Sept. 17, 1935. G. D. FISH 2,014,430

OVERHEAD RAILWAY FOR SUSPENDED CARS

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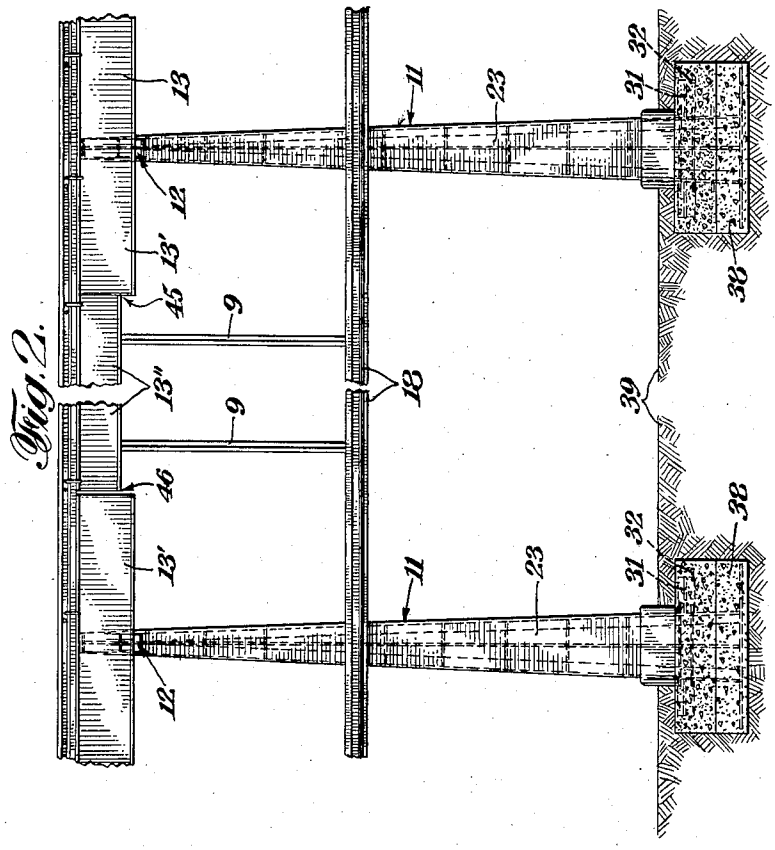


Fig. 2.

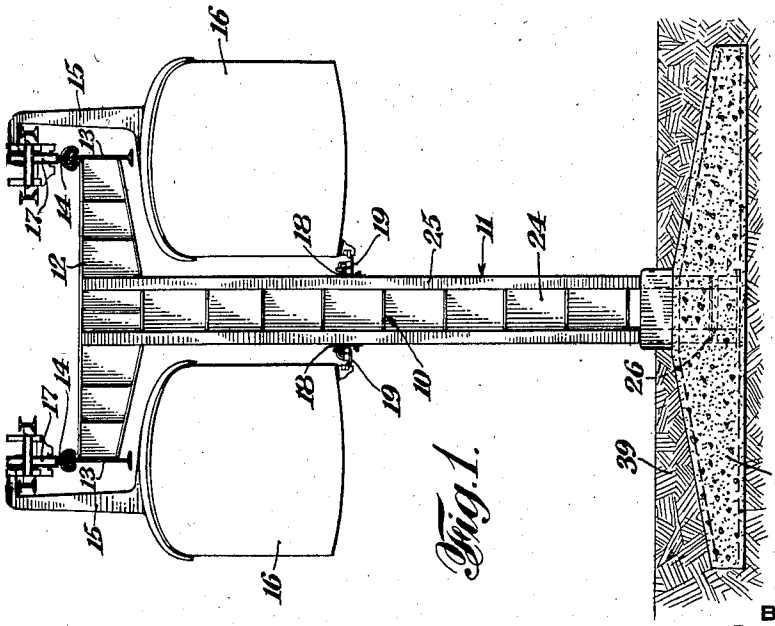


Fig. 1.

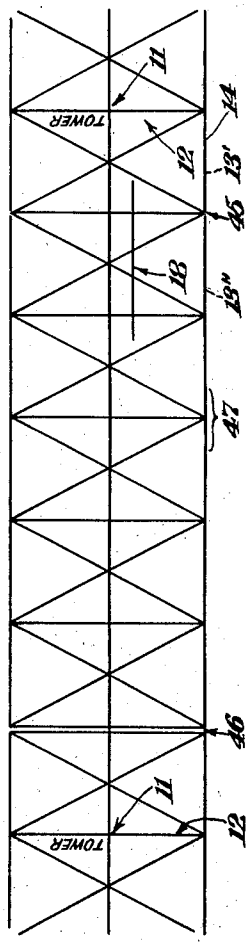


Fig. 3.

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Fig. 4.

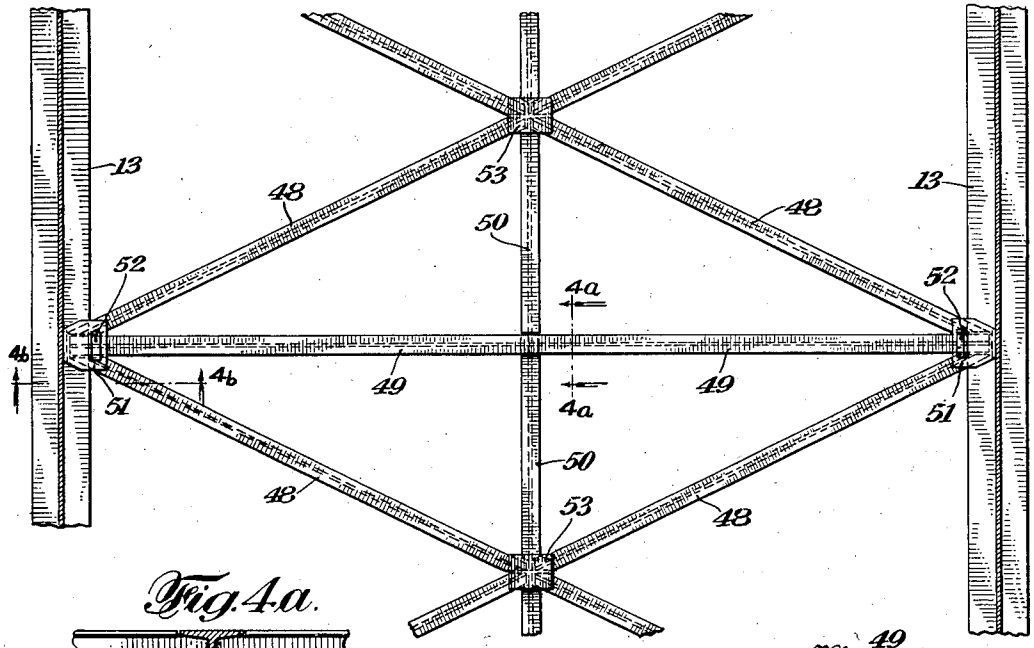
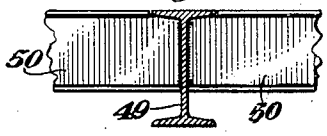


Fig. 4a.



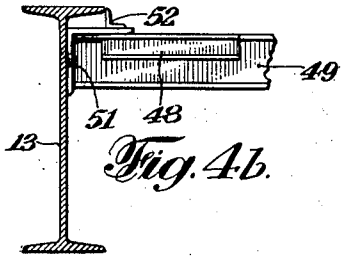


Fig. 4b.

Fig. 5.

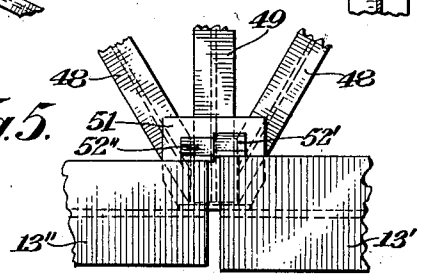


Fig. 4c.

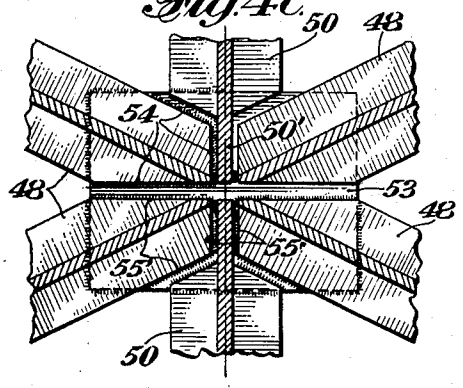
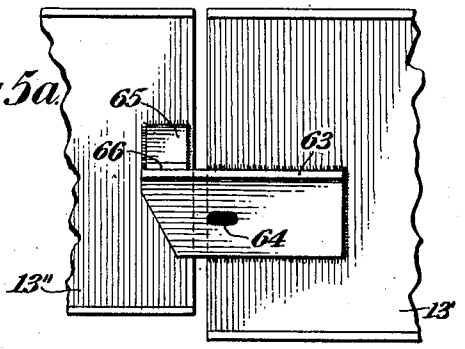


Fig. 5a.



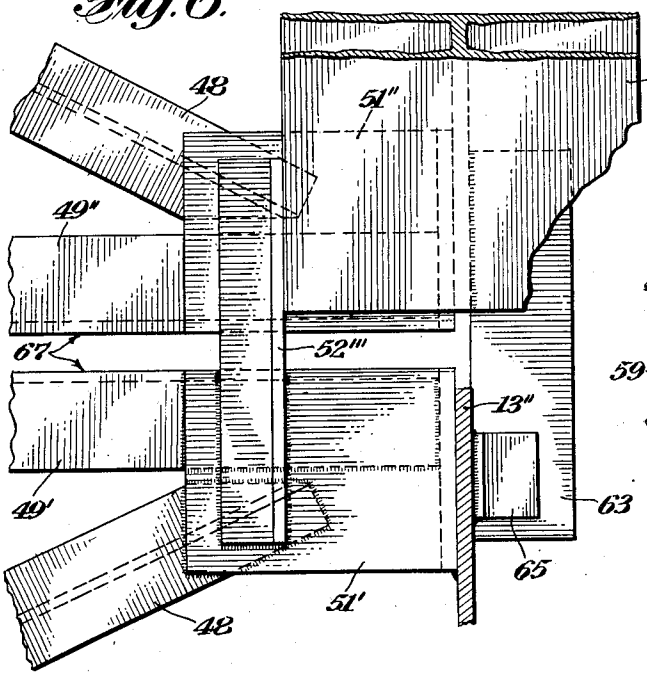
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Fig. 6.



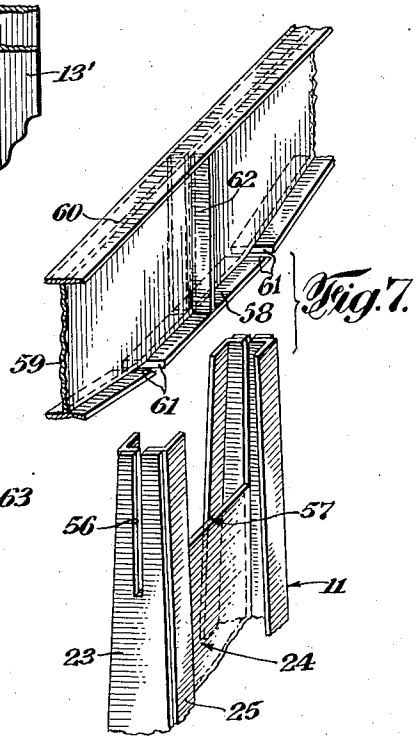


Fig. 7.

Fig. 8.

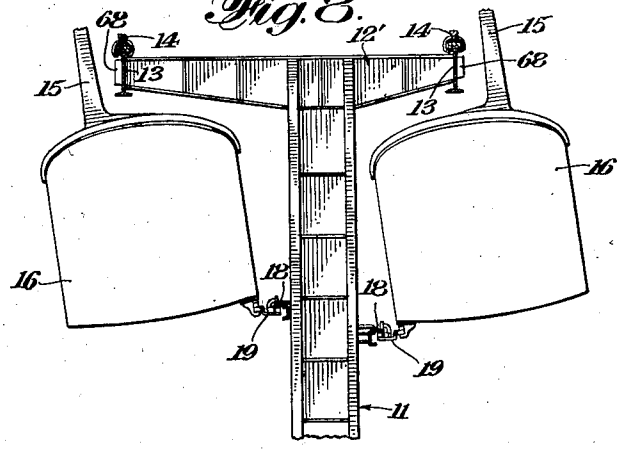


Fig. 10.

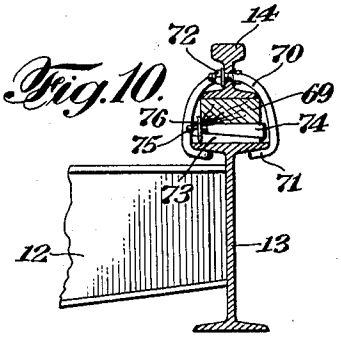


Fig. 9.

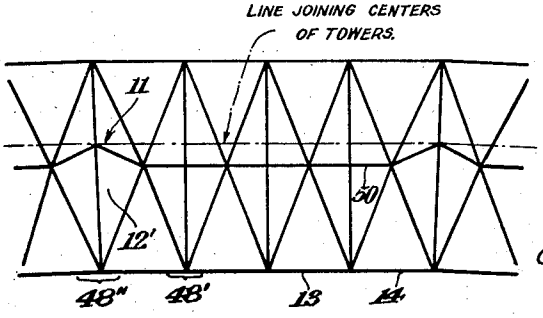
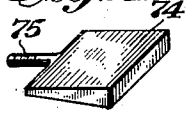


Fig. 11.



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2,014,430

OVERHEAD RAILWAY FOR SUSPENDED CARS

Gilbert D. Fish, Pelham, N. Y., assignor to Frank S. Lyon, Minneapolis, Minn.

Application February 17, 1931, Serial No. 516,461

8 Claims. (Cl. 104—125)

Among the objects of my invention are to provide a monorail supporting structure for suspended cars and to provide for the fabrication of certain parts of this structure in the shop and their practicable and convenient assembly in the field. Other objects have relation to strengthening the structure with respect to lateral stresses, assembling the component towers and tower arms, providing an advantageous disposition of cantilever and suspension spans, expansion joints, and the attachment of the rail with means for its alignment. All these objects and other objects and advantages of my invention will become apparent on consideration of a specific example of practice of the invention which will be disclosed in the following specification. It will be understood that this disclosure relates principally to this particular example of the invention and that its scope will be indicated in the appended claims.

Referring to the drawings: Figure 1 is a transverse section showing one of the towers of my improved railway supporting structure; Figure 2 is an elevation looking at a right angle to the direction of the view in Figure 1; Figure 3 is a diagrammatic top plan view; Figure 4 is an enlarged detail top plan view of a diamond bracing frame; Figures 4*a* and 4*b* are detail sections taken as indicated in Figure 4; Figure 4*c* is a horizontal section looking up and showing the structure where these diamond frames are joined together; Figure 7 is a perspective drawing showing the assembly of the tower and tower arm; Figure 5 is a detail plan view at a splice; Figure 5*a* is a detail elevation at a splice; Figure 6 is a horizontal section at an expansion joint; Figure 8 is a transverse section on a curve, corresponding otherwise to Figure 1; Figure 9 is a diagrammatic top plan view on a curve; Figure 10 is a detail section showing the rail supporting girder and the rail thereon; and Figure 11 is a perspective view of an adjusting wedge utilized in aligning the track.

A row of towers 11, each supporting a tower arm 12, carries the longitudinal girders 13, on which rest the track rails 14. Under each girder hangs a car 16, supported on the track rail 14 by the goosenecks 15 and truck wheels 17. Slightly below the bottom of the car 16 an arm 19 projects with rollers engaging a guide rail 18, supported on the sides of the towers 11 and by the intermediate hanger rods 9. Each tower comprises a transverse web plate 24 to which are welded two side plates 23 having angles 25 welded along their edges; also transverse horizontal bracing plates 10 are provided as shown in Figure 1 and elsewhere in the drawings.

The tower arms 12 are made up in the shop, ready to be united with the top ends of the towers as shown in Figure 7. Each tower arm consists of a vertical transverse web plate 59 with a lower flange plate 58 and an upper flange plate 60, all welded together and with vertical bracing plates 62 also welded to all these members. In the lower flange plate 58, two transverse slots 61 are made at the shop. The upper end of the tower 11 is fabricated in the shop, to have the form shown in the lower part of Figure 7. The web of the tower 11 is cut short of the top at 57 by an amount equal to the depth of the tower arm and the two plates 23 are slotted vertically at 56 above the level of the end 57. Thus it will be seen that the tower arm drops definitely into place, the edges of the plate and angles 25 adjacent to the slot 56 projecting up through the slots 61, and the flange plate 58 resting solidly on the top edge 57 of the tower web plate 24. After the parts are assembled in this way, they are welded along the meeting edges and faces.

A system of bracing is employed between the girders 13, as shown generally in Figure 3, and more in detail in Figure 4. The girders are alternately disposed as cantilevers 13′ and suspension members 13″, as shown in Figure 2. It will be seen that the suspension members 13″ are shorter and of lighter cross section. If the towers are uniformly spaced at intervals a and the length of the projecting end of each cantilever member is b, then the total length of each cantilever member is $a+2b$ and the total length of each suspension member is $a-2b$. At one end of each suspension member 13″ there is a splice joint 45, connecting it to the projecting end of the cantilever member 13′. At the other end of each suspension member 13″ there is a supporting expansion joint 46.

The girders 13 have diamond frame braces between them, indicated generally by the reference numeral 47 in Figure 3, which shows their arrangement and inter-connecting points. Each diamond frame consists, as shown in Figure 4, of four side T-bars 48, a long transverse diagonal I-beam 49, and two smaller longitudinal I-beams 50 in alignment, forming the other diagonal with their ends butting against the bar 49 and welded thereto, as shown in Figure 4*a*.

The ends of the side T-bars 48 are beveled off and brought adjacent to the corresponding end of the cross I-beam 49. Then the short angle

51 (see Figure 4b) is laid over these ends and welded thereto. This is the way the corners of the diamond frames at the ends of the longer diagonals are assembled at the shop. At the other corners the assembly is made as shown in the horizontal section of Figure 4c, which is taken looking up. Here the two adjacent ends of the side T-bars 48 are beveled and brought to butt against the web 50' of the corresponding diagonal beam 50. A rectangular plate 53 is overlaid and these three bars are all welded thereto at 54, but leaving half the plate projecting free to facilitate assembly in the field. At the remaining corner of the diamond frame the ends of the two side T-bars 48 and the one diagonal I-beam 50 are brought together in the same way and welded together at 55, but without welding to the plate 53. Thus when the diamond frames 47 leave the shop, each carries two angles 51, but only one flat plate 53, to which the adjacent members are welded as indicated at 54.

In the field, the diamond frames 47 are placed consecutively between the assembled girders 13 and to these the angles 51 are welded. Then the short angles 52 are placed on the respective angles 51 and against the upper flange of the girder 13, as shown in Figure 4b, and welded to both members.

The diamond frames are placed consecutively so that the plate 53 carried by each one overlaps the joined members 48 and 50 of the next consecutive frame, and to these the plate 53 is then welded in the field as indicated at 55' in Figure 4c. At each tower there is a modified diamond frame built up in the field with the tower crossarm serving as its transverse diagonal member.

At the point 45 in Figure 3, I have indicated a splice at one end of the suspension span, where it is supported by the projecting end of the cantilever span. The modification at this point is shown in Figures 5 and 5a. The diamond frame at this point is the same as elsewhere, but the single angle 52 shown in Figures 4 and 4b is replaced by two angles 52' and 52'' shown in Figure 5. These are adapted to the different cross sections of the girder members 13' and 13''. Also, at the splice 45 the angle 63 is welded to the end of the cantilever girder 13' and its end projects under the angle 65 welded to the corresponding end of the suspension girder 13''. After assembly, as shown in Figure 5a, the two angles 63 and 65 are welded together at 66. To increase the strength of the connection between the girder end 13' and the angle 63, the latter is slotted at 64 and a weld is made in this slot. Thus it will be seen that through the angle 65 and the projecting angle 63, the end of the suspension member 13'' is supported on the end of the cantilever member 13'.

At the other end of the suspension member 13'', that is at 46 as seen in Figure 3, an expansion joint is provided. For this purpose the diamond frame at this place is replaced by two half diamond frames, a detail of this expansion joint being shown in Figure 6. Instead of a single angle 51, as in Figures 4 and 4b, there are two angles 51' and 51'', one for each half diamond frame, as shown in Figure 6. The angle 52''' is welded to the angle 51' on the end of the suspension member and projects over the angle 51'' welded to the end of the cantilever member but has a sliding connection therewith. The clearance for this expansion joint is shown at 67, and the angle 52''' can slide on the supporting angle 51'' for expansion and contraction.

On curves, the tower arms are offset as seen in Figure 8, compared with Figure 1; here the tower arm is indicated as 12'. On curves the towers are relatively close together and the girders 13 are cut to extend only between the consecutive ends of the tower arms, which project slightly between the adjacent ends of the girders as shown at 68 in Figure 8. The guide rails 18 are positioned in relation to the track rails 14 so that the cars 16 shall have the proper inclination for a practical intermediate speed of the cars around the curves. That is, if the car goes around a curve at the intermediate speed for which the structure is designed, then the lateral thrust between the guide 18 and the engaging arm 19 will be substantially zero. If the car goes more slowly, or stands still, this thrust will be considerable in one direction, and if the car goes faster than the speed mentioned, the thrust will be of considerable magnitude in the opposite direction.

The diamond frames on the curves between towers are substantially the same as shown in Figure 9 compared with Figure 3. The longitudinal diagonal frame members 50 lies somewhat to one side of the center line of the towers. At each tower there are two special half diamond frames, half on each side of the tower crossarm, and having the general design shown at 48'' in Figure 9.

Referring to Figure 10, this shows a cross section of one of the girders 13, supported on the end of the tower arm 12. The wooden sleeper 69 extends longitudinally above the girder 13 and supports the track rail 14, which is bolted in place by the bolts 70 with hooked heads 71 under the edges of the top flange of the girder 13 and with screw threaded ends projecting through holes in the rail 14 and held by nuts 72. By loosening the nuts 72 on one side and tightening them on the other, the rail 14 can be deflected laterally to secure its proper alignment.

At intervals, under the wooden sleeper 69, pairs of opposite wedges 73 and 74 are placed. Each wedge 74 has a screw threaded projection 75 engaged by a washer and a nut at 76. Driving the wedge 74 to the left as seen in Figure 10, the rail 14 can be elevated slightly at this point, the nuts 72 being slacked off enough to accommodate this adjustment, and at the proper adjustment, it can be held by tightening the nut 76. On the other hand, the rail 14 can be lowered at this point by slacking the nut 76 and driving the wedge 74 the other way. It will be seen that the hooked bolts 70 provide for lateral adjustment of the rail 14, and these hooked bolts in conjunction with the wedges 73 and 74 provide for vertical adjustment, so that very perfect alignment of the rail 14 can be secured and this may be accomplished in a convenient manner.

Assuming that the row of towers 11 has been placed, it will readily be seen that the building of the rest of the structure can be done mostly in the shop; that there are a few simple unit combinations than can be made up in the shop and assembled with only a small amount of welding in the field. First, the cross arms 12 are dropped in place on the towers 11 and welded, as seen in Figure 5, then the girders 13 are secured to the ends of the cross arms 12 by fillet welds for straight track, with alternating cantilever and suspension spans, and by the type of joint shown in Figure 8 on curves, where the girders extend simply from cross arm to cross arm. Next, the diamond frames 47 are rapidly fitted in consecutively between the girders, to which they are

welded at the ends of the transverse diagonals, as described heretofore, and each added diamond frame is welded at one junction corner to the corresponding corner of the frame previously placed.

On curves, the construction is slightly different, as shown in Figure 9, and at the expansion joints, such as 46, in Figure 3, the half diamond frames must be employed. On curves the tower arms are offset as at 12' in Figure 8 and the guides 13 are set at different levels so as to put the cars at the proper banking for a chosen intermediate speed. Here the girders all serve as trusses between towers and the diamond frame work is modified, as shown in Figure 9.

When assembled, the sides of consecutive diamond frames are generally in alignment in pairs, and two such aligning sides constitute a diagonal brace between the parallel girders 13. Thus the diamond panels may be made up in the shop, and easily assembled with the girders in the field to give a resultant complete system of diagonal bracing between the girders.

I claim:

1. In combination, a series of towers each having a horizontal H-section, slotted down from the top in the plane of its cross member, a cross arm comprising a vertical web resting in said slot, the adjacent edges and faces of the tower and cross arm being welded together, longitudinal girders supported on the ends of the cross arms, and track rails on said girders.

2. In combination, a series of towers each of rolled steel construction and on each tower a cross arm having a vertical web, said tower being slotted down from the top and said web resting in said slot, the adjacent edges and faces of the tower and cross arm being welded together, longitudinal girders supported on the ends of the cross arms, and track rails on said girders.

3. In combination, a series of towers each of rolled steel construction and on each tower a cross arm having a vertical web, said tower comprising a vertical web member ending below the top of the tower, the part of the tower higher than this being slotted in the plane of said web, the web of said cross arm lying in said slot, the cross arm resting on the top of the web of the tower, and the adjacent edges and faces of the tower and cross arm being welded together, longitudinal girders supported on the ends of the cross arms, and track rails on said girders.

4. In combination, a tower having a horizontal H-section with angle bars reenforcing its edges, said tower being slotted down from the top in the plane of the H cross member and said member being cut off at the level of the bottom of the slot or slots, and a cross arm with a vertical web lying in said slot or slots, the bottom of said cross arm resting on the upper end of the said H cross member and the adjacent edges and faces of the tower and cross arm being welded together.

5. In combination, a row of towers, cross arms at the tops thereof, and a row of longitudinal girders on each side, supported on the ends of the cross arms, the girders being alternately longer and shorter than the spaces between the towers, the longer girders resting on the towers and projecting each way and serving as cantilevers, and the shorter girders serving as suspension members between the projecting ends of the cantilevers.

6. In combination, a row of towers, cross arms at the tops thereof, and a row of longitudinal girders on each side, supported on the ends of the cross arms, the girders being alternately longer and shorter than the spaces between the towers, the longer girders resting on the towers and projecting each way and serving as cantilevers, and the shorter girders serving as suspension members between the projecting ends of the cantilevers, said shorter girders each being definitely supported by a splice connection at one end and by an expansion joint at the other end.

7. In combination, a row of towers, cross arms at the tops thereof, and a row of longitudinal girders on each side, supported on the ends of the cross arms, the girders being alternately longer and shorter than the spaces between the towers, the longer girders being of greater cross section and resting on the towers, and projecting each way, and serving as cantilevers, and the shorter girders being of less cross section and serving as suspension members between the projecting ends of the cantilevers.

8. In combination, a row of towers, cross arms at the tops thereof, a row of longitudinal girders on each side, supported on the ends of the cross arms, these girders being alternately longer and shorter than the spaces between the towers, the longer girders resting on the towers and projecting each way and serving as cantilevers, and the shorter girders serving as expansion members between the projecting ends of the cantilevers, and a series of braced diamond frames between the girders and connected thereto at two opposite vertices of each frame, the remaining vertices being connected between the said frames in sequence.

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