Sheet 1, 2 Sheets.

O. G. Leopold.

Truss Bridge.

No. 60,205. Patented Dec. 4, 1866.

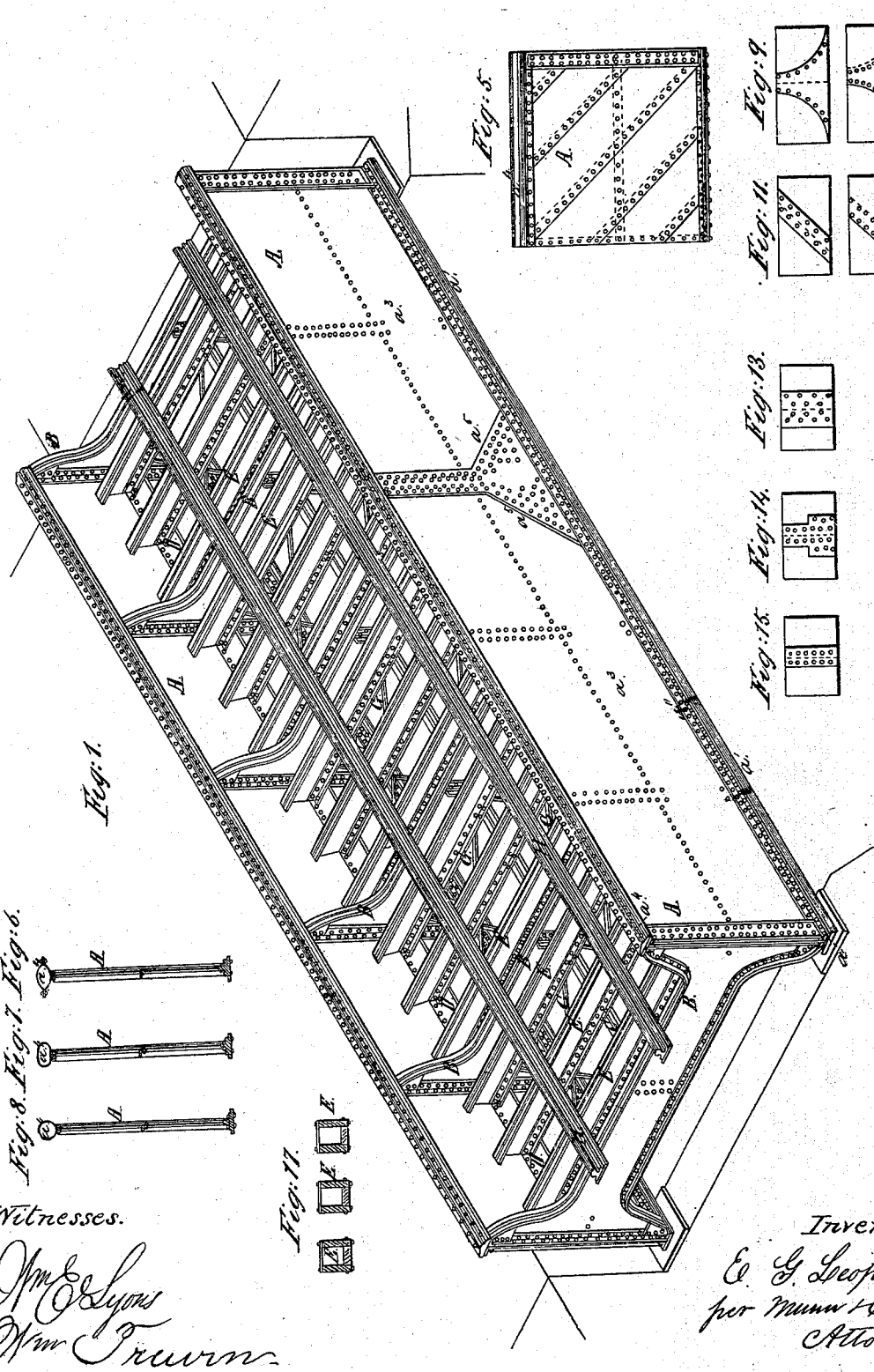

Fig: 1.

Fig: 5.

Fig: 9.

Fig: 10.

Fig: 11.

Fig: 12.

Fig: 13.

Fig: 14.

Fig: 15.

Fig: 8. Fig: 7. Fig: 6.

Fig: 17.

Witnesses.

Wm. E. Lyons

Wm. Truran

Inventor.

E. G. Leopold.

per Munn & Co.

Attorneys

Sheet 2, 2 Sheets.

O. G. Leopold.

Truss Bridge.

No. 60,205. Patented Dec. 4, 1866.

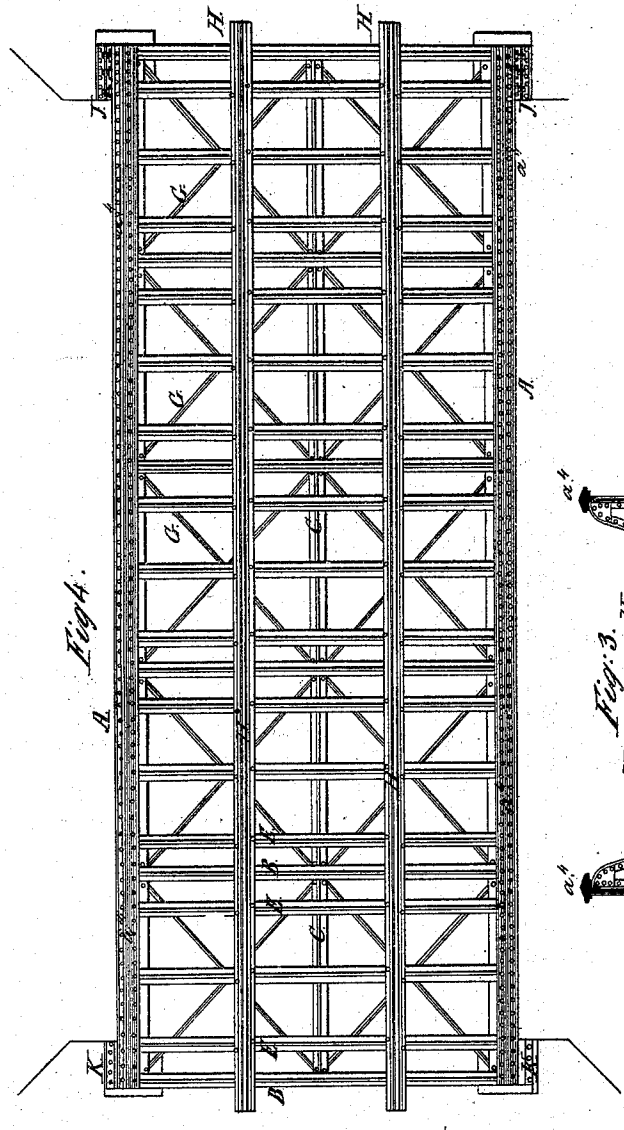

Fig. 4.

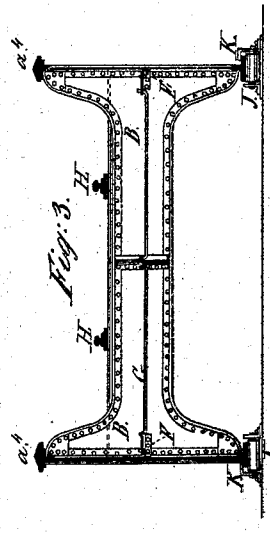

Fig. 3.

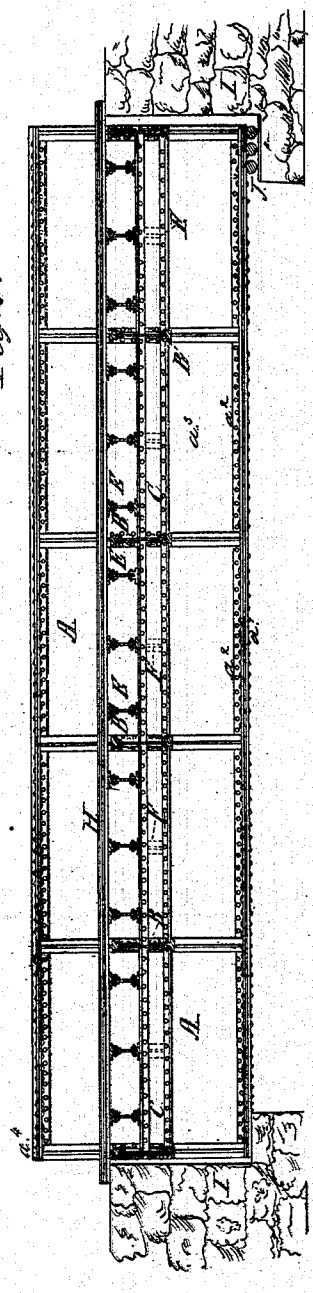

Fig. 2.

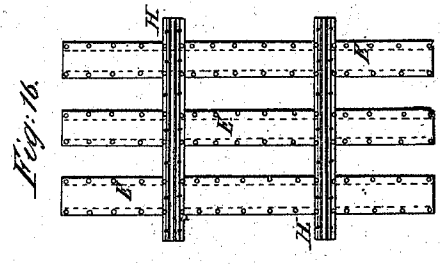

Fig. 1b.

Witnesses.

Wm. E. Lyons.

Wm. Truran.

Inventor.

E. G. Leopold

per Munn & Co.

Attorneys

United States Patent Office.

IMPROVEMENT IN BRIDGES.

O. G. LEOPOLD, OF CINCINNATI, OHIO.

Letters Patent No. 60,205, *dated December* 4, 1866.

SPECIFICATION.

TO ALL WHOM IT MAY CONCERN:

Be it known that I, O. G. LEOPOLD, of the city of Cincinnati, Hamilton county, State of Ohio, have invented a new and useful Improvement in Bridges; and I do hereby declare that the following is a full and exact description thereof, which will enable others skilled in the art to make and use the same, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1 is a perspective view of my improved bridge.

Figure 2 is a vertical longitudinal section of the same.

Figure 3 is a vertical cross-section of the same.

Figure 4 is a top or plan view of the same.

Figure 5 is a detail view of a portion of a girder illustrating one mode of joining the plates of the central rib.

Figures 6, 7, and 8, are cross-sections of the side girders illustrating different modes of forming the top rail of the girders.

Figures 9, 10, 11, 12, are detail views illustrating different modes of joining the plates.

Figures 13, 14, 15, are detail views illustrating the old manner of joining the plates.

Figure 16 is a detail view illustrating one mode of forming the cross-ties.

Figure 17 is a cross-section of fig. 16.

Similar letters of reference indicate like parts.

The construction of this bridge is based upon the theory of the neutral line or point of gravity of the cross-section of a loaded beam supported at its ends, and for its form the double-shaped cross-section was adopted as the strongest with reference to the metal expended. To these as the leading ideas the whole structure was made to conform in its combination as well as in all its minor parts, and was made to serve the purpose aimed at, viz, the production of a strong, durable, and comparatively light structure.

The beams of the bridge consist of a combination of plate and angle iron, which by means of rivets are formed into a parallel wrought-iron girder, A, whose cross-section resembles the double T, thus: I. The lower stringer or flange, a^1, is flat iron of proportional strength to the span of the bridge, to which by means of angle iron, a^2, the central rib or vertical plate, a^3, of the T is fastened. The thickness and height of the rib, a^3, is also made proportional to the respective span. The top rail or flange, a^4, of the beam may be made either of flat iron, as seen in fig. 1, or of plate in tubular form as illustrated in figs. 5, 6, 7, 8, the latter preferred for reason of compensating (with less expenditure of metal) for the difference in the strength that wrought iron presents to an expansive strain, thus balancing the resistance of that portion of the cross-section of the girder lying above the point of gravity to that lying below the same, or, in other words, bringing the neutral line in the middle of the cross-section of the beam. This line, from the manner in which the load operates upon the resisting strength of the beam, being the line of stability, is selected for the attachment of the roadway, thus laying the load in the strongest point of the girder. The height of the girders, A, being determined by and proportional to the span of the bridge, and in conformity to the best rules of the most approved engineering authorities, it also determines the relative position of the lateral T-shaped braces, B; their distance from each other being proportional to the height of the girders, A, subdivides the latter into square fields or sections, thus imparting the requisite stiffness to the central rib, a^3, of the girder. These braces, B, presenting at the end view of the bridge, with the girders as heads, also a double T form, have likewise a double T-shaped cross-section produced by a combination of plate and angle iron. The braces are fastened to the girders by means of rivets; thus that while riveted fully at each end or respective head of the T, to the plates of the central rib of the girder above the point of gravity or the neutral line, they are only fastened near the lower flange by means of a few rivets, thereby avoiding an unnecessary and rather injurious weakening of the girder at those points where the expansive force is operating on its strength, and still accomplish the object of keeping the lower parts of the braces in their proper relative positions. These braces are, in their turn, stiffened in the centre of their length, or half-way between the two principal girders, by a longitudinal bar, C, of a double T-shaped cross-section, and of a height to correspond with the bars or carriers, D, which are fastened at the point of gravity or line of stability of the central rib of the main girders, thus affording an additional or central supporting point for the lateral ties or sills, E, of the roadway. On the inner side of each girder, A, at the line of stability, a flat bar, D, is fastened by means of angle iron and rivets to the central rib, a^3, of the T-shaped

main girders, A, which serves as carrier to the cross-ties or sills, E, of the roadway, thus loading the girders of the bridge at the neutral line where the two opposite forces—compression and expansion—meet, that operate upon a loaded beam according to the established principle by the experiments of Hodgekisons, Barlow, Fairbairn, Stephenson, Weisbach, and other standard authorities, this line being the line of stability, from the fact that in case of breakage this point of the cross-section of the girder will suffer comparatively the least injury. These plates or bars, D, are braced at equal distances by small triangular brackets, F, formed of plate and angle iron, in each and all of the intervening spaces between each pair of contiguous lateral braces, as indicated by dotted lines in fig. 2. Each section or field of the lateral bracing of the bridge receives additional strength from the diagonal tie-rods, G, fastening the two opposite points or corners of each pair of contiguous braces, B, on each side of the central longitudinal brace bar, C, together. In execution of the whole combination a due regard is had for such forms, sizes, and manner of workmanship, as the teachings of experience have pointed out; thus no joints in the lower stringers or plates, or in fact in any portion of the bridge exposed to the expansive strain, are formed on a straight or right angular line, but either on a diagonal or circular line, as seen at a^5, fig. 1, and illustrated in figs. 9 to 12 inclusive, thereby obviating the weakening of those points in comparison to the full strength of the solid metal in the proportion as 1 to 8. At points situated above the neutral line, or in parts where the compressive force is operating, joints in straight lines, as customary, may be made, as not interfering materially with the strength of the bridge. The upper rail, a^4, head of the T or top of the principal girders are to be made tubular, in preference to solid flat bar or plate, as this form affords greater strength with comparatively less expenditure of metal under a compressive strain. The particular form of this tube is not an essential feature, but may be either circular, elliptical, triangular, square, oblong, or of any other similar form by which the same effect is obtained. For the protection or in order to reduce the thickness of the lower stringer, a^1, and increase proportionally its width with reference to its requisite strength, plates forming, with the stringer for a base, a triangle in the cross-section may be introduced, thus affording additional lateral stiffness, and at the same time throwing off the water. The beams or the cross-ties (sills) E, of the roadway, I would either make of metal placed on wooden blocks, so as to preserve a certain requisite elasticity to the rails of a railroad, or form them of three parts of heavy planking with a light metal plate for cover, as illustrated in figs. 16 and 17, thus producing lighter hollow rails and decreasing thereby the dead load on the bridge, giving protection to the wood by admitting a current of air through it, sheltering the wood against the influences of the wet resting on the beam, and at the same time preventing the timber from being cut or otherwise tampered with from malicious intents. These sills or beams, E, should be of height sufficient to prevent the track-rail, H, or platform for roadway, from resting on the lateral braces, B, but should be exclusively, and in accordance with the principle involved, supported by the bars D and C at a level and in line with the neutral or line of stability of the principal girders, A. The girders, A, of the bridge are not bolted or anchored to the abutments, I, but are held and made to slide freely on rollers, J, in shoes or flanged sockets, which overlap the lower flanges, a^1, of the girders, A.

Making the attached drawings a part of my description, as illustrating more fully and comprehensibly the parts and combination of my parallel wrought-iron girder bridge, I lay no claim to the principles applied, or any of its known or otherwise hereinbefore employed forms of material, but claim as my invention, as best suited to the specific purposes in view, viz, strength and lightness of structure.

I claim as new, and desire to secure by Letters Patent—

1. The general arrangement and combination of wrought angle iron and plate in a bridge, so as to present in the cross-section of the girders and all other essential parts of the bridge, the double-T form, substantially as described.

2. The arrangement and adaptation of the bar D to the central rib a^3, in such a manner that the platform or roadway of the bridge shall be located at or near the line of stability, or neutral line of the girder, substantially as described.

3. And in combination with the above, I claim the lateral bracing for the support of the roadway, substantially as described.

4. Making, in the combination of the double T of the bridge girder, the upper stringer or head of the same of either a flat bar or a hollow tube of any form, substantially as described.

5. Making the sills or cross-ties of the roadway of hollow wooden beams instead of solid timber, and covering the same with metal plate, substantially as described.

The above specification of my invention signed by me this fourteenth day of November, 1865.

O. G. LEOPOLD.

Witnesses:

JAMES FOSTER, Jr.,

OTTO HEINEMANN.