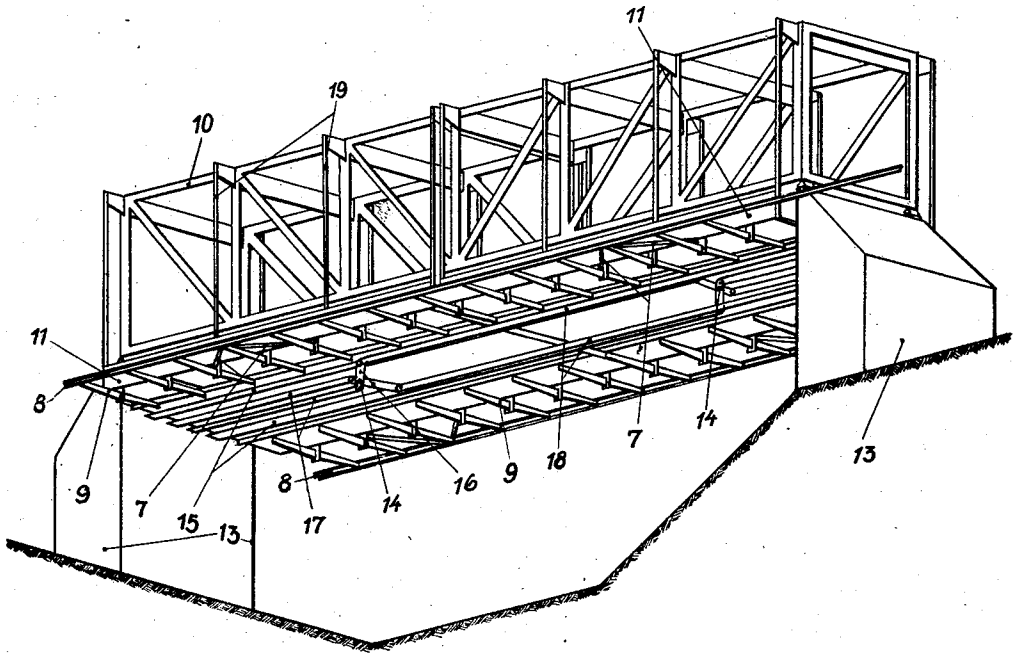
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RAIL SUPPORTING STRUCTURE FOR LONG SPANS FOR HIGH SPEED SUSPENDED VEHICLES

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Fig. 1



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RAIL SUPPORTING STRUCTURE FOR LONG SPANS FOR HIGH SPEED SUSPENDED VEHICLES

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Fig. 2

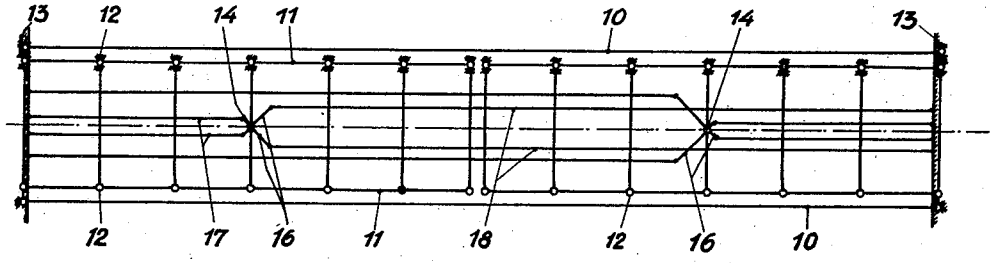


Fig. 3

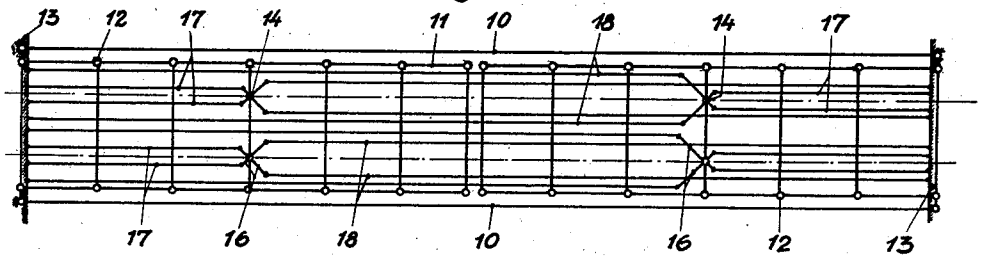


Fig. 4

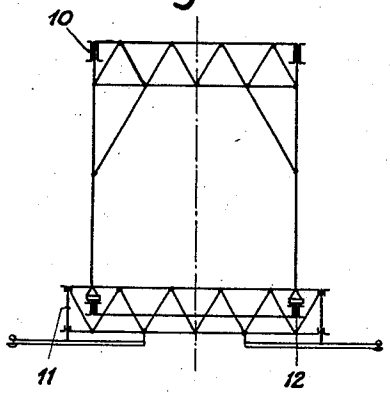


Fig. 5

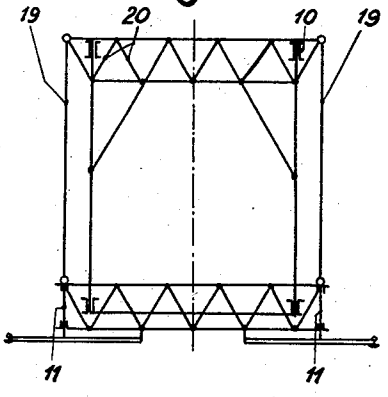
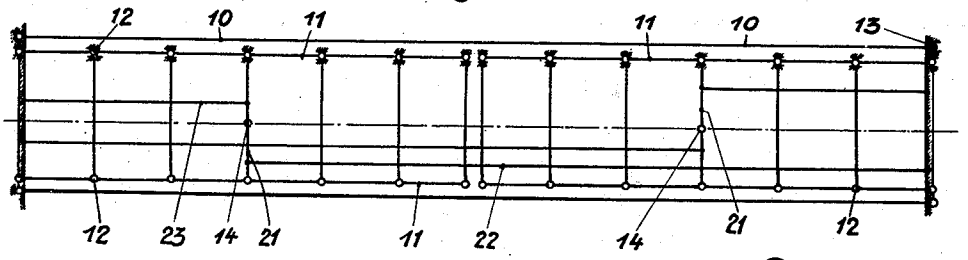


Fig. 6



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UNITED STATES PATENT OFFICE

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RAIL-SUPPORTING STRUCTURE FOR LONG SPANS FOR HIGH-SPEED SUSPENDED VEHICLES

Application filed July 29, 1929, Serial No. 381,956, and in Germany August 25, 1927.

In the U. S. A. Patent No. 1,659,322 a rail supporting structure is described for high speed suspended vehicles, in which the rail itself has a continuous unbroken surface, the joints of the individual rail lengths being butt pressed; they could equally well be welded. To compensate for the differences in length between the rail and supporting structure occurring with temperature changes, the lateral carrying arms for the rail are made hinged or easily bendable in the horizontal plane. Where very long spans form part of the structure, the amount of this lateral swinging or bending of the lateral carrying arms may be so great as to exceed the allowable limit for safe operation with high speed vehicles. It is, however, necessary in many cases for a span to be used which exceeds the amount so limited.

According to the present invention, by using an additional arrangement, rail supporting structures for high speed suspended vehicles can be made with any desired span. The apparatus is such that, with the rail continuous, that is, either welded or butt pressed at the joints, the swinging or bending sidewise of the lateral carrying arms is within permissible limits. This is effected according to the invention by auxiliary carriers being arranged end to end on a main girder extending over the whole span so that, though supported by the main carrier they can expand and contract considerably under temperature changes independently of the main carrier. Each auxiliary carrier is at the same time firmly anchored to the ground. According to the invention this anchoring of the auxiliary carriers is effected by means of scissor-like levers, and links in the form of longitudinally extending members arranged to take both tension and compression stresses. The scissor levers have their lever arms so designed in relation to the lengths of the links that the point of attachment of the scissor lever link to the auxiliary carriers remain stationary in space under all temperature conditions.

An object of the invention is the provision in a suspended railway, of a rail-supporting structure in which the stresses caused by the differences between the expansion and contraction of the supporting structure and the rails, and due to change in temperature or to sudden braking of the trains, are not transmitted to the span members of the main supporting structure, but are transmitted directly to the towers supporting the spans.

Another object of the invention is the provision of a rail-supporting structure for a suspended railway in which the rails are not carried directly by long rigidly secured supporting spans but are carried on short frames which are partially movable.

Several examples of rail supporting structures embodying the invention are shown in the accompanying drawings.

Figure 1 shows such a structure in perspective, Figure 2, is a diagrammatic plan view from below of a fundamentally similar structure with one scissor lever and link arrangement for each auxiliary carrier. Figure 3 shows a similar construction with two scissor lever and link arrangements for each auxiliary carrier. Figures 4 and 5 are cross sections and Figure 6 shows a structure with a different scissor lever and link arrangement, in plan view from below.

In the drawings it has been assumed that the spans to be bridged are of lengths which are at least twice as great as would occasion the maximum allowable swing or bending of the lateral carrying arms in a normal construction of rail support for high speed suspended vehicles.

In the examples shown, two auxiliary carriers 11 are supported on a main frame 10 by means of bearings 12 so that they can move longitudinally but not laterally (Figure 2). The main frame 10 is supported on the pillars 13 by means of a connection permitting a slight longitudinal movement of the frame 10 with respect to the pillar whereby expansion of the frame 10 does not place a strain on the pillar 13. In Figure 1 the bearings are replaced by pendulum suspensions 19 which must naturally be made sufficiently stiff to resist permanent deformations.

On the auxiliary carriers 11, which are here shown arranged beneath the main girder

10 to facilitate reading of the drawings, a track corresponding to that of the patent U. S. A. No. 1,659,322 is arranged, which track consists of spaced lateral rail-carrying arms 9 and a continuously welded rail 8, carried at the outer ends of the arms. The rail is formed of a material having a very low coefficient of thermal expansion whereby the length of the rail is substantially unaffected by changes in temperature. The lateral arms are secured at their inner ends and at their centres to the auxiliary carriers 11 (as may be seen in Figures 4 and 5). A rod construction 7 secures the rail to the centre of the auxiliary carrier 11.

The auxiliary carriers 11 are anchored to the fixed pillars 13 at either end of the main girder by means of scissor levers 16 and links 17, 18, in such a manner that the pivot points 14 of the scissor levers on the auxiliary carrier 11 remain stationary in space, for all conditions of temperature to which the structure may be subjected. The mid point of the auxiliary carrier is chosen as this fixed point whereby the minimum displacement of the ends is secured. Thus, the greatest possible length of auxiliary carrier can be used, having regard to the maximum permissible horizontal bending or swinging of the lateral arms.

To the ends of the scissor levers are pivoted the tension and compression links 17 and 18 which are securely anchored to the pillars 13. The length of the lever arms bear the same ratio to one another as the length of the corresponding links, consequently with the same material the changes in length of the links occuring during temperature changes are compensated by the movements of the scissor arms while the point 14 remains stationary in its position.

Forces (as take place for example during braking or acceleration of a vehicle) which act longitudinally of the auxiliary carrier and are applied through the point 14, do not cause longitudinal movement of the auxiliary carrier. Such longitudinal forces are on the contrary transmitted to the pillars 13 through the links 17 and 18. It is essential for the two pairs of links 17 and 18 to be made resistent to buckling since with some longitudinal loads they are submitted to axial compression. Obviously to fix each auxiliary carrier two or more scissor lever and link arrangements can be provided. This is advantageous particularly when eccentric loads are applied and the additional moment has to be transmitted from the auxiliary carrier to the main structure. The moments thus arising from eccentric longitudinal loads can then easily be compensated for by the provision of several scissor lever and band arrangements. Such an arrangement is shown in Figure 3.

In many cases the auxiliary carrier can be held fixed by two links made resistent to, or supported against, buckling which are secured to the opposite ends of a cross beam arranged in scale-beam fashion. Figure 6 shows such an arrangement. The auxiliary carriers 11 are longitudinally movable on the main carrier 10 by the aid of bearings 12. At the points 14 are pivoted levers 21 to the ends of which are secured links 22 and 23 respectively. The length of the lever arms bear the same ratio to one another as the length of the links secured to them. During temperature changes the links can freely expand and contract; on the occurrence of longitudinal forces, similar force transmission takes place to that described above.

Thus it will be seen that the expansion or contraction of the main frame, due to temperature changes, is not transmitted to the rail and conversely, the expansion (or stretching) or contraction of the rails due to sudden braking is not transmitted to the main frame. The rails are, in effect, "floated" on the main frame by means of the auxiliary frames and are only held against longitudinal displacement by the connection between the auxiliary carriers and the pillars. As the pivot points are always held in the same positions the rail is not subject to any longitudinal displacement due to the effect of changes in temperature on structure members.

The auxiliary carriers can be supported at many points as shown in Figure 2, so that they can be built as lightly as possible. They can be supported, as indicated in Figure 4, by the aid of roller bearings 12, or they may be supported as shown in Figure 5 by means of a pendulum support arrangement. The auxiliary carrier is suspended from the upper cross members 20 of the main girder 10 by means of pendulum members 19 which are made resistent to buckling to cope with negative, i. e. upward loads. The pendulum members can be suspended by means of pin connections or spring members.

The invention is naturally not limited to spans having a length of twice the maximum allowed in prior art structures, but suitable arrangements according to the invention can be provided for a span as long as any which can be built by present day constructional technique.

I claim:

1. In a rail structure, the combination of a main structure, a plurality of auxiliary carriers arranged end to end supported by said main structure and movable longitudinally with respect thereto, and means anchored to the ground for holding one point on each of said auxiliary carriers longitudinally fixed.

2. In a rail supporting structure, the combination of fixed supports, a main girder structure bridging said supports, a plurality of auxiliary carriers arranged end to end supported by said main girder structure and

movable longitudinally with respect thereto, and means anchored to said fixed supports for holding one point on each of said auxiliary carriers longitudinally fixed.

3. In a rail supporting structure, the combination with a main structure of a series of auxiliary carriers arranged end to end supported by said main structure but movable longitudinally with respect thereto, and means anchored to the ground for holding the mid point on each of said auxiliary carriers longitudinally fixed.

4. In a rail supporting structure, the combination of a main supporting structure, a plurality of auxiliary carriers arranged end to end supported by said main structure and movable longitudinally with respect thereto, and means anchored to the ground having a fixed point, said means being attached at said point to each of said auxiliary carriers.

5. In a rail supporting structure, the combination of a main supporting structure, a plurality of auxiliary carriers arranged end to end supported by said main structure and movable longitudinally with respect thereto, a lever pivoted intermediate its ends to each of said auxiliary carriers, and a link secured to each end of each of said levers and anchored to the ground, the links secured to opposite ends of any one of said levers being anchored to the ground on longitudinally opposite sides of said lever and the arms of each lever being in the same ratio as the lengths of the links respectively secured thereto.

6. In a rail supporting structure, the combination of two fixed supports, a main girder structure bridging said supports, a plurality of auxiliary carriers arranged end to end supported by said main girder structure and movable longitudinally with respect thereto, a lever pivoted intermediate its ends to each of said auxiliary carriers and a link secured to each end of each of said levers and secured to one of said fixed supports, the links secured to the opposite ends of any one of said levers being anchored to the said supports at the opposite ends of said main girder structure respectively and the arms of said levers being in the same ratio as the lengths of the links secured respectively thereto.

7. In a rail supporting structure, the combination of a main structure, a plurality of auxiliary carriers arranged end to end supported by said main structure and movable longitudinally with respect thereto, a plurality of levers pivoted intermediate their ends to each of said auxiliary carriers, and a link secured to each end of each of said levers and anchored to the ground, the links secured to the opposite ends of any one of said levers being anchored to the ground on longitudinally opposite sides of said lever and the arms of each lever being in the same ratio as the lengths of the links respectively secured thereto.

8. In a rail supporting structure, the combination of a main structure, a plurality of auxiliary carriers arranged end to end supported by said main structure and movable longitudinally with respect thereto, a plurality of levers pivoted scissor fashion between their ends to each of said auxiliary carriers and a link secured to each end of each of said levers and anchored to the ground, the links secured to the opposite ends of any one of said levers being anchored to the ground on longitudinally opposite sides of said lever, and the arms of each of said levers being in the same ratio as the lengths of the links respectively secured thereto.

9. In a rail supporting structure, the combination of two fixed supports, a main girder structure bridging said supports, a plurality of auxiliary carriers arranged end to end and supported by said main girder structure and movable longitudinally with respect thereto, a plurality of levers pivoted scissor fashion between the ends of each of said auxiliary carriers, and a link secured to each end of each of said levers and anchored to one of said fixed supports, the links secured to the ends of any one of said levers being secured to the said supports at the opposite ends of said main girder structure and the lengths of the arms of each of said levers being in the ratio of the links secured respectively thereto.

10. In a rail supporting structure, the combination of a main structure, a plurality of auxiliary carriers arranged end to end each supported at a series of points by said main structure and movable longitudinally with respect thereto and means anchored to the ground for holding one point on each of said auxiliary carriers longitudinally fixed.

11. In a rail supporting structure, the combination of a main structure, a plurality of auxiliary carriers arranged end to end supported by said main structure so as to be movable longitudinally but not laterally with respect thereto and means anchored to the ground for holding one point on each of said auxiliary carriers longitudinally fixed.

12. In a rail supporting structure, the combination of a main structure, a plurality of carriers arranged end to end each supported at a series of points by said main structure so as to be movable longitudinally but not laterally with respect thereto and means anchored to the ground for holding one point on each of said auxiliary carriers longitudinally fixed.

In testimony whereof I have affixed my signature.

FRITZ HEYNER.