Oct. 4, 1960 A. J. HIRST ET AL 2,954,747

RAILWAY VEHICLES

Filed July 24, 1958 2 Sheets-Sheet 1

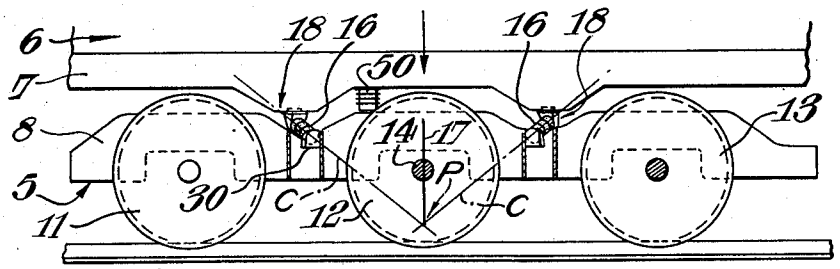


Fig. 1.

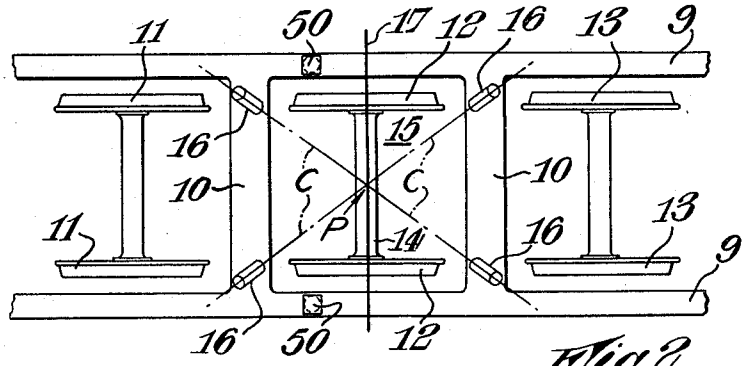


Fig. 2.

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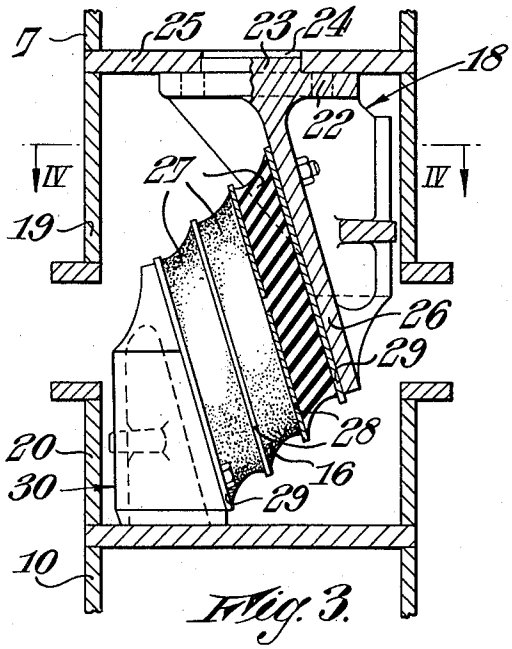


Fig. 3.

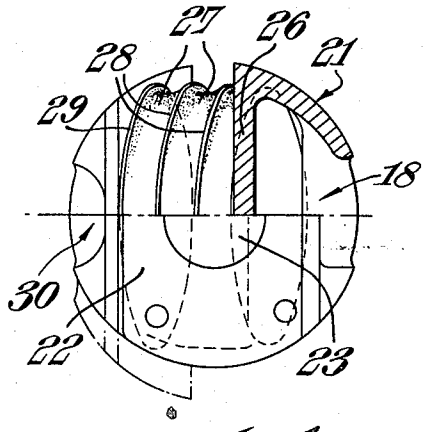


Fig. 4.

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RAILWAY VEHICLES

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6 Claims. (Cl. 105—196)

This invention concerns railway vehicles comprising a bogie and relates especially to bogies having an uneven number of pairs of wheels (i.e. a bogie having a central pair of wheels such as a six-wheeled bogie) wherein the space between the pair of central wheels is occupied e.g. by an axle and/or an electric traction motor. With such an arrangement it has been customary hitherto to connect the underframe of the vehicle to the bogie by a pivot pin disposed over the central axle and above the bogie frame because the space between the wheels is not available. The traction point is therefore high which is considered undesirable. By the traction point is meant the point of application of the resultant longitudinal force acting between the bogie and the body of the railway vehicle.

It is the object of this invention to provide a railway vehicle comprising a bogie with a low effective traction point which will offer small resistance to relative horizontal rotation between the bogie frame and the underframe of the vehicle as occurs when negotiating a curve, the suspension however, providing sufficient transverse flexibility.

Another object of the invention is to provide such a suspension which dispenses with the conventional bolster thereby saving in weight.

A practical application of the present invention will now be described, by way of example only, with reference to the drawings of the accompanying specification whereof:

Fig. 1 is a diagrammatic side view of a railway vehicle according to the present invention,

Fig. 2 is a diagrammatic plan view of the vehicle of Fig. 1,

Fig. 3 is a side elevation, partly in section, of a detail of construction of the vehicle of Fig. 1, and

Fig. 4 is a plan view of Fig. 3 and partly in section on the line IV—IV of Fig. 3.

Referring to the drawings: the railway vehicle comprises a bogie **5** and a body **6**. The body **6** is provided, in any known or convenient manner, with an underframe **7**. The bogie **5** comprises a frame **8** having side members or solebars **9** and transoms **10** (see Fig. 2) the bogie frame **8** being mounted on three pairs of wheels **11**, **12** and **13**. At least the axle **14** of the central pair of wheels **12** is driven by an electric motor in any convenient manner, the motor being supported between the transoms **10** within the space **15** between the pair of wheels **12**.

The conventional arrangement of connecting the underframe **7** to the bogie frame **8** utilising a pivot pin which depends from the underframe **7** and passes into a socket carried by the bogie frame **8** can only be adopted when space **15** is occupied if the pivot-socket assembly is placed high up so as to clear the electric motor and the axle in the space **15**. Such a high traction point is, for known reasons, considered undesirable.

According to the present invention the underframe **7** is supported on the bogie frame **8** by two pairs of rubber springs **16** arranged one each on opposite sides of a

vertical plane **17** through the axis of rotation of the axle **14**. That is, as shown in Fig. 2, a pair of springs **16** lie in front of the planes **17** and another pair lie behind the plane. The springs **16** of each pair are near to the solebar **9** of the bogie frame.

The upper ends of the springs **16** abut a wedge member, diagrammatically indicated in Fig. 1 at **18**, as will later be described and similarly the lower ends of the springs **16** engage a wedge member carried by the bogie frame **8** also as later described.

The springs **16** act under vertical loading in combined shear and compression, the compression axes of the springs **16** being directed downwardly and inwardly to intersect at P which is in the pertical plane **17**. The intersection may be at rail level but in practice is above rail level and below the axle **14**.

In Figs. 1 and 2 the compression axes of the springs **16** are indicated at C and the point of intersection, or focal point, P.

With an arrangement of springs as described the effective traction point through which traction and braking forces will act is very near to the point P. The result is therefore that although the under-frame **7** is supported on the bogie frame **8** by springs **16** which are at least in part above the top of the bogie frame nevertheless a low traction point is obtained, the latter being close to the point P the position of which is determined by the disposition of springs **16**.

The traction point, by suitably disposing the springs **16**, may be selected to be at any suitable and required position e.g. between the level of the rails and the centre of gravity or at either of these positions.

The springs **16** in part support the vertical load of the body **6**, the underframe **7** being also supported upon the bogie frame **8** through the agency of a pair of rubber side bearers **50**, one for each solebar **9**. The side bearers **50** are connected to the underframe **7** and the bogie frame **8** and have considerable vertical stiffness. The bearers **50** act in shear for horizontal loads both transversely and longitudinally.

The load on the side bearers **50** is so selected that under all traction and braking forces encountered in use the side bearers remain in compressive loading. Similarly, under all normal operating conditions the springs **16** are in compression i.e. are not subjected to tension.

The side bearers **50** have little transverse flexibility but the springs **16** may have a relatively great transverse stiffness. The latter may be reduced by providing that the side bearers have a negative transverse flexibility (by increasing the compressive load thereon to a required amount) thereby reducing the stiffness of the springs **16**.

The side bearers **50** may be in the plane **17** i.e. in the plane of the traction point P but this is not necessary and, as shown in Fig. 2, the bearers **50** are to one side of the plane **17**. The extent to which they are offset from the plane **17** is selected to compensate for unequal load distribution of the body **6** on the bogie.

An important advantage of providing the side bearers **50** is that the roll centre is relatively high. If the side bearers **50** are dispensed with the roll centre would then coincide substantially with the point P. The side bearers raise the roll centre above the point P and by suitable design of the bearers this is done, to a required extent.

The bearers **50** may have their compression axes slightly inclined inwardly so that with relative transverse movements of the underframe and bogie frame they act slightly in compression but mainly in shear.

The suspension described dispenses with the conventional bolster so that the weight of the vehicle is correspondingly reduced. The transoms **10** are customarily provided between the axles and if they are of cast or

welded box construction the weight thereof is relatively small and the space they occupy is not great.

Among the advantages of the arrangement described, additional to those referred to above, is that when the bogie runs over a vertical curve there is no loss, or substantially no loss, of adhesion between the wheels and the track. Again, as compared with conventional connections comprising a pivot-socket assembly the resistance to rotation of the bogie relatively to the body about a vertical axis passing through the point P (resulting, for example, from negotiating a horizontal curve) is relatively small being due to the shear resistance of the springs **16** and the shear resistance of the side bearers **50**. Moreover, because the bolster is eliminated the weight and complexity of the suspension is correspondingly reduced and this is especially apparent in comparison with a suspension wherein a bolster is provided between the front and central axles and between the central axle and the rear axle, the bolsters being connected together by a bridging member which carries the socket of the pivot-socket connection mentioned above.

The springs **16** have their compression axes C inclined horizontally and vertically (see Fig. 2) with the result that transverse forces are resisted in combined shear and compression (but mainly in shear) and longitudinal forces are also resisted in combined shear and compression (but mainly in compression). To reduce the compression resistance for transverse forces the springs **16** may be brought closer to the central longitudinal plane of the bogie and/or moved further away from axis **17**.

Although the suspension described comprises four rubber springs **16**, three or any number more than four may be provided, all the springs being equi-angularly spaced about point P with their compression axes downwardly and inwardly directed to intersect at point P.

Figs. 3 and 4 illustrate the preferred connection of the rubber springs **16** to the bogie frame **8** and the underframe **7**. The underframe is provided or formed with a cylindrical recess **19** which is above and co-axial with a corresponding recess **20** in the bogie frame **8**. The open side of the recesses **19, 20** face towards each other. The inner, side-wall surface of the recess **19** is cylindrical and the wedge **18** has a part cylindrical surface **21** (Fig. 4) which accurately fits the inner surface of recess **19**. The wedge member **18** under the spring load is forced against the side wall and the engagement of the surface **21** with the side wall provides adequate support for the wedge member **18**. A horizontal platform **22** at the top of wedge member **18** has an upstanding spigot **23** which enters a hole **24** in a plate **25** which closes the end of the recess **19**. The wedge **18** is also formed with an inclined plate **26** against which the upper end of the spring **16** abuts.

Each spring **16** comprises discs **27** of rubber with metal interleaves **28** and metal end plates **29**, the end plates and interleaves being bonded to the discs **27**. The end plates **28** are secured, as by bolting, to the wedge plate **26**.

The lower end of the spring **16** is similarly attached to a wedge **30**, which is of similar construction to the wedge **18**, and is received within the recess **20**.

The bogie arrangement described is provided at each end of the vehicle.

By the term rubber as used throughout the specification is to be understood natural or synthetic materials or admixtures thereof which are resilient and flexible and have rubber-like properties.

While the arrangement described has the axle **14** driven by a electric motor the invention may also be applied to a bogie in which the central axle is not motored, the axle alone preventing use of a conventional pivot pin.

The springs **16** may be so arranged that the point P is offset lengthwise from the central transverse plane of the bogie i.e. the point P is nearer one end of the bogie than the other.

We claim:

1. A railway vehicle comprising a body, a bogie having a frame, at least a pair of rolling-wheel axles mounted in the frame, and a spring assembly by which the body is supported on the bogie for relative pivotal movement about a substantially vertical axis, said spring assembly constituting the sole means for the transmission of longitudinal forces between the body and the bogie frame and comprising at least three rubber springs equi-angularly spaced about the pivotal axis and fixedly connected at both ends between the body and the bogie frame with the compression axes of all of the springs directed downwardly and inwardly to a common intersection point on the pivotal axis.

2. A railway vehicle comprising a body, a bogie having a frame, at least a pair of rolling-wheel axles mounted in the frame, and a spring assembly by which the body is supported on the bogie for relative pivotal movement about a substantially vertical axis, said spring assembly constituting the sole means for the transmission of longitudinal forces between the body and the bogie frame and comprising at least three rubber springs equi-angularly spaced about the pivotal axis and fixedly connected at both ends between attachments on the body and attachments on the bogie frame, with the compression axes of all the springs directed downwardly and inwardly to a common intersection point on the pivotal axis said attachments being arranged in pairs, each pair having confronting surfaces between which one of said rubber springs is held in combined shear and compression by the vertical load.

3. A railway vehicle comprising a body, a bogie having a frame, at least a pair of rolling-wheel axles mounted in the frame, and a spring assembly by which the body is supported on the bogie for relative pivotal movement about a substantially vertical axis, said spring assembly constituting the sole means for the transmission of longitudinal forces between the body and the bogie frame and comprising at least three rubber springs equi-angularly spaced about the pivotal axis and fixedly connected at both ends between attachments on the body and attachments on the bogie frame with the compression axes of all the springs directed downwardly and inwardly to a common intersection point on the pivotal axis below the horizontal plane containing the wheel axles and above rail level, said attachments being arranged in pairs, each pair having confronting surfaces between which one of said rubber springs is held in combined shear and compression by the vertical load.

4. A railway vehicle comprising a body, a bogie having a frame, three rolling-wheel axles, mounted in the frame, and a spring assembly by which the body is supported on the bogie for relative pivotal movement about a substantially vertical axis near the axis of the central wheel axle, said spring assembly constituting the sole means for the transmission of longitudinal forces between the body and the bogie frame and comprising four rubber springs equi-angularly spaced about the pivotal axis and disposed in transverse pairs between the central wheel axle and each other wheel axle, said springs being fixedly connected at both ends between attachments on the body and attachments on the bogie frame with the compression axes of all the springs directed downwardly and inwardly to a common intersection point on the pivotal axis below the horizontal plane containing the wheel axles and above rail level, said attachments being arranged in pairs, each pair having confronting surfaces between which one of the rubber springs is held in combined shear and compression by the vertical load.

5. A railway vehicle as claimed in claim 4, wherein the ends of each of said rubber springs are received in a cylindrical recess in the body and bogie frame respectively, said recesses housing the attachments for the spring which are constituted by wedge members having part-cylindrical surfaces to fit the inner surfaces of the recesses.

6. A railway vehicle comprising a body, a bogie having a frame, at least a pair of rolling-wheel axles mounted

in the frame, and a spring assembly by which the body is supported on the bogie for relative pivotal movement about a substantially vertical axis, said spring assembly constituting the sole means for the transmission of longitudinal forces between the body and the bogie frame and comprising at least three rubber springs equi-angularly spaced about the pivotal axis and fixedy connected at both ends between attachments on the body and attachments on the bogie frame, with the compression axes of all the springs directed downwardly and inwardly to a common intersection point on the pivotal axis said attachments being arranged in pairs, each pair having confronting surfaces between which one of said rubber springs is held in combined shear and compression by

the vertical load, and a pair of rubber side bearers connected one on each side between the bogie frame and the body and held at least mainly in compression by the vertical load, the side bearers accommodating relative pivotal movement between the bogie and the vehicle body in shear.

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