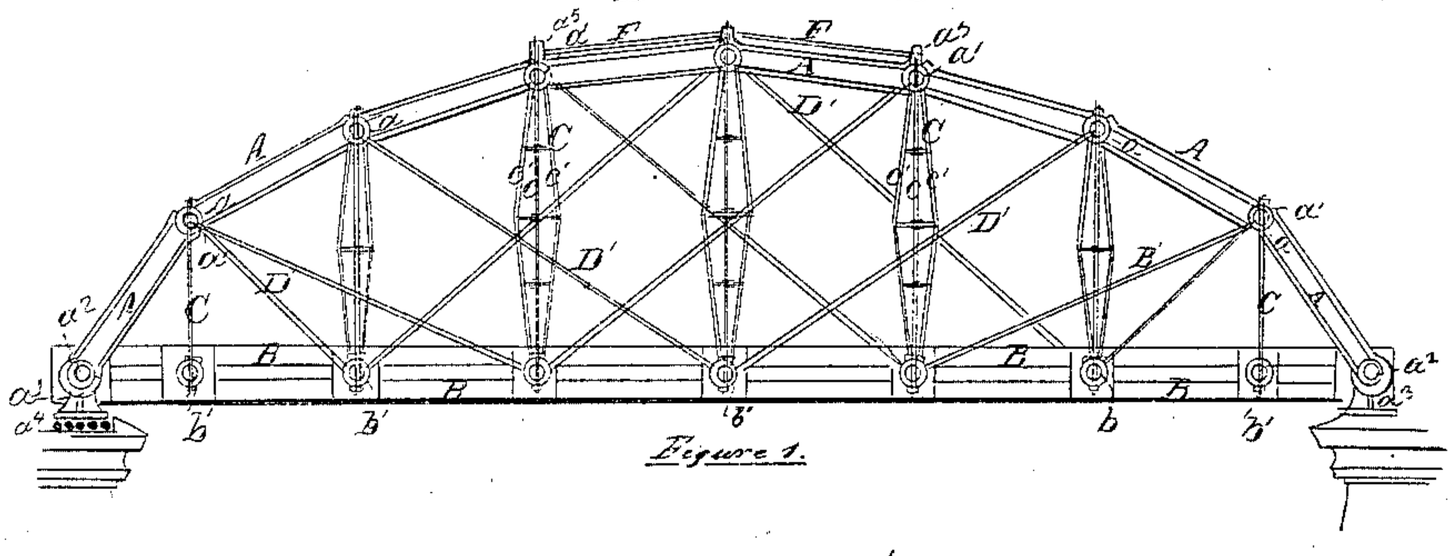
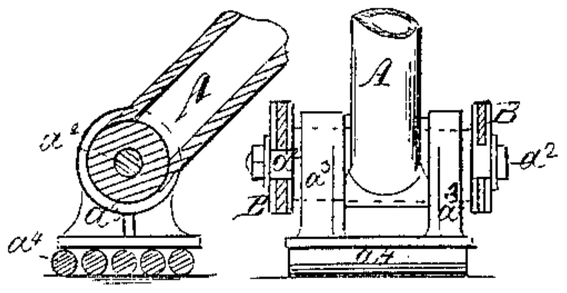
G. P. Herthel Jr.,

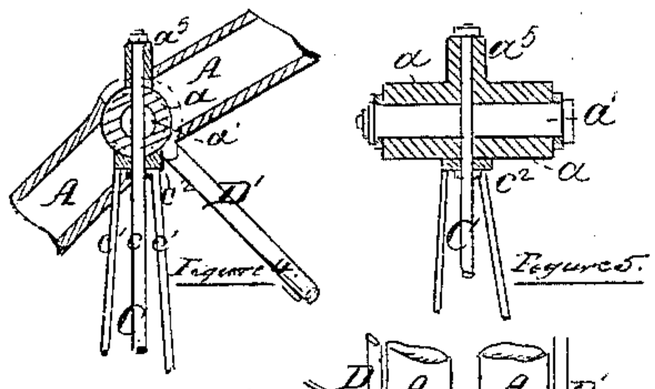
Truss Bridge.

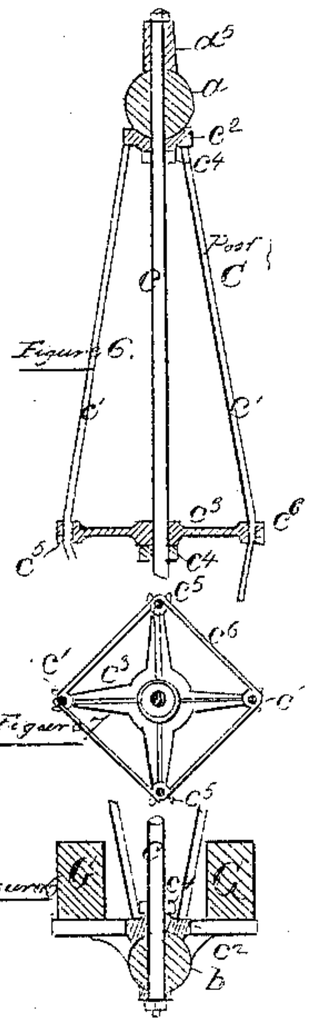
No. 90,263. Patented May 18. 1869.











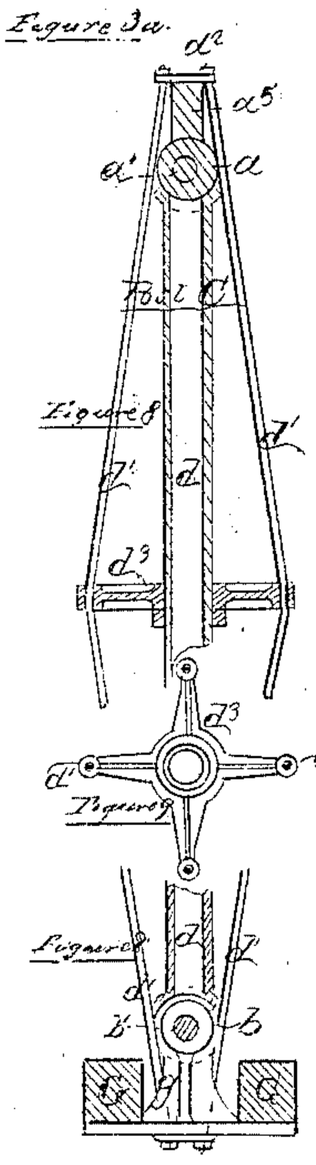
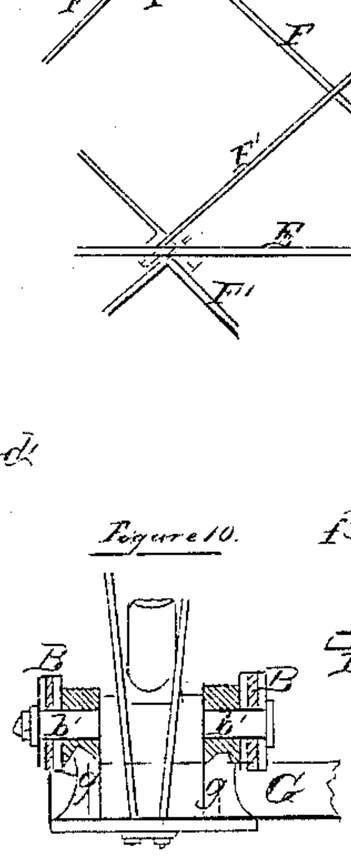


Figure 10.



Witnesses.

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GEORGE P. HERTHEL, JR., OF ST. LOUIS, MISSOURI.

Letters Patent No. 90,263, *dated May* 18, 1869.

IMPROVED TRUSS-BRIDGE.

The Schedule referred to in these Letters Patent and making part of the same.

To all whom it may concern:

Be it known that I, GEORGE P. HERTHEL, JR., of the city of St. Louis, in the county of St. Louis, and State of Missouri, have made certain new and useful Improvements in Truss-Bridges; and I do hereby declare that the following is a full and clear description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

The nature of this invention is, first, in such an arrangement of the integral parts of the upper or curved chord, or member of a truss-bridge, as shall cause the panel-length to diminish in progressing from the centre to each end of the bridge-truss, in order that the total load received on the end panels, and panels near the ends, shall be less than the load received by centre panels and panels near thereto, so as to, in whole or in part, counterbalance and counteract the undue effect of rolling loads, when passing on or off a truss-bridge.

The said nature of this invention is, secondly, in so arranging the abutment-seats of a truss, or trusses, that deflection of such truss, or trusses, by loads thereon, shall not act otherwise than uniformly on the abutment-seat plates.

The nature hereof is, thirdly, in such detail construction of the posts, or struts of a truss, that the said posts, or struts, shall be capable of sustaining compression and tension-strains, or either compression or tension-strains; and

The nature hereof, finally, relates to certain detail devices for supporting floor-braces of a truss-bridge, and to certain other detail devices for connecting and adjusting the lateral, or wind-braces of truss-bridges, all of which will more fully herein appear.

I construct my said truss-bridges of wrought and cast-iron, or similar materials, such as are applied in similar structures. Generally, parts strained by compression-forces will be formed of cast-iron, and those strained by tension-forces will be of wrought-iron, but steel or wood may be applied, the application of the different materials, unless hereinafter specially limited, being in the discretion of the constructor.

To enable those skilled in these arts to make and use my said improved structure, I will now fully describe the same, referring herein to the accompanying—

Figure 1 as a general sectional elevation of a bridge-truss.

Figure 2 as a transverse central sectional elevation of two parallel trusses, connected by wind-braces, or laterals, and floor-beams.

Figure 3 as a longitudinal section of the abutment-joint and support.

Figure 3*a* as an end elevation of said abutment-joint and support.

Figures 4 and 5 as longitudinal and transverse sectional elevations, respectively, of the upper chord post-joint, (called hereinafter the king-bolt joint.)

Figures 6 and 7 as sectional elevations and sectional plans of one form of strut, or post, and

Figures 8 and 9 as sectional elevations and plans of a second form of strut, or post.

Figure 10 as an elevation of the lower chord post-joint, (called hereinafter the queen-bolt joint,) and floor-beam connections.

Figures 11, 12, and 13, as detail figures, illustrating the top lateral, or wind-brace adjustments and attachments.

I construct my said truss with a straight, or nearly straight lower chord, and a curved upper chord, and with struts and diagonal braces of the general form shown in figs. 1 and 2, and I refer, in regard hereto, to the patents issued to me for improvements in truss-bridges, bearing date respectively the 20th day of November, 1866, and the 26th day of November, 1867.

As indicated in fig. 1, I construct the upper member of said truss of chord-pieces, A, which form the mathematical chords of a circular, parabolic, or elliptical curved lines.

The said chord-pieces abut against the king-bolt sleeve *a*, surrounding a wrought-iron or steel king-bolt, a^1, as fully indicated in figs. 4 and 5.

At the ends of the truss, the end-bolts a^2 receive the lower chord, B, formed of wrought-iron bands.

From each of said king-bolts a a^1 depend the posts, or struts C, connecting with the lower chord by the queen-bolt sleeves *b* and queen-bolts *b'*. The arrangement here indicated differs from that described in said patents of November 20, 1866, and November 26, 1867, in the introduction of sleeves *a* and *b* about the king and queen-bolts, respectively, and it will be seen, that by the use of wrought-iron or steel king and queen-bolts, the braces D' may be more readily connected hereto by the usual eye-jointed ends, as indicated in figs. 4 and 5.

Again, as said sleeves will usually be of cast-iron, they, to resist great strains, must be of great diameter, and if the lower chord were herewith directly connected, the bands composing said lower chord would be spread apart, to allow said sleeves to pass, thereby occupying more space than consistent with economy.

It will, then, be seen that the upper chord-pieces A abut against said sleeves *a*, and similarly, the strut may abut against said sleeves, but the braces will be hinged about the bolt a^1, by eye-joints, as above specified, and the lower chord-bands will pass about the queen-bolt *b'*, as shown in the figs. 5, 3*a*, and 10.

It is well known that when a great rolling load, such as a railroad-train, passes rapidly upon the first panels of a bridge, a great concussion is thus thrown upon the parts first receiving strain. In order to permit said parts to receive said strain, and to prevent said strains from being excessive, I reduce the end panels in their length, as heretofore expressed to be in the nature of my invention, and I accomplish this, and, at the same time, make the chord-pieces A more eco-

nomical in construction, by giving to all said chord-pieces equal lengths.

As the chord-pieces A vary in their inclination to the horizontal line, it will be seen, from fig. 1, that the panel-lengths will vary about as the cosines of the angles of inclination of the respective chord-pieces A with a horizontal line. Thus the panels increase in length from the ends of the truss toward the centre of span. Then, as the load received and carried on each span is about proportional to its length, the end panels receive less load than the centre ones, and as the end panels are subjected to greater concussion by trains or loads, in running on or off the bridge, the entire strain on all panels is thus more nearly equalized than if all panels were of the same length. And, furthermore, owing to said equal lengths of chord-pieces A, one pattern may be used herefor, (provided other dimensions are equal.) Thus an economical feature is added to the advantage before mentioned.

To distribute the great weight of the bridge and its load upon the abutment, I arrange, either about the end-bolts a^2, or the end-bolt sleeves, the seats a^3, the connection being such that the truss may freely deflect without turning or tipping said seats a^3, as shown in figs. 3 and 3*a*.

On one end of the truss, said seat a^3 rests directly upon an abutment-plate; at the other end, the seat a^3 will rest on rollers, a^4, and these rest on an abutment-plate. Then when the truss, by acting of loads thereon, deflects, all parts being hinged about the end-bolts a^2, or their sleeves, the base of the seat a^3 will always rest evenly and uniformly on all rollers thereon, instead of canting, as it must with other forms of construction.

In order to connect, in a flexible manner, the wind-struts with the upper chord, I arrange on the king-bolt sleeves *a* the projection, or crown a^5. This is of circular shape, as indicated in figs. 4, 5, and 11. As this projection is usually cast with the sleeve *a*, I strengthen the same by passing the post or strut-rods centrally through or round about the same, as hereinafter shown.

Against the crown a^5 the wind-strut E abuts, as shown in fig. 11, being thus flexibly connected therewith.

Whenever the load on the truss is not great, as in ordinary highway-bridges, I construct the posts, or struts C as shown in figs. 4, 5, 6, and 7.

The said strut is formed of a tension-rod, *c*, and compression brace-rods, c^1. The tension-rod *c* passes through the king-bolt sleeve and its crown, and connects this with the queen-bolt and sleeve, the same being arranged with a screw-nut, at one or both ends, for adjustment. Said rod is thus capable of transmitting the load received from the floor-beams G to the upper chord.

In order to make the strut act under compression, I arrange the brace-rods c^1 between the cap-castings c^2, trussing them at centre of height against the post *c*, by the spider c^3.

The caps c^2 set by fitted surfaces around the sleeves *a* and *b*, and said cap may be prevented from moving up or down on the rod *c* by little bands, c^4, shrunk or forged on said rod. Similarly, the band c^5 retains the spider c^3.

The rods c^1 may be connected with the cap c^2 by screw-threads, or by nuts each side, or in any other manner.

In order that the rods c^1 may the better resist the compression on the strut, it is important to prevent them from leaving the spider c^3. This I accomplish by passing said rods between the wrought-iron band c^6, and the forked ends c^5 of the spider. Said detail feature may, however, be effected by making the spider-ends to clasp around the rod c^1, confining them, as in fig. 9. If said struts are long, additional spiders may be introduced, to brace the parts *c* and c^1.

It will be seen that the form of strut, or post now described, is especially applicable when the compression-strains are small and the tension-strains are great.

In the reverse case, I construct the strut as indicated in figs. 8, 9, and 10, using a cast or wrought-iron column, *d*, abutting between king and queen-bolt sleeves and the tension-rods d^1, bracing said column by the central spider d^3, said parts being connected as formerly described for the parts *c* and c^1.

In order, however, that the brace-rods d^1 shall not only prevent the column from deflecting under great strains, but shall also be capable of transmitting the loads from the floor-beam G to the upper chord, I pass said rods d^1 through the cap-plate d^2, above and on the crown a^5, (or on the sleeve *a* direct,) securing the said braces adjustable by screw-nuts.

Again, the said rods d^1 pass below the queen-bolt sleeve, and are secured similarly as above the king-bolt, by a cap-piece, or the same may be passed beneath the floor-beam chair *g*, and thus receive the weight from the floor-beams directly, as in fig. 8.

I am aware that struts have been trussed, or braced before, but I lay claim to the peculiar construction before described, by which my said struts are capable of resisting either compression or tension, or both. Thus, in the parts *c* and c^1, arranged as before indicated, the rods c^1 truss and aid the central rod *c* to resist compression, but the rods c^1 are not intended to resist tension, the rod *c* being constructed herefor. On the other hand, the column *d* is intended to resist by compression only, but it is not only trussed by the rods d^1, but said rods are arranged to carry up the load on the floor-beams. Thus, in both forms, I achieve a double advantage by said trussed form of strut. Lastly, in both of said arrangements the crown-piece a^5 is strengthened by wrought-iron rods passing through or around the same.

As before indicated, the lower cap-piece c^2, resting on the queen-bolt sleeve *b*, may be arranged to receive the floor-beams, as in fig. 6.

In case that the floor-beams are to be arranged below the lower chord B, I arrange the floor-beam seat *g* as indicated in figs. 8 and 10, hanging the same on the queen-bolt *b'*, or its sleeve *b*. In either case the parts are not rigidly connected, but, having round surface-bearings, there can be no undue or transverse strains.

The crown-pieces a^5 were constructed to receive the ends of the wind-posts E, and posts E extend between corresponding panel-points of the contiguous trusses, as shown in fig. 2.

In order that said posts may the better sustain their own weight, and have more clear (head) room between themselves and the floor-beams, I arrange said posts in an arched form; but, as by the thrust on said posts, caused by action of winds against the trusses, said posts might deflect upwardly in the centre, I brace said posts, and tie them down to the posts C, by the angle-bars *e*.

The diagonals of the lateral bracing I arrange as indicated in the figs. 11, 12, or 13.

The diagonal rods, or flat bars F, are arranged to pass around the crown a^5, and run to the centre of span of the post E. They are joined to said post, by the bolt *f*, which is more plainly shown in detail in fig. 12.

A shoulder, f^1, and the nut f^2, holds said bolt firmly to the post E, the bolt then passing through the braces F, and a nut, f^3, sustaining the same.

In this construction, the brace-bars F may be forged in continuous bands, and they are adjusted by drawing up the nuts f^3, and, at the same time, brace the posts E against lateral deflection.

In case it be inconvenient to make the bars F continuous, they may be made as indicated by F′, in fig. 11, and in the detail fig. 13, to pass through the post E, being held adjustably by a screw and nut at ends.

It will be well to arrange special castings to receive the ends of the brace-bars where they cross and connect with the post E, as indicated in fig. 13.

The application of the details here described is in nowise limited to truss-bridges, but the said parts may and will find application in the great number of structures used to sustain permanent or moving weights, such as bridges, roof-trusses, floor-trusses, railings, &c.

Again, it is to be understood that the general form of truss here described and indicated by figure, may be inverted, and thus the upper chord become the lower one; but this does in nowise alter the application of the specific features of this invention. It merely necessitates certain changes of material and certain modifications of detail, which may be safely left to the discretion of the engineer.

Having thus fully described my invention,

What I claim, is—

1. In the construction of bridges, the combination of the equally-divided curved or polygonal chords, with vertical posts, and horizontal chords, and tie-rods, the whole arranged substantially in the manner and for the purpose herein described.

2. The construction of a post, or strut, so as to resist strains of both tension and compression, either from a central rod, *c*, acting principally under tension, and trussing the same by compression-truss c^1, or from a central column, *d*, acting solely under compression, and trussed by rods d^1, arranged to sustain tension, and combining said parts with the floor-beams G, or its seat *g′*, and upper chord A, in the manner and for the purpose herein set forth.

3. The end-bolts a^2, or their sleeves, in combination with their seats a^3 and rollers a^4, in the manner and for the purpose herein set forth.

4. The crown-pieces a^5, in combination with the king-bolts a^1, or their sleeves, as and for the purpose herein set forth.

5. The floor-beam seat, resting upon or suspended from the queen-bolt or queen-bolt sleeve, as and for the purpose herein set forth.

6. The wind-strut E, when arched and braced by the angle-bars *e*, as herein set forth.

7. The diagonal bands F or F′, when formed continuously, and adjusted by the bolt *f*, when combined with the wind-struts E, substantially in the manner and for the purpose herein set forth.

In witness of which invention, I have hereunto set my hand, this 1st day of June, A. D. 1868.

GEO. P. HERTHEL, JR.

Witnesses:

M. RANDOLPH,

ROBERT BURNS.