R. B. OSBORNE.
Truss-Bridge.

No. 197,286. **Patented Nov. 20, 1877.**

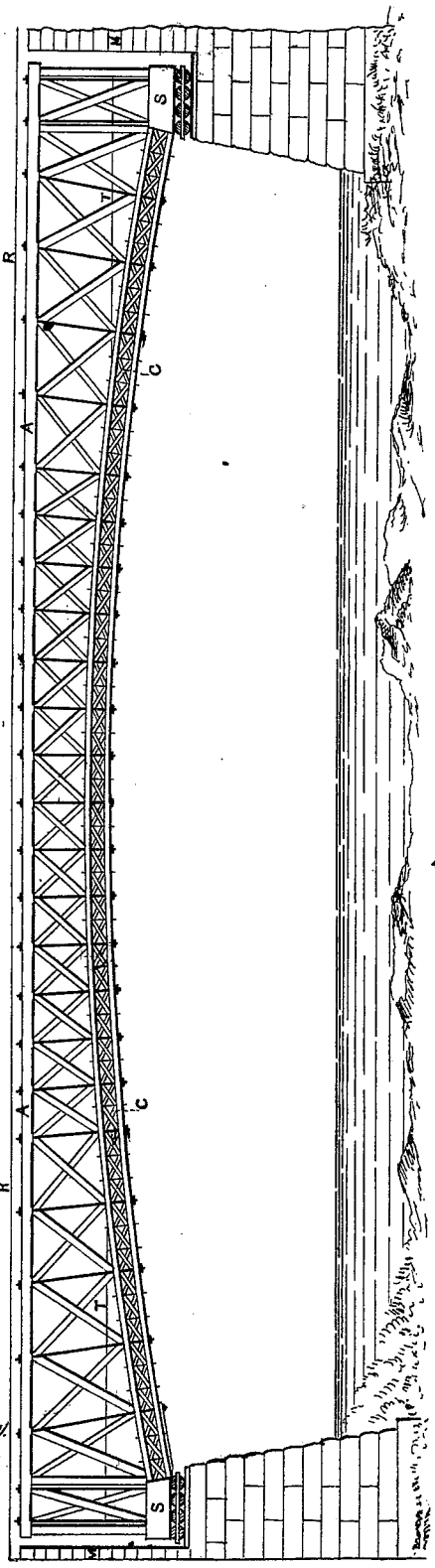

FIG. I.

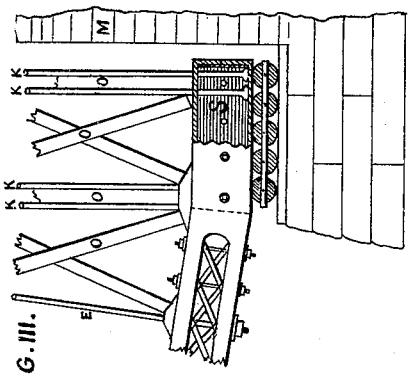

FIG. III.

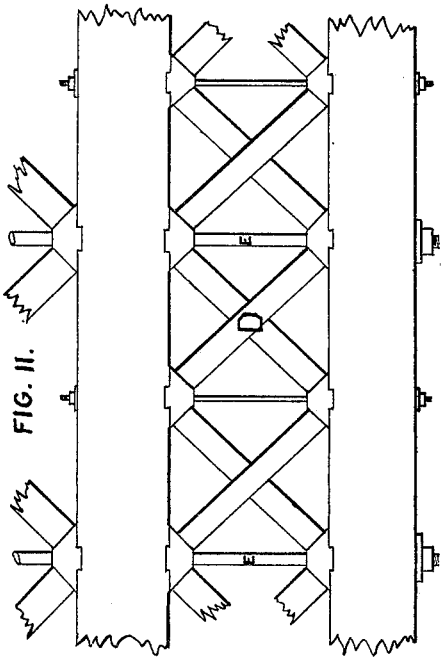

FIG. II.

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UNITED STATES PATENT OFFICE.

RICHARD B. OSBORNE, OF NEW CASTLE COUNTY, DELAWARE.

IMPROVEMENT IN TRUSS-BRIDGES.

Specification forming part of Letters Patent No. **197,286**, dated November 20, 1877; application filed June 30, 1877.

To all whom it may concern:

Be it known that I, RICHARD B. OSBORNE, of New Castle county, in the State of Delaware, civil engineer, have invented certain new and useful Improvements in Bridges, of which the following is a specification, reference being had to the accompanying drawings, and to the letters of reference marked thereon.

My invention has particular reference to the employment of arches of iron or other material, in connection with any of the well-known trusses, and the combination of the same in such a manner as to insure the united and simultaneous action of both systems under all conditions.

In the annexed drawings, forming a part hereof, Figure 1 is a side elevation of my invention, which I term my improved "elastic arch truss-bridge;" Figs. 2 and 3 show enlarged views of details thereof, as hereinafter described.

The arch has long been used to assist straight beams or trusses, and we may not question the power of a properly-proportioned arched rib to sustain a load, if it only be so braced as to prevent any change in its shape; but all the present contrivances for using a truss to stiffen and brace an arch are defective, inasmuch as the two systems have no lasting concert of action, and soon permit independent working of both, so that one or the other is generally found to be doing the whole duty. This is so well known to engineers that when the arch is used with the truss each is made sufficiently strong to bear the entire weight unaided by the other.

Arched ribs have been also used as the primary support of structures with stiffening-braces and counter-braces by various well-known arrangements to prevent their change of figure; but all such appliances are distinct and separate from the arch itself. The wear and tear of heavy traffic, and the unequal contraction and expansion of the distinct parts, in time derange the adjustment of the bracing, and the arch, no longer confined to its proper shape, loses its rigidity, which can only be restored by a nice readjustment of the bracing. The arch and the king-truss are among the oldest principles in mechanical construction, and if properly combined, so as to work harmoniously, they will enable longer and safer spans in bridges to be built than have heretofore been attempted.

Again, iron structures being subject to great contraction and expansion, arches are, at times, unduly exercised, and, springing from fixed skewbacks, are subject to a great degree of strain, under expansion, to be relieved of which the crowns of the arches rise and lift the whole superincumbent weight. An arched rib, under these conditions, however able to endure its heaviest passing loads, will sometimes tremble with the weight of a single person walking over it. A want is therefore here seen of some device by which the arch can be kept in its natural state of repose, ready to exert its full power whenever a live load passes over it.

In carrying out my invention, I employ a truss as a proper accompaniment of every arched rib; but I make the truss a part of the arch, and I use the arch in the formation of the truss. I have, to give vertical stiffness, the combined depth of the truss and the arch, the whole acting as a truss, the bottom chord of which is not only an arch but an arched truss itself, having a twofold character and a twofold power—a combination which is claimed to have great value. I build this arch of timber or of iron, or steel-plates rolled flat or corrugated. I use corrugated plates in this shape for various reasons: First, I get a large superficies of metal in a small space; secondly, an increased vertical stiffness; and, thirdly, simplicity of construction of costly parts of the structure. The chords constructed in this way, whether intended to remain curved or straight, can be put up in straight lengths, and without expensive manipulation of their parts, and from these the arches can be drawn into their proper shape, by their own capacity of self-adjustment in the use of their braces and connecting-rods, forming the arches into a truss, curved as required. The rods of the main truss pass through this arch as through a bottom chord, and have their nuts and plates below it. The main and counter braces abut on skewback-blocks resting on it as on a bottom chord of a straight truss. The truss sus-

tains the arch in its proper shape, and no portion of the truss can throw an unequal strain on any portion of the arch as long as the several members of the truss perform their duty.

It will be observed that this arch, acting as a bottom chord, is itself a truss, and therefore that its members exert a compressive force at the center of the span; yet the strain on every bottom chord of a truss is tensile, being at its maximum at the center of the span; but in this arch (though it forms the bottom chord of a truss) the strain at the crown would be doubly of compression. The resistance of the truss-sections at the ends of the bridge (and of each section in order in a diminishing degree toward the center of the span) against a change of figure makes the bases S fixed skewbacks in relation to the arched truss and within the limits of the bridge structure, although the whole is related to the piers by rollers.

Every pound of tensile strain exerted upon the bottom arched chord is transmitted in compression to the top chord, and as long as this member is sustained by its struts, and its vertical rods do their duty, the arch will retain its proper shape, even though it were not abutted against rigid skewbacks on the abutments, but simply rested on ordinary bridge-seats. Here is a new and most beneficial development of a principle by which the arch and truss are made to act in concert, (as all experienced bridge-builders will admit,) and this fact points to the next subject of my improvement, which is claimed to be of great importance in the construction of bridges under any plan that utilizes our American well-proved systems.

I have stated that this arch truss-chord will be retained in its true shape by its connection with and its forming a part of the truss. I know by experiment that were this arched chord formed merely of a flexible chain this would be the case. It would then, however, be wholly under a tensile strain; but its arch-like shape would be kept intact. This being the case, if the arch be built of stiff plates, and it abuts against skewbacks formed at its feet, and combined therewith as a part of the main truss, and resting on rollers, the chord will have power to act as an arch against its skewbacks with a force equal to the friction of the weight of the span on the rollers; but there will be an elongation of the arch under high temperature. The greatest elongation of the arch divided by two, minus a small fraction, will then be the safe measure of the distance the skewbacks should be allowed to move on their rollers on each abutment, where I use the masonry of the abutment to check and hold them rigid, in which case I secure additional strength to the bottom chord as an arch, at the very time when it is in its weakest condition, owing to its expansion. By this arrangement there is always more or less of a counteracting compressive force exerted on the bottom chord of the main truss, and the constructing engineer has the power, with great facility, by the method explained, to regulate and limit tensile strain as he may see proper by shortening the travel of the movable skewbacks by a suitable construction of the backing masonry of the abutments.

It is claimed that this elastic character given to structures where the arch is incorporated, and the systems of arch and truss are combined in one, will meet many requirements that we have heretofore recognized, and will supply for future use long, safe, and economical spans for railroad and ordinary travel.

D is a side elevation of a part of the arch-chord C C, showing the king-bolts E E, which come from the upper chord, A A, and, passing through this arch-chord, are secured by nuts in the usual way. All these king-bolts are in the radial lines of a circle, of which the arch-chord is an arc. R R stand on the line which is the level of the line for railroad travel, and T T are on the line for common travel, when both are to be accommodated in the same structure. M represents the masonry, built at a fixed distance behind the skewback, to be determined by the judgment of the engineer of construction. S is the self-adjusting skewback, made of cast-iron, held in place by the flat plates of the arch, which embrace it on all sides. The braces O O and the rods K K of the main truss, by their connection with it, make it a part of said main truss, and hold it in position for the arch to abut on.

The following are the salient points of improvement in bridge construction to be found in my invention.

The combination herein described of the arch and ordinary truss in one structure produces a concert of action between the two systems which has been long desired, but never to my knowledge effected.

By using an arched chord of approved principle and construction as the bottom chord of an ordinary main truss, and connecting it with the rods and braces of said main truss, by passing the main rods through the arch, the arch is utilized as a bottom chord, and as an arch also, and a truss is procured of greatly increased strength, all superfluous weight being avoided.

The well-known properties of the arch in its action under loads are brought into use to aid those members known as the bottom chords of a truss, thereby decreasing or neutralizing, in whole or in part, by compression, the tensile strains exerted on the bottom chords.

By the method of bracing and counterbracing the arched rib herein described, a change in its figure cannot occur, and its stiffness is reliable and permanent. The self-adjusting and movable skewbacks for the arches incorporated with the truss regulate the same and permit their expansion to act only up to fixed limits, when their character becomes so far modified that they act as arches under full compression. An elastic character is thus given to the whole structure to prevent the injurious action of heavy loads while the structure is af-

fected by great contraction or expansion of its component materials.

I prefer to use in the chords of the bridge corrugated plates of iron or steel, laid in double or more lines, one on the other, breaking joints, and riveted or bolted together, this construction giving greater area of cross-section and increased strength to these members.

I lay no claim to any of the well-known systems mentioned in this specification, or to any others of a like character that may be used in the construction of my improved bridge; but I do claim the peculiar combinations herein set forth to afford new results.

Having described my invention, I claim as new and wish to secure by Letters Patent of the United States—

1. The combination of an ordinary main truss, an arched truss forming the bottom chord thereof, and main rods or king-bolts running through both the main truss and the arched truss, substantially as and for the purposes specified.

2. A bridge structure having incorporated therein an ordinary main truss and an arched truss, forming the lower chord thereof, and a series of main rods or king-bolts standing in the radial lines of a circle of which the arched bottom chord is an arc, as and for the purposes set forth.

3. The arched bottom chord, having bracing and counterbracing, as shown, combined with the main truss, and with the main rods of said truss passing through both the main and arched trusses, substantially as described, whereby while the main truss retains its powers, the arch must retain its shape and act in concert with the main truss.

4. A bridge having incorporated in its structure an ordinary main truss and an arched bottom chord, consisting also of a truss combined with self-adjusting and movable skew-backs, substantially as and for the purposes specified.

In testimony whereof I have hereunto subscribed my name in the presence of two subscribing witnesses.

RICH. B. OSBORNE.

Witnesses:
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