No. 629,902. Patented Aug. 1, 1899.

W. E. GUNN.

BRIDGE.

(Application filed Mar. 20, 1899.)

(No Model.)

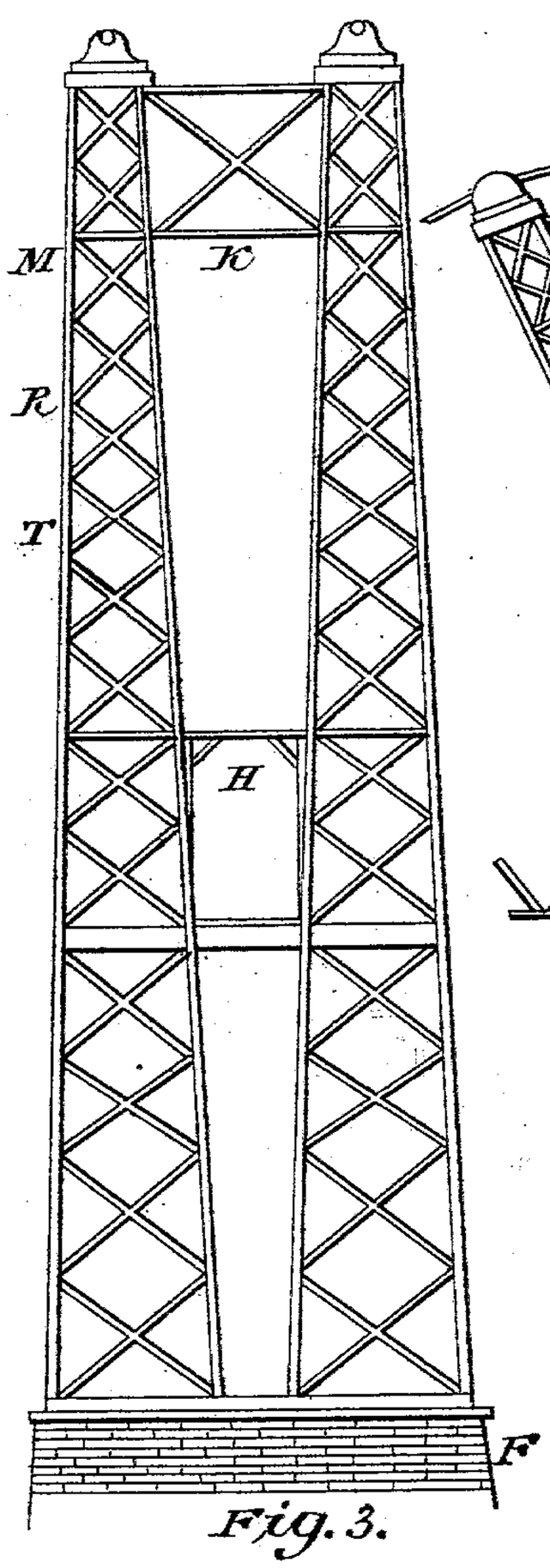


Fig. 3.

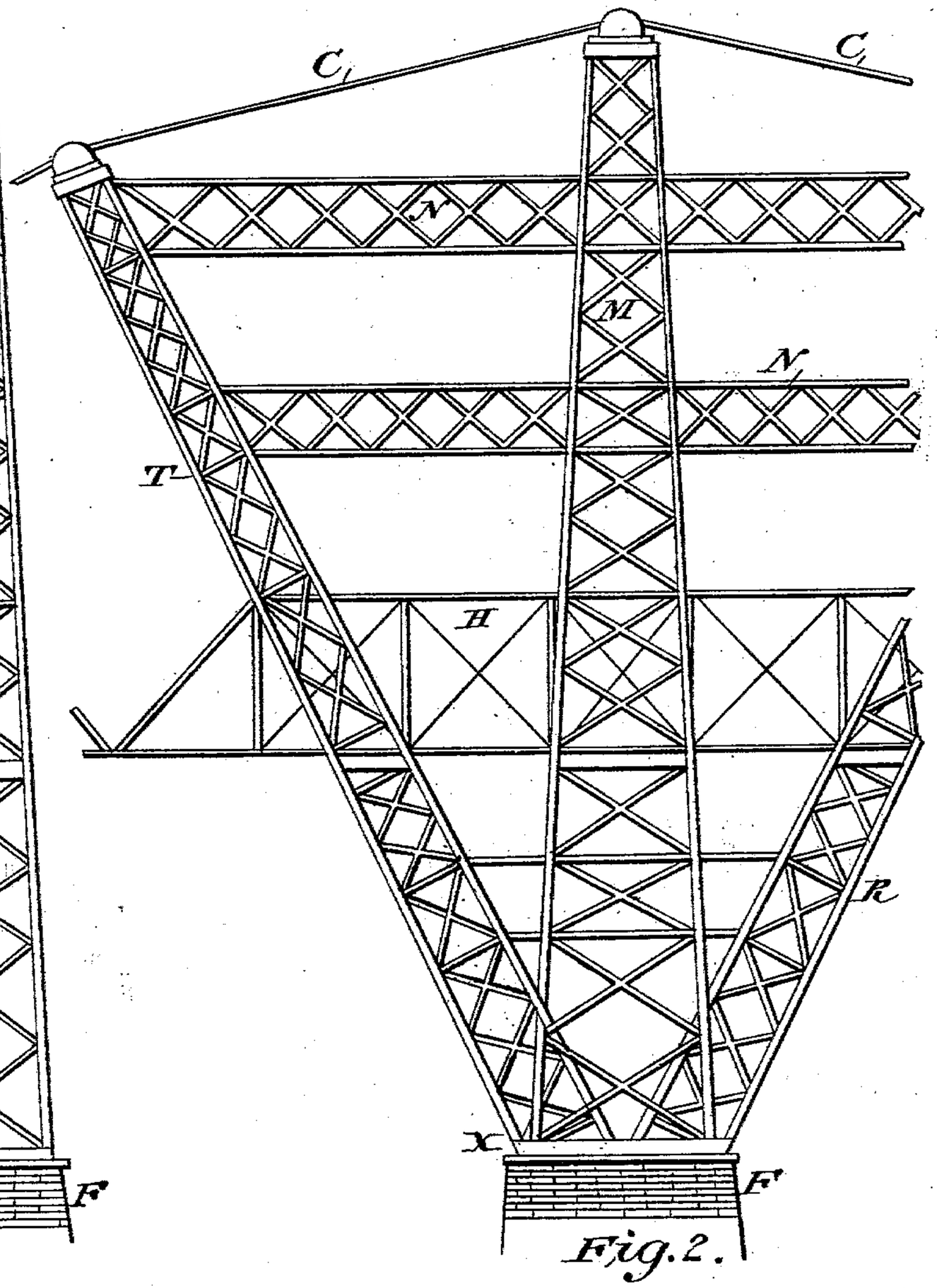
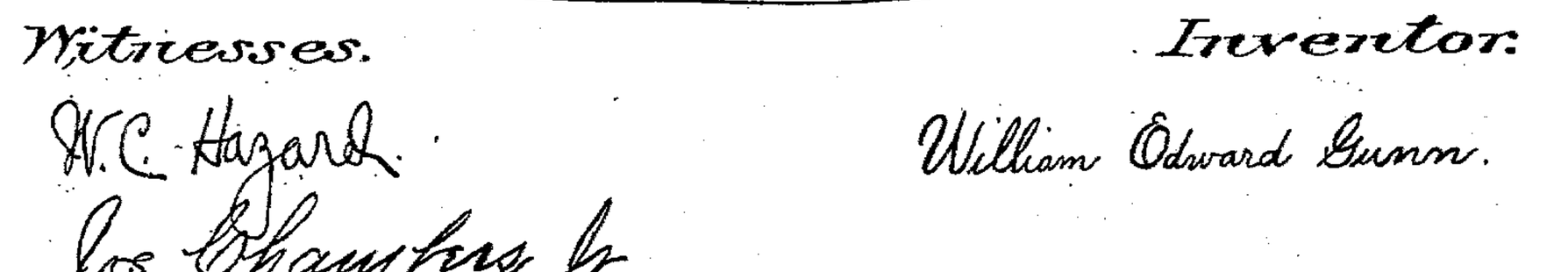


Fig. 2.

Fig. 1.



Witnesses.

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WILLIAM EDWARD GUNN, OF COVINGTON, KENTUCKY.

BRIDGE.

SPECIFICATION forming part of Letters Patent No. 629,902, dated August 1, 1899.

Application filed March 20, 1899. Serial No. 709,773. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM EDWARD GUNN, a citizen of the United States, residing at Covington, in the county of Kenton, State of Kentucky, have invented a new and useful Bridge, of which the following is a specification.

My invention relates to improvements in suspension-bridges which are composed of wire or other cables passing over towers, with floor system suspended from said cables.

The object of my invention is to secure a larger amount of strength and stiffness in a bridge with a given amount of cables and anchorage or to reduce the amount of material in the cables, suspenders, anchorages, and towers necessary to obtain a required degree of strength and stiffness; and it is also the object of my invention to reduce the amount of material in the floor system which must be suspended from the cables both on the main span between the towers and on the opposite side of the towers away from the center of the bridge and toward the ends of the bridge, commonly called the "land-spans." I attain these objects by constructing said bridge in the manner illustrated in the accompanying drawings, in which—

Figure 1 is a vertical section of the bridge in the direction of its length—the direction of travel. Fig. 2 is an enlarged view of the tower in the same direction. Fig. 3 is a vertical elevation of the tower shown across the bridge at right angles to the direction of travel.

I deem all the drawings necessary to explain the nature of my invention to a man skilled in bridge construction.

Similar letters refer to similar parts throughout the several views.

The bridge consists of two triple towers A and A, resting on masonry or other support at F, cables C C passing over the towers and fastened in anchorage masonry or in other manner to the ground at B B, also of suspenders D and stiffening-trusses E E, carrying the floor, also of a truss fastened to the inside of each tower and projecting past the sides of same, as shown at H H. Overfloor cables or stays, as shown by dashed lines J, may be used.

The towers can best be made of steel, but can be constructed of other material, especially on bridges of small span, as iron or wood, or wood and iron, or wood and steel. In bridges where steel towers are used the posts, which are shown in outline on drawings, will be built according to customary designs for steel columns—as, for instance, two channels fastened together by riveted lattices and plates—and so as to all the members of both towers and trusses the use of customary forms of chords, beams, posts, struts, ties, and floor-beams is contemplated. Each tower is sextuple, being composed of one pair of vertical towers between two pairs of diverging towers, one pair of which lean toward the land and the other pair leaning toward the middle of the bridge or river-channel. All these six towers being combined into one structure are here referred to as a "tower."

For wide bridges more leaning and vertical towers may be combined to form one—for instance, three or more vertical and the same number leaning toward the land or end of bridge and another set equal in number leaning in the opposite direction.

Each set of towers must be tied to each other and braced from each other, as at K. This connection must act as a brace, especially when the cables are cradled—namely, drawn in the middle of the center span nearer together than at the towers. The cables ought usually to be cradled to help resist wind-pressure.

The sets of tower members that diverge from the vertical set must be held to each other by cables or by trusses N N, or by both cables and trusses.

The trusses N N may be constructed of any customary form or may consist of horizontal cables trussed together. The purpose of this truss is to hold the leaning towers at fixed distances horizontally and lessen the deflection of the bridge caused by a heavy load compared to a light load. This object can also be further secured by holding the cables C C down between the leaning members and between the towers and anchorage.

The tower members should be held at their base by struts X, that shall take up the horizontal thrust, so that the weight of the tower and its load shall descend vertically on the masonry or other support.

In large bridges the cables should rest on

saddles of steel or iron on the tops of the towers, and these saddles should be movable in the direction of the length of bridge on rollers, and the base of each saddle should be at right angles to the line that bisects the angle the cable turns at said saddle. In smaller bridges the cables may pass over fixed bearings on top of the towers.

The land-span may be partly or entirely supported by suspenders from the cables, or may, especially in large bridges, be a truss carrying its own weight and load. The form of truss shown on the drawings is not an essential feature. Other customary forms may be used.

The cables can best be fastened in the masonry at the ends of bridge by passing the wires of which it is composed around pins held by eyebars, which pass into the masonry linked to other eyebars by pin connections, and finally to a large plate at or near the base of the anchorage masonry or in the natural formation.

The suspenders nearest to the towers had best be omitted to a distance from the center of the tower equal to the distance from the center of the tower to the middle of the land-span for purpose of having the tower balanced.

Expansion can best be provided for at the center of the middle span and at the anchorage ends of land-spans, but may be arranged at the ends of the spans fastened in the towers.

The towers are meant to act in conjunction with the truss-span which they carry to secure the advantage of the cantaliver principle both toward the middle span and toward the ends of the bridge, and are also intended to secure the advantage of the arch form from the base of the tower to the bottom of the truss. The tower should be stronger below than above the truss H. This truss H may best be constructed as a component part of the towers and not as a separate structure attached to the towers.

The leaning towers can best diverge about twenty-six and one-half degrees from vertical. In a very large bridge it would be possible to insert more than one set of towers between this pair of outside leaning towers, and these intermediate tower members could be either vertical or leaning less than the outside pair.

The cables should descend from the tops of the towers toward the land at about the same slope they have on the side toward the middle of the bridge.

In light bridges the swaying resulting from wind-pressure may be lessened by cables from the bottom of the bridge to the base of the towers or to the ground.

The slope of the cables from the tops of the leaning tower member to the top of the vertical tower member should be about thirteen and two-thirds degrees above horizontal. The cable should bend at the top of the vertical tower member about twice as much as at the top of either leaning tower member. The three tower members should be about equal to each other in length.

The stiffening-truss may be converted into a continuous truss the whole length of the bridge. In this case the truss may be connected with the towers so as to move horizontally but not vertically, the chords sliding in grooves and the expansion occurring at the ends of the bridge.

Overfloor cables or stays may be used or they may be entirely omitted.

While on the drawings only one main suspended span is shown, it is apparent that the same form of towers may be applied to a number of suspended spans by use of intermediate towers, each of which should be similar to the towers shown.

By the use of towers with diverging arms the points of support of the cables are brought nearer together and the depth of the sag of cable below a horizontal line, usually called its "deflection," is increased compared to the distance between supports, decreasing the tension resulting from a given load. The diverging form of the leaning tower members, combined with the cantaliver-span, also decreases the length of the suspended structure carried by cables. While double diverging towers alone thus decrease the absolute load on the cables and the relative resulting tension in the cables as compared to a single-tower bridge, and therefore in all ordinary cases effect an economy, still this net economy is effected in spite of the fact that a given vertical load at the top of the tower produces a larger compression in the leaning tower than in a vertical tower in proportion as the inclined length of the tower is greater than its vertical height above its base.

By the arrangement of a triple tower, as described above, about one-half of all the load is supported by the central vertical tower member, and this part of the load is conveyed to the base more economically through this vertical tower member than through leaning members, while all the advantage of reduced load and tension from the diverging tower members is retained.

The triple towers by elevating the direction of the cable from the supports at tops of diverging tower members toward the center of tower also decrease the size of the tie N N necessary to hold the tops of diverging tower members toward each other.

The triple tower herein described also decreases the size of the truss H by supplying intermediate points of support and carrying the load at middle of same more directly to the base than in the case of double towers alone.

It is evident that a larger number of main cables may be used than is herein shown, either parallel to each other horizontally or one above the other, and if the latter that they may be trussed to give stiffness to the bridge. Customary methods of wind-bracing at top and bottom of trusses may be used.

I am aware that prior to my invention bridges have been made with cables, towers, suspenders, trusses, stays, and anchorages. I therefore do not claim such a combination broadly; but

What I do claim as my invention, and desire to secure by Letters Patent, is—

1. The combination in a bridge of triple towers composed of one set of upright members with two sets of leaning members diverging in opposite directions from each other from a common base toward their tops and in the direction of the length of the bridge substantially as herein described.

2. The combination in a bridge of triple towers each composed of one set of vertical towers and two sets of leaning towers on opposite sides of this central set of towers and diverging toward their tops from each other and in the direction of the length of the bridge, with cables suspenders trusses and anchorages all substantially as above described.

3. The combination in a bridge of two or more towers each composed of one or more nearly or quite vertical sets of tower members and two sets of tower members diverging about equally in opposite directions from each other and in the direction of the length of the bridge from their bases toward their tops, with cables suspenders trusses and anchorages all substantially as described.

4. The combination in a bridge of triple towers composed of one upright set of tower members with two sets of tower members diverging in the direction of the length of the bridge from a base below the level of the bridge-floor, toward their tops, with a truss carrying a floor system through the tower and projecting past the sides of the tower as a cantaliver, and with cables suspenders stiffening-trusses and anchorages all substantially as described.

WILLIAM EDWARD GUNN.

Witnesses:
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FOSTER V. COX.