D. M. PFAUTZ & J. L. LUCKENBACH.

TRUSS SYSTEM FOR ELEVATED RAILWAYS.

APPLICATION FILED JUNE 29, 1908.

915,377.

Patented Mar. 16, 1909.

3 SHEETS—SHEET 1.

Fig. 1.

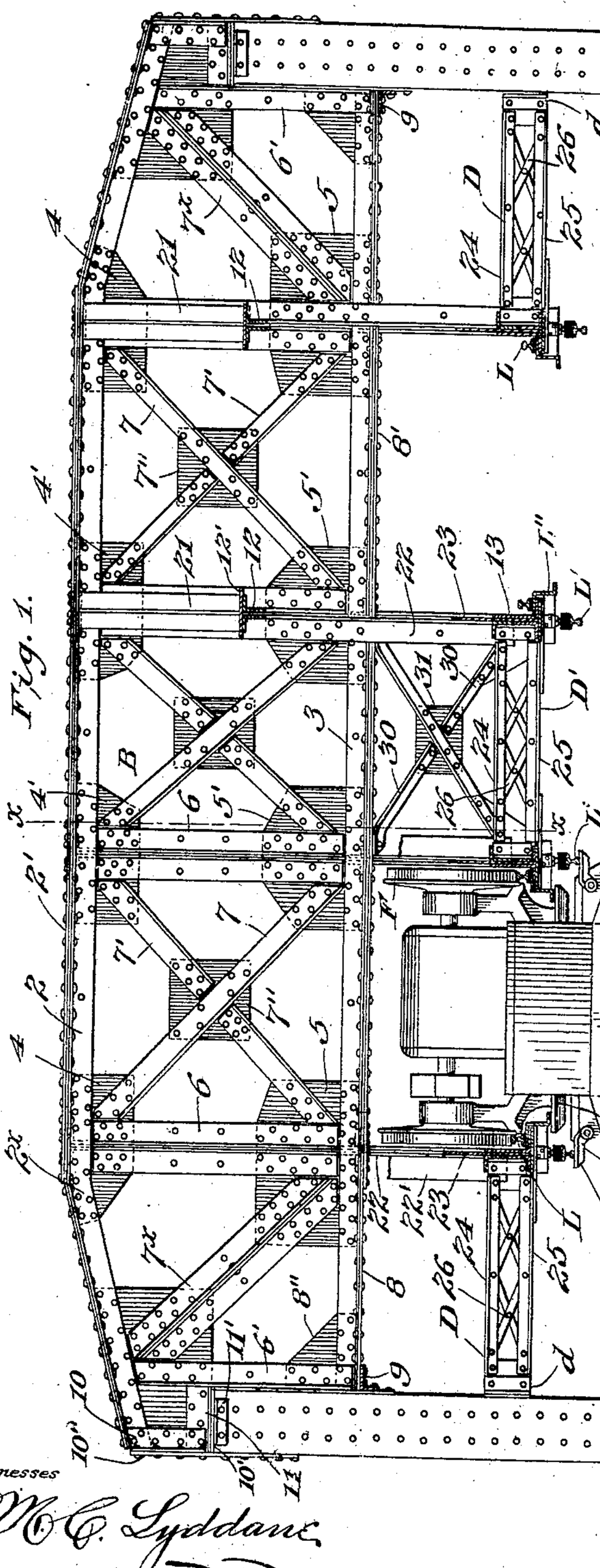
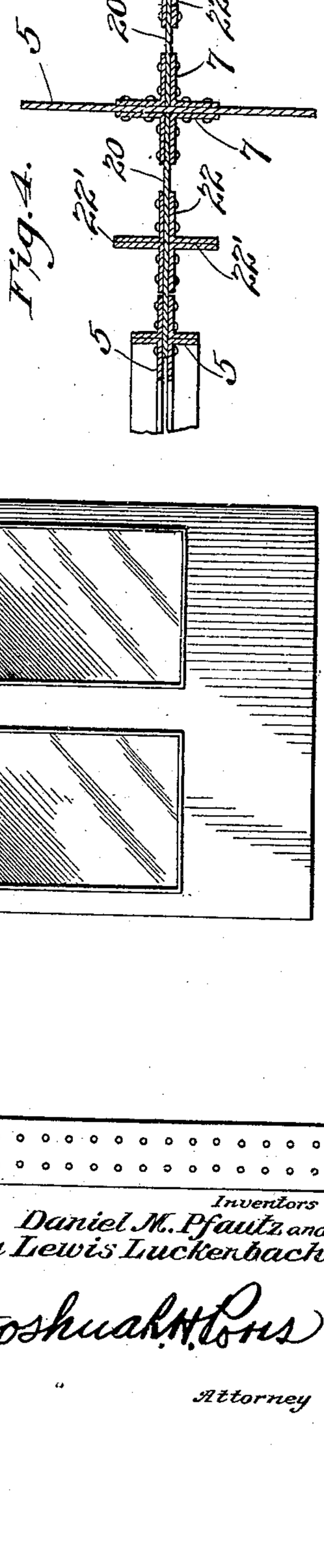


Fig. 4.



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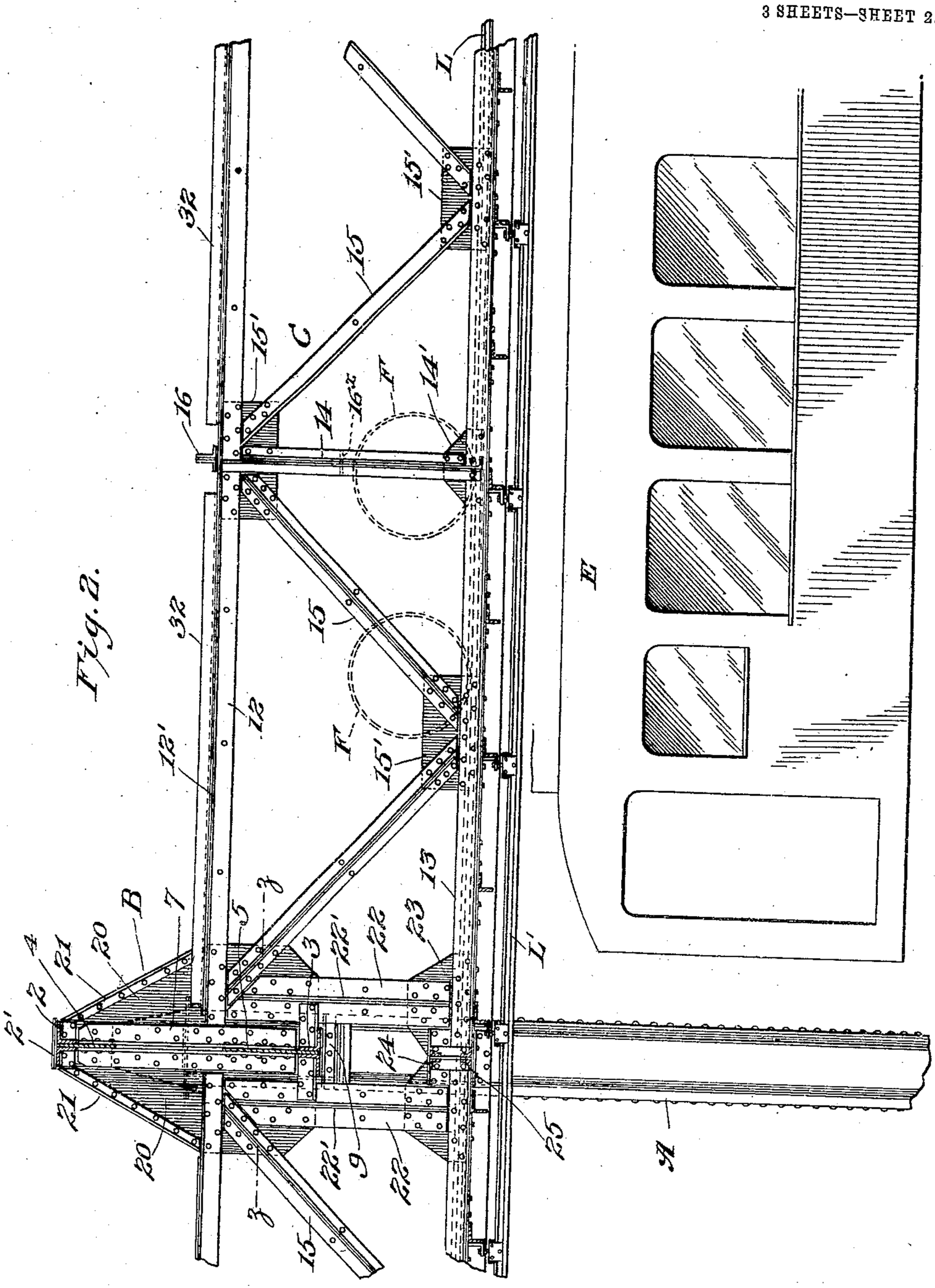

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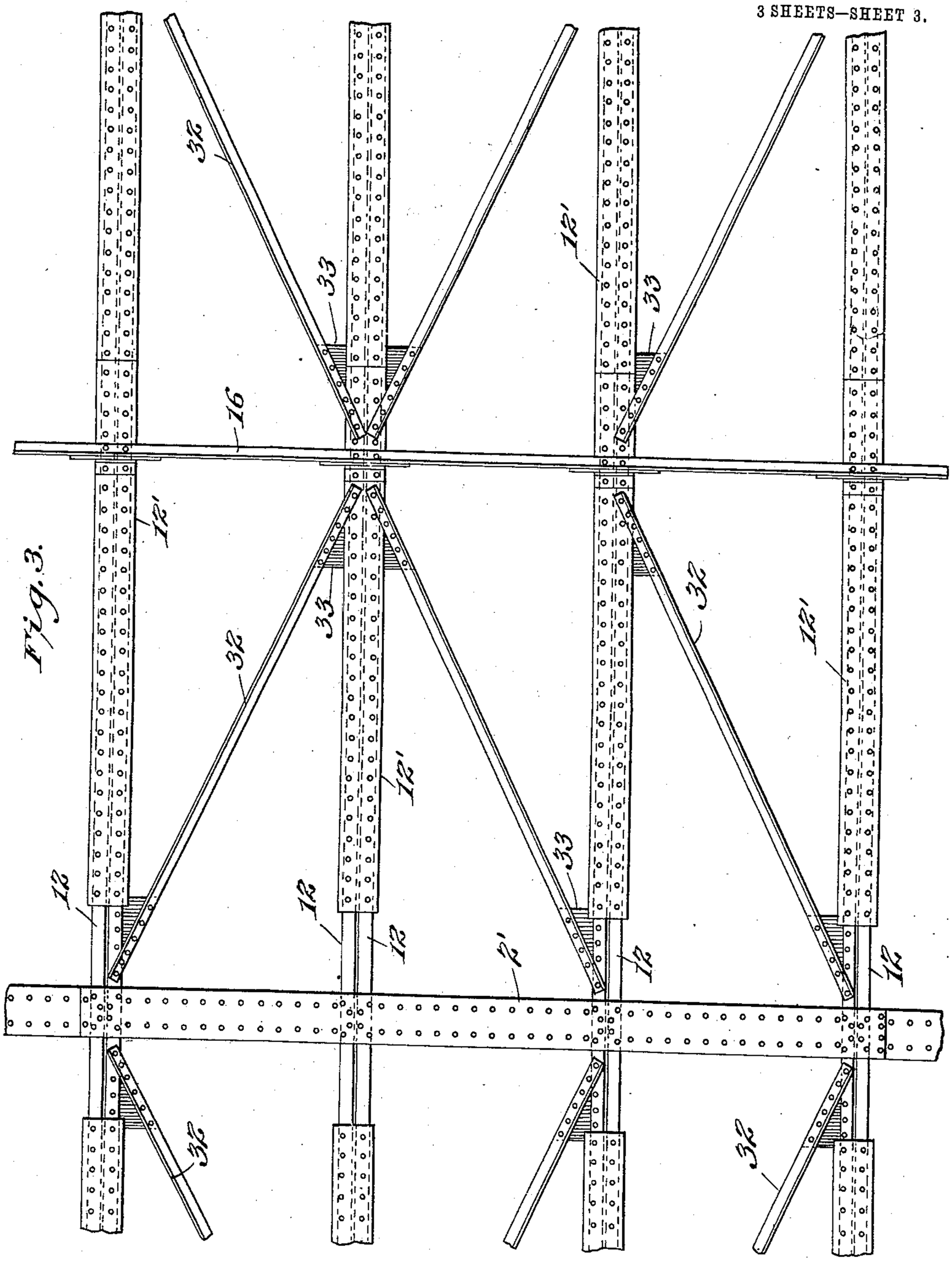

Fig. 3.

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TRUSS SYSTEM FOR ELEVATED RAILWAYS.

No. 915,377. Specification of Letters Patent. Patented March 16, 1909.

Application filed June 29, 1908. Serial No. 440,810.

To all whom it may concern:

Be it known that we, DANIEL M. PFAUTZ and JOHN LEWIS LUCKENBACH, citizens of the United States, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in a Truss System for Elevated Railways, of which the following is the specification.

Our invention relates to elevated railways of the general character described and illustrated in Patent No. 840,801, granted to Daniel M. Pfautz, on January 8, 1907, and particularly to a transverse truss therefor, the means whereby such truss is supported from vertical columns, and means whereby it is connected to the longitudinal trusses of the structure.

In elevated railways of the character above referred to, the car is suspended from an overhead wheeled truck. The track rails on which the rails run are carried upon a column-supported superstructure. The space between said rails and between the rail supports which depend from said superstructure must be entirely free and open for the passage of the truck and wheels. This would leave the lower ends of the depending rail-supporting members unbraced against lateral thrust and lacking in the requisite rigidity.

To securely brace said truck-carrying members or supports against lateral thrust, while leaving the space between them open for the passage of the wheel trucks is one of the objects of our invention.

Another object is to provide a main transverse truss for such a structure together with certain ties, braces and connections to the track-supporting longitudinal trusses.

A further object is to provide a system of horizontal trussing for said longitudinally extending trusses.

In the drawings, Figure 1, is a face view of one of the main transverse trusses, the longitudinal trusses and tracks being shown in section. Fig. 2, is a face view of one of the longitudinal trusses, the transverse trusses being shown in section taken on line *x*—*x* of Fig. 1. Fig. 3, is a top plan view of the elevated structure showing the horizontal system of trussing between the longitudinal vertical trusses. Fig. 4, is a horizontal section on the line *z*—*z* of Fig. 2.

Like reference characters throughout the several views designate like parts.

In general, our elevated structure comprises a plurality of longitudinal trusses intersected by main transverse trusses supported on columns, and also intersected by intermediate transverse truss elements supported on the longitudinal trusses. It is of course understood that there may be as many longitudinal trusses as there are rails to be supported:—thus, in a one track system there would be two continuous longitudinal trusses, while in the systems shown in the drawings for supporting two tracks, there will be four of the longitudinal trusses.

The main transverse trusses are supported at each end upon columns A, which may be in general of any ordinary construction, but are preferably square in section and formed of riveted plates. Each of the main trusses B, supported on the columns, consists of an upper chord composed of two opposed angle irons 2, held together by a gusset plate 2′, riveted thereto. The ends of the upper chord are downwardly bent from the points $2^{\times}$, to the extremities of the truss. The lower chord is composed of two opposed angle irons 3. The downwardly extending flanges of both the upper and lower chords are riveted to gusset plates 4, 4′, 5, 5′, to which in turn are riveted the transversely projecting flanges of vertical angle irons 6, which connect the upper chord with the lower chord and form the vertical elements of the trusses. Diagonal crossed struts 7, 7′, extend from the junctions of the vertical elements to the diagonally opposite junctions of the verticals with the chord irons. The struts 7′, are formed in two parts to allow the strut 7, to pass, and the middle of strut 7 and the ends of struts 7′, are riveted to a connecting plate 7″.

It will be seen from the drawing that the transverse truss is divided by the vertical beams 6, into panels, each panel, except the two end panels, being cross trussed. The two end panels are provided with outwardly and upwardly inclined struts composed of two joined angle irons $7^{\times}$. The extreme vertical member is formed of two angle irons 6′, instead of four, the flanges of which are riveted to the inside face of column A. The lower flanges of angle irons 3, forming the lower chord are riveted to a gusset plate 8,

extending the whole length of the lower chord, and to a shorter gusset plate A′, extended beneath the three middle panels. At its extremities the lower chord is supported upon angle iron brackets 9, riveted to the inner faces of columns A.

It will be noted from Fig. 1, that the panels at the extremities of the transverse truss B, are narrower than the middle panels and that the upper chord beams of the trusses extend beyond the end verticals 6′, a distance equal to the width of column A. This is to afford a support for the transverse truss on top of said column. This support is secured by providing on each end of the truss, the downwardly extending opposed angle irons 10, which rest upon angle iron seats 11, riveted to a cap plate 10′, which is supported at its ends upon the angle bracket 11′. The ends of supports 10, are also riveted to an angle plate 10″. A shear plate is interposed between the upper chord beams 2, the vertical angle irons 10, the adjacent flanges of the vertical angle irons 6′, and the adjacent flanges of the strut 7×, and is riveted to these members. The lower edge of this plate rests upon the cap plate 10′, and is held thereon by the angle irons 11. The junctions of the lower chord beams 8, with the end vertical 6′, are also strengthened by plates 8″.

It will be seen that the elements we have described above constitutes a truss, transverse to the line of track, supported at its end upon columns, said truss supporting a series of longitudinal trusses which extend parallel with and directly support the rails of the track. It will be noted that in detail the truss is composed entirely of angle irons, and gusset plates at the juncture of the angle irons.

Referring to Fig. 2, C designates the longitudinal truss as a whole. In detail this truss is composed of the upper chord 12, formed of the two opposed and riveted angle irons, the lower chord 13, formed of opposed and riveted angle irons, the vertical elements 14, each formed of two opposed angle irons, and the diagonal struts 15, also formed of opposed angle irons, and each extending downward from the upper end of the vertical elements 14, to the lower chord at a point midway between each two vertical elements. The vertical elements are connected to the upper and lower chords by gusset plates 15′, to which the flanges of the angle irons forming these elements are riveted. It is to be understood that the vertical irons 14, form part of a transverse truss system different from the transverse truss system heretofore described, these intermediate trusses being described and claimed in an application filed coincident herewith Serial No. 440,811. 16 designates the upper chord of one of these intermediate trusses, the lower chord of which is shown in dotted lines at 16×. This chord 16× is on a level with the lower chord 3, of the truss B.

As shown in Fig. 3, the angle irons forming the upper chord 12, are riveted to a cover plate 12′. The lower chord 13, of the longitudinal truss supports the third-rail L′, from which power is taken to the car.

The details of the track rail and third-rail support are shown in our pending applications Serial Nos. 440,807 and 440,808 and hence will not be described here.

It will be noted that the longitudinal trusses C, are on a lower level than the main transverse truss B, and it is in the means of connecting these intersecting and differently elevated trusses that one of the features of our invention consists.

As will be seen from Fig. 1, between each of the longitudinally extending flanges of the vertical angle irons 6, and the truss B, is located pair of shear plates 20, 20. The upper side edges of these plates are inclined downwardly and outwardly and are strengthened by the opposed angle irons 21. The angle irons 21, extend down to the upper face of the upper chord 12 of the longitudinal truss and bears upon the same. Each of the plates 20, is riveted to the vertical angle irons 6, of the truss B, to the upper longitudinal chord 12, and to the upper ends of the adjacent struts 15, hence they are supported very strongly upon the upper truss. This rigid support and attachment is required because it is from these plates 20, that the lower longitudinal chords 13, are hung. This support is accomplished by means of vertical suspending angle irons 22. There are two pair of these angle irons, one pair located on each side of the vertical members 6, 6, of the main transverse truss, each pair of suspending angle irons 22, having opposed riveted flanges 22′. As above noted there are two suspending angle irons 22 for each track, one iron for each rail L, and the flanges 22′, project away from the rail carried thereon as shown in Fig. 1. At their lower ends the suspending angle irons 22, are riveted to plates 23, one for each pair of suspending irons. These plates in turn are riveted to the lower chord 13, of the longitudinal truss C.

It will be seen that so far as described, the lower ends of the suspending elements 22, would not be braced against lateral thrust, such lateral thrust as would be caused by the passing of a train. Inasmuch as such unbraced suspending elements would be bound to vibrate laterally to some extent and to yield under the pressure of a train, we provide lateral braces and truss girders D, D, D′. The girders D, are located between the lower ends of the outer suspending members and the columns A. The girder D′, is located between the two inner suspending members, each of these girders is alike and

consists of the upper and lower angle irons 24, 25, and the cross struts 26, all riveted together, thus forming a compound I-beam as shown in section in Fig. 2. It is to be understood of course that we may use the lateral braces at any point along the length of the longitudinal truss, and not merely at the suspending members.

The ends of the beams are attached to the flanges 22′, of the suspending members 22, in any suitable manner. The other ends of the girders D, being supported and attached to the columns A, by brackets *d*, of any suitable or desired construction. The two midmost suspension elements 22, are also connected against lateral thrust by the crossed braces 30, which extend upward to the lower chord 3, of the truss B, and are riveted at their middles upon the gusset plate 31.

It will be seen from the construction above described that we have provided for the lateral thrust upon the lower ends of the suspending elements 22, and have counteracted such thrust by the compound girders D, and that by the construction of the truss B, we have provided for counteracting and taking care of all strains incident to an overhead railway system of the character described. Particularly we have provided a main transverse supporting truss which is supported upon the top of columns A, and which is not in shear.

In addition to the longitudinal truss and the transverse trusses heretofore described and referred to, we also provide a very simple horizontal trussing which consists in extending angle irons diagonally from one of the flanges of the upper chord 12, across to the corresponding flange of the next adjacent chord of the longitudinal truss, thus tying the longitudinal upper chords together by means of the diagonal truss rods 32. The junction of the angle irons 32 with the upper chord irons is further strengthened by gusset plates 33.

In Fig. 3, is shown a top view of the structure, the angle irons 21 being removed in order to show more clearly the engagement of the horizontal truss irons 32, with the angle irons 12. 12′ designates a cap plate which is riveted to the upper flange 23 of the angle irons 12.

Of the elevated system as a whole it may be said that it is designed to carry the suspended car E shown in Fig. 1, having wheels F, contact shoes G, taking power from the third-rail, and safety arms H, engaging with guard irons L″, and preventing the car from lifting off the track.

In considering the system devised by us it must be at all times kept in mind that the longitudinal trusses below the point $16^{\times}$ (see Fig. 2) and the lower chord 3, of the truss B, are disconnected from each other and that the space between the two parallel longitudinal trusses and below the transverse trusses must be entirely free from and unoccupied by ties or braces for the passage of the car trucks and wheels. It is from this peculiar condition that the necessity of this peculiar construction of longitudinal and transverse trusses has arisen.

It is also to be noted that the vertical suspending elements 22, of the lower longitudinal trusses are in line with and connected to the vertical elements 6, of the upper transverse trusses, and hence that all the elements of the lower and upper trusses coact with each other to support the car and mutually act to resist either vertical or lateral strain. In this connection it will be seen that the vertical members of the upper or transverse trusses are also braced and tied to each other, so as to distribute the strain properly over the entire compound beam, and that the longitudinal trusses are braced laterally against the thrust of passing trains as well by the diagonal bars 32, as by the outwardly extending bracing girders D.

While we have shown what we believe to be the best constructional details of our elevated system we do not wish to be limited thereto, as the details may be of course varied, if not with as good results, at any rate with results adequate to possible conditions.

Our construction provides an entirely rigid structure for a type of railway in which many novel engineering difficulties are to be overcome. The means by which the track and third rails are supported, attached, and insulated form subjects of other pending applications Serial Nos. 440,808 and 440,809.

Having thus described our invention what we claim as new and desire to secure by Letters Patent is:

1. In an elevated structure of the class described, parallel longitudinal trusses each supporting a track rail on one side thereof; and main transverse trusses said transverse trusses intersecting and supporting said longitudinal trusses at a point above the neutral axis of each longitudinal truss and columns upon which the ends of the main transverse trusses immediately bear and are supported.

2. In an elevated structure of the class described, parallel longitudinal trusses each supporting a track rail on one side thereof; and main transverse trusses each supported at its ends upon columns; the upper chord of said longitudinal truss intersecting said transverse truss at a point midway between the upper and lower chords of the transverse truss, and the lower chord of the longitudinal truss being below the lower chord of the transverse truss; said longitudinal trusses being supported upon said transverse trusses.

3. In an elevated railway structure of the

character described, parallel longitudinal trusses each consisting of upper and lower chord members, vertical beams and diagonal tie-bars connecting the upper and lower chords; said longitudinal trusses each supporting a track rail on the one side thereof; and main transverse trusses each supported at its ends upon columns, each of said transverse trusses composed of upper and lower chord members, vertical beams, and diagonal tie-bars between each two vertical beams, connecting the upper and lower chords together; said transverse trusses intersecting and supporting each of the longitudinal trusses at a point above the neutral axis thereof; the lower chord of the longitudinal trusses being braced against lateral thrust.

4. In an elevated railway structure, parallel longitudinal trusses each consisting of an upper chord member and a lower chord member, vertical beams connecting the two, and diagonal bars between each two of the vertical beams connecting the upper and lower chord members; each of said longitudinal trusses supporting a track rail on the side thereof; and main transverse trusses intersecting and supporting the longitudinal trusses at a higher level than the latter and each supported at its ends upon columns; each of said transverse trusses composed of an upper chord, a lower chord, vertical beams connecting the two, and diagonal braces between the upper and lower chords; said main transverse trusses having supporting plates riveted thereto, the longitudinal trusses being provided with vertical suspending beams riveted to said plates and depending below the lower chord of the transverse truss and attached at its lower ends to the lower chord of the longitudinal truss.

5. In an elevated railway structure, main transverse compound trusses; parallel longitudinal compound trusses each supporting a rail of the track, intersecting the transverse trusses on a lower level and supported therefrom; and columns upon which the ends of the transverse trusses immediately bear and are supported.

6. In an elevated railway structure of the character described, main transverse compound trusses, parallel longitudinal compound trusses, and vertical suspending bars supported at their upper ends from said transverse trusses and connected at their lower ends to said longitudinal trusses; and columns upon which the ends of the main transverse trusses immediately bear and are supported.

7. In an elevated structure, main transverse compound trusses; parallel longitudinal compound trusses intersecting the transverse trusses on a lower level, the upper chord of each of said longitudinal trusses being supported on said transverse trusses; and suspending members supported at their upper ends from said transverse trusses, said suspending members being attached at their lower ends to the lower chords of the longitudinal trusses and columns upon which the ends of the main transverse trusses immediately bear and are supported.

8. In an elevated railway structure of the character described, main column-supported transverse compound trusses having a series of vertical members connecting the upper and lower chords thereof, plates riveted to said vertical members and projecting on both sides thereof, longitudinal trusses intersecting said transverse trusses below the level of the latter, said longitudinal trusses having vertical suspension bars connected at their lower ends to the lower chords of the longitudinal trusses, said bars being riveted at their upper ends to said supporting plate.

9. In an elevated railway structure of the class described, main column-supported transverse compound trusses having a series of vertical members connecting the upper and lower chords thereof; plates riveted to said vertical members and projecting on both sides thereof; and longitudinal trusses intersecting said transverse trusses below the level of the latter, said longitudinal trusses having vertical suspension bars riveted at their upper ends to said plate on either side of the vertical elements of the transverse truss, the lower ends of said suspension bars being connected to the lower chords of the longitudinal trusses.

10. In an elevated railway structure of the class described, main column-supported transverse compound trusses having a series of pairs of vertical angle bars connecting the upper and lower chords thereof; plates transverse to the axis of said truss located between the adjacent flanges of each pair of vertical angle irons and projecting on both sides thereof and riveted thereto; and longitudinal trusses intersecting said transverse trusses below the level of the latter; said longitudinal trusses having two pairs of vertical, suspension angle bars, a pair of said angle bars being located on opposite sides of the said transverse trusses, the upper ends of said angle bars being riveted to the supporting plates of the transverse truss, and the lower ends connected to the lower chords of the longitudinal trusses.

11. In an elevated railway structure of the class described, transverse compound trusses supported at their ends upon columns, each transverse truss having a series of pairs of vertical angle irons riveted to each other and to the upper and lower chords of the truss; and longitudinal trusses intersecting said transverse trusses below the level of the latter, said longitudinal trusses having vertical suspension bars connected at their lower ends to the lower chord of each truss, the upper ends of said bars being connected to the trans-

verse trusses in line with the vertical angle irons of said transverse trusses.

12. In an elevated railway structure of the class described, transverse compound trusses supported at their ends upon columns, each transverse truss having a series of pairs of vertical angle irons riveted to each other and to the upper and lower chords of the truss; crossed bracing irons between the pairs of vertical angle irons; and longitudinal trusses intersecting said transverse trusses below the level of the latter, said longitudinal trusses having vertical suspension bars connected at their lower ends to the lower chords of the trusses, the upper ends of said bars being connected to the transverse trusses in line with the vertical angle irons of said transverse trusses; the lower chords of the two outer of said longitudinal trusses being braced laterally against said columns, and the lower chords of the two inner of said longitudinal trusses being braced laterally against each other.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

DANIEL M. PFAUTZ.
JOHN LEWIS LUCKENBACH.

Witnesses:
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