United States Patent

[11] 3,528,374

[72] Inventor **Alan Herbert Wickens**
Duffield, England

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[73] Assignee **British Railways Board**
London, England
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[33] **Great Britain**
[31] **5,371/67**

[54] RAILWAY TRUCK RESILIENTLY INTERCONNECTED AXLE BOXES

15 Claims, 10 Drawing Figs.

[52] **U.S. Cl.** **105/182,** 105/4, 105/165, 105/168, 105/176, 105/179, 105/197, 105/208.1, 105/218; 280/106

[51] **Int. Cl.** **B61f 5/00,** B61f 5/30, B61f 5/41

[50] **Field of Search** 105/3, 4, 157, 165, 167, 168, 176, 178, 179, 180, 182, 197, 200, 208, 208.1, 208.2, 218; 280/106

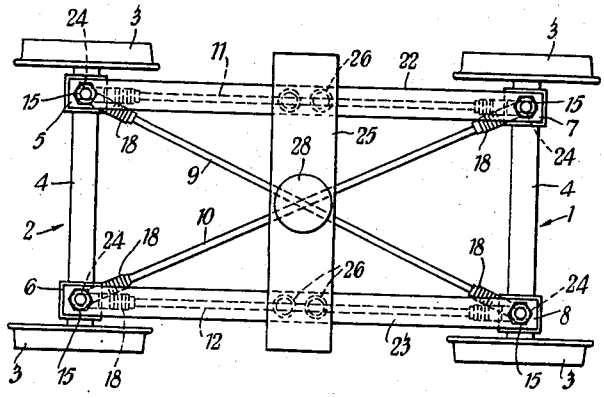
[56] **References Cited**

UNITED STATES PATENTS

424,062	3/1890	Hazard	105/4
495,849	4/1893	Stuebner	105/165X
1,414,955	5/1922	Kadel	105/179
1,640,179	8/1927	Buckwalter	105/182
2,115,095	4/1938	Bugatti	105/4
2,347,628	4/1944	Cottrell	105/208.2
2,871,800	2/1959	Rossell	105/157
2,920,580	1/1960	Williams	105/4X

Primary Examiner—Arthur L. La Point
Assistant Examiner—Howard Beltran
Attorney—Sommers and Young

ABSTRACT: A railway vehicle or a bogie thereof having at least two wheel-sets, each with a live axle mounted at each of its ends in a respective axle bearing, the two axle bearings of one wheel-set each being elastically interconnected either by mechanical or fluid linkages with both axle bearings of the other wheel-set to provide bracing therebetween, and the vehicle body being supported on the wheel-sets in a manner offering substantially no restraint to horizontal rotation of the vehicle body relative to the wheel-sets.



Patented Sept. 15, 1970 3,528,374

Sheet 1 of 3

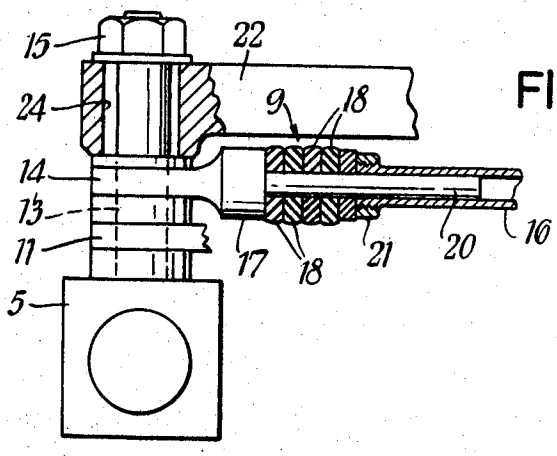


FIG. 2.

FIG. 1.

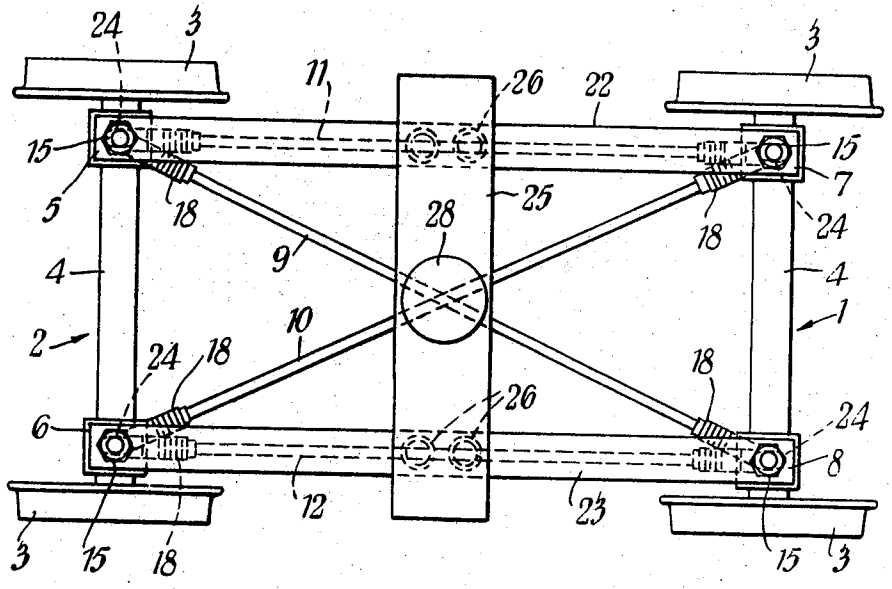
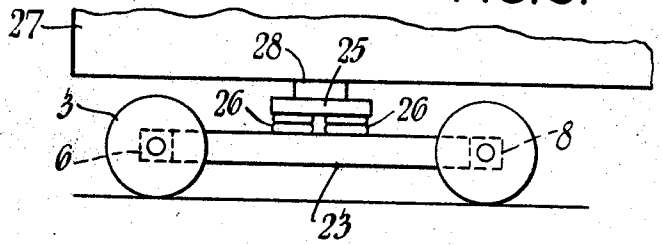


FIG. 3.



INVENTOR
ALAN HERBERT WICKENS
By Sommers & Young
Atty's

FIG. 4

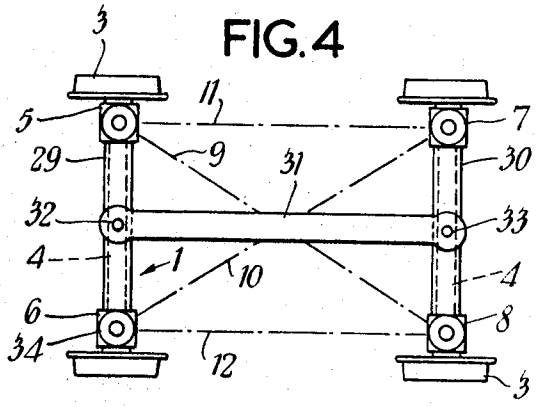


FIG. 5

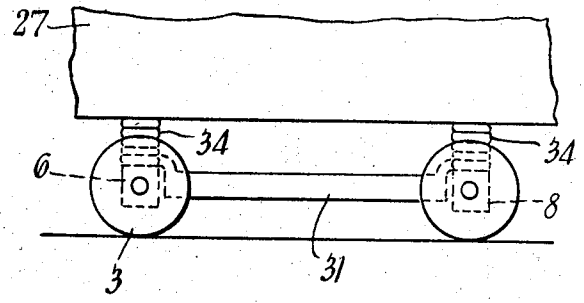
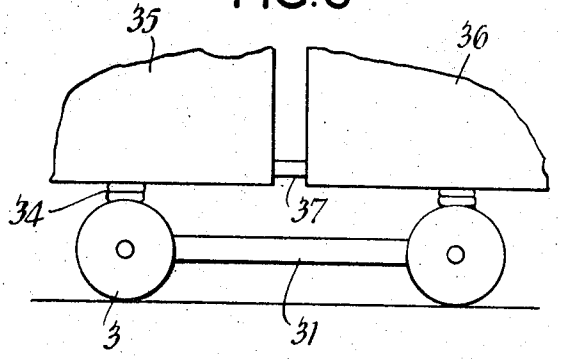


FIG. 6



INVENTOR
ALAN HERBERT WICKENS
By Sommers & Young
Atty's

FIG.7

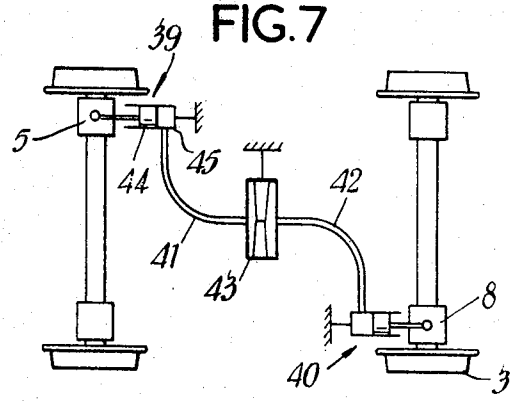


FIG.8

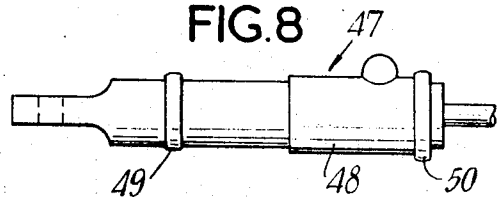


FIG.9

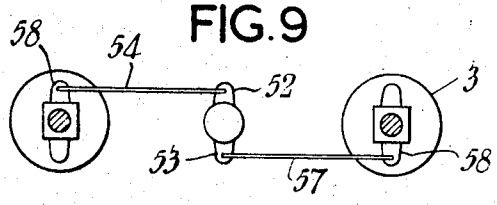
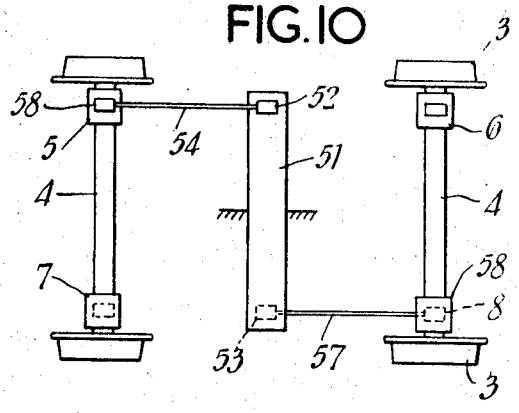


FIG.10



INVENTOR

ALAN HERBERT WICKENS

By Sommers & Young

atty's

RAILWAY TRUCK RESILIENTLY INTERCONNECTED AXLE BOXES

This invention relates to railway vehicles and to trucks for railway vehicles. In addition to railway vehicles in which the vehicle body is supported on trucks, the invention is applicable to railway vehicles in which the vehicle body is supported directly on the wheel-sets, *e.g.* four-wheeled vehicles, and in which a combination of truck supporting and direct wheel-set supporting for the vehicle body is used. The invention is also applicable to railway vehicles which are articulated together and where adjacent ends of two vehicles are carried on a single common supporting truck.

Existing designs of railway vehicles depend for their riding stability on the provision of rotational stiffness and frictional restraint between the vehicle body and the wheel-sets. Consequently high stability performance is only obtained at the cost of inferior performance in negotiating curves in the railway track, where the rotational stiffness and frictional restraint hinder the required movement of the wheel-sets relative to the vehicle body in order to enable the wheel-sets to negotiate a curve in the track.

The object of this invention is to provide good stabilization of a vehicle at high speeds, while permitting the vehicle to move freely through curves, even of small radius.

According to the invention, in a railway vehicle or a truck thereof, having at least two wheel-sets each with a live axle mounted at each of its ends in a respective axle bearing, the two axle bearings of one wheel-set are each elastically interconnected with both axle bearings of the other wheel-set to provide bracing therebetween, and the vehicle body is supported on the wheel-sets in a manner offering substantially no restraint to relative horizontal rotation between the vehicle body and the wheel-sets. Thus the invention provides diagonal bracing and longitudinal bracing between each axle bearing of a wheel-set and the two axle bearings of the other wheel-set.

The elastic interconnections between the axle bearings may comprise a system of links, springs, rods or other members capable of providing the required amount of elasticity, or conversely stiffness, in compression and tension. For example the elastic interconnections may consist of metal rods with rubber bushes of appropriate stiffness at their ends, or alternatively rubber members may be interposed along the length of the rods to provide the required elasticity. Alternatively the elastic interconnections may comprise a fluid system.

In order that the invention may be readily understood, various vehicle and truck constructions in accordance therewith will now be described by way of example, with reference to the accompanying diagrammatic drawings, in which:

FIG. 1 shows a plan view of a first construction of truck;

FIG. 2 shows to a larger scale than FIG. 1 the connection of one of the elastic bracing members of the bogie to an axle bearing housing;

FIG. 3 shows in side elevation the mounting of a vehicle body on the bogie of FIG. 1;

FIG. 4 shows a plan view of a second truck construction;

FIG. 5 shows the mounting of a vehicle body on the truck of FIG. 4,

FIG. 6 shows the truck construction of FIG. 4 serving to mount two vehicle bodies articulated to each other;

FIG. 7 is a plan view of a third truck construction employing fluid elastic members;

FIG. 8 is a detail showing one end of an elastic member combined with damping means;

FIG. 9 shows in side elevation a truck construction employing a torque tube to provide the required elasticity in the bracing system; and

FIG. 10 shows a plan view of the truck construction of FIG. 9.

Referring now to FIG. 1 of the drawings, the truck has wheel-sets 1 and 2 each comprising wheels 3 mounted on live axles 4, that is to say axles which are solidly connected to the wheels and which rotate in bearings. The axle 4 of the wheel-set 2 rotates in axle bearings 5 and 6 and the axle 4 of the wheel-set 1 rotates in bearings 7 and 8.

Stabilization of the truck is provided by elastic bracing members 9 to 12 in the form of struts. The elastic bracing member 9 extends diagonally of the truck between axle bearing 5 and axle bearing 8. The elastic bracing member 10 extends diagonally of the truck between axle bearing 6 and axle bearing 7 and is unconnected with the elastic member 9. The elastic bracing member 11 extends longitudinally of the truck between axle bearing 5 and axle bearing 7 and the elastic bracing member 12 extends longitudinally of the truck between axle bearing 6 and axle bearing 8.

At their ends the elastic bracing members 9 to 12 are connected to the axle bearings 5 to 8 in such manner that they are pivotable about vertical axes. FIG. 2 shows one way in which this may be achieved in simple manner, the connection for the elastic member 9 being referred to; such a connection is of course applicable to the other elastic members 10 to 12. A bolt 13 extends vertically from the housing of the axle bearing 5 and an eye is provided in the flattened end 14 of the elastic member 9 through which the bolt 13 passes to provide the pivotability of the bracing member. The end of the bracing member 9 is retained on bolt 13 by a lock nut 15.

The bracing members 9 to 12 have been referred to as elastic bracing members because they have elastic characteristics. To provide the desired elastic characteristics the bracing members 9 to 12, as shown most clearly in FIG. 2 for the elastic member 9, may comprise a central tubular strut portion 16 and end fitting 17 at each end thereof. Between each end fitting 17 and the central portion 16 are interposed a series of rubber washers 18 which give the required elasticity to the members 9. At one end the series of washers 18 abuts against a face of the end fitting 17 and at the other end abuts against a thrust washer 19 which in turn abuts against a nut 21 threadedly engaging the central tubular portion 16. To locate the washers 18 and thrust washer 19, the end fitting 17 has a spindle 20 extending into the central tubular portion on which the washers 18 and 19 are supported. After fitting of the bracing members the rubber washers 18 are prestressed by adjustment of nut 21.

The elasticity, or conversely, the stiffness of the diagonal elastic members 9 and 10 will be the same and the stiffness of the longitudinal elastic members 11 and 12 will also be the same, thereby producing a symmetrical arrangement, but the stiffness of the diagonal members 9 and 10 is not necessarily the same as the stiffness of the longitudinal members 11 and 12.

Lightweight side frames 22 and 23 extend longitudinally of the truck and are connected at their ends to the axle bearings. The mounting of the side frames 22 and 23 on the axle bearings is such that the side frames 22 and 23 are only required to support vertical loading; that is to say they do not become stressed longitudinally by displacement of one of the axles relatively to the other. Such a mounting of the side frames could be effected in several ways as will be appreciated by persons skilled in the art. Thus the side frames 22 and 23 could be mounted on the same pivot bolts 13 as the bracing members 9 to 12 as shown in FIG. 2, the pivot bolts 13 passing into longitudinal bearing slots 24 in the side frames.

Extending between the side frames 22 and 23 to form a truck body therewith is a truck bolster 25 which is mounted on the side frames 22 and 23 through conventional vertical springing 26. This verticle springing may be in the form of air springs as shown in FIG. 3 or coiled metal compression springs. The vehicle body 27 is mounted at one end on the truck in conventional manner through a vertical pivot 28 on the bolster 25. A similar truck will also be provided at the other end of the vehicle body. Resistance to lateral movement of the vehicle body relatively to the truck will be provided in conventional manner, for example by air springs or tie rods, these being arranged so that they do not restrain to any significant extent the horizontal rotational movement of the body 27 about the pivot 28.

In FIGS. 4 and 5 a different truck construction is shown. The arrangement of the elastic bracing members is the same as that for the truck of FIG. 1 and the elastic bracing members have therefore been given the same reference numerals as in

FIG. 1 as have the axles, axle bearings and wheels. The manner in which the vehicle body is supported on the truck is however different from that of FIG. 1. In the truck construction of FIGS. 4 and 5, the axles of the wheel-sets 1 and 2 are encased in axle housings 29 and 30 which are connected at their ends to the bearing housings, to provide rigid structures with the bearings housings. A beam 31 extends along the central longitudinal axis of the truck and is mounted at its ends on vertical pivots 32 and 33 to tie the wheel-sets 1 and 2 together but permit free horizontal rotation of the sheel-sets relatively to the beam 31.

The vehicle body is mounted on the truck through vertical springing 34, which, it will be appreciated by those skilled in the art, will not restrain to any significant extent the horizontal rotation of the vehicle body relatively to the wheel-sets. In the truck construction of FIGS. 4 and 5, the beam 31 could be omitted in the case where the elastic bracing members 9 to 12 are mechanical struts such as those shown in FIGS. 1 and 2.

In a modification of the truck construction of FIGS. 4 and 5, the vertical springing supporting the vehicle body 27 could be mounted on the beam 31, so that no restraint to horizontal rotation of the vehicle body relatively to the wheel-sets is provided. Suitable lateral stability of the vehicle body will be provided by springs or tie rods as will be appreciated by those skilled in the art, but in a manner providing no significant restraint to the horizontal rotation of the vehicle body relatively to the wheel-sets.

In FIG. 6 is shown the manner in which the truck of FIGS. 4 and 5 supports the adjacent ends of two vehicle bodies 35 and 36 articulated together at 37.

In FIG. 7 is shown an alternative form of elastic bracing member to that previously described. In this case each elastic member is a fluid elastic member. For clarity only one elastic bracing member has been shown, this being the diagonal bracing member (corresponding to bracing member 9 of FIG. 1) between axle bearing 5 and axle bearing 8, but similar bracing members are also provided to correspond to the bracing members 10 to 12 of FIG. 1. Each bracing member comprises hydraulic fluid displacers 39 and 40 acting on the axle bearings 5 and 8 respectively. The fluid displacers 39 and 40 are connected by ducts 41 and 42 to an air spring 43 which provides the required elasticity for the bracing member. In the example shown, each of the fluid displacers 39 and 40 comprises a piston 44 working in a cylinder 45. The pistons 44 of the fluid displacers are connected to the axle bearings 5 and 8 by universal couplings and the cylinders 45 are fixed in space for example by being secured to the vehicle body (not shown) or a frame connected between the axles or to a beam connected between the axles such as the beam 31 of the FIG. 4 and 5 constructions. The truck shown in FIG. 7 may be provided with side frames, vertical springing and a bolster in the manner of FIG. 1 for mounting the vehicle body. Although the fluid displacers have been shown in FIG. 7 as pistons and cylinders, other types of actuators may be used, for example rolling diaphragm type actuators.

If desired the fluid displacers or other actuators used can be operated in response to an external signal so as to steer the vehicles in curves. The signal would be such as to deform the truck in plan view by extending or contracting the appropriate elastic members so that the axles extend radially to the curve.

In FIG. 8 is shown a form of elastic member designated 47 corresponding to that shown in FIG. 2 but in which a viscous or hydraulic vibration damper 48 is interposed between the rubber washers 49 and 50 to provide an appropriate damping force.

In FIGS. 9 and 10 is shown an arrangement whose manner of operation corresponds essentially to that of the previously described arrangements, but in which the required elasticity is provided by a torque tube 51. At the ends of the torque tube 51 are provided two diametrically opposite radial lever arms 52 and 53. The lever arm 52 at one end of the torque tube 51 extending upwardly and the lever arm 53 at the other end of the torque tube extending downwardly. To the outer ends of the lever arms 52 and 53 are connected rods 54 and 57 which extend from the axle bearings 5 and 8 respectively. The rods 54 and 57 are pivoted at their axle bearing ends to lugs 58 extending from the axle bearings and at their torque tube ends are pivoted to the outer ends of the lever arms 52 and 53. The torque tube 51 is secured against lateral and longitudinal displacement relative to the vehicle body but is free to rotate about its longitudinal axis relative to the body. For clarity only the linkage corresponding to two elastic bracing members is shown.

From an inspection of FIGS. 9 and 10 it will be seen that bracing members are shown corresponding to the bracing members 11 and 12 of FIG. 1. A similar linkage and torque tube is provided to correspond to the bracing members 9 and 10 of FIG. 1, but the lever arm 53 and lug 58 would then extend upwardly from the torque tube 51 and bearing 8, the lever arm 52 and lug 58 remaining as shown.

The truck construction of FIG. 10 may be provided with side frames, vertical springing and a bolster corresponding to that of FIG. 1 for mounting the vehicle body.

The purpose of the described configurations of elastic bracing members is to provide predetermined elastic restoring forces when the wheel-sets of the vehicle or truck move from the perfectly square position shown in the drawings, that is to say when the axles move out of parallel with each other. These elastic restoring forces are strongly stabilising as has been proved by extensive tests and permit the stable operation of a railway vehicle at high speeds. This is achieved with minimal rotational restraint between wheel-sets and vehicle body and so permits the vehicle to move freely through curves.

If the vehicle or truck is provided with more than two wheel-sets, the configuration of bracing members is provided between each adjacent pair of wheel-sets. Thus if the vehicle or truck has three wheel-sets, the configuration of bracing members shown for example in FIG. 1 is provided between the middle wheel-set and each of the outer wheel-sets.

I claim:

1. In a railway vehicle, running gear for said vehicle comprising in combination:
- at least two wheel sets each including a live axle;
- an axle bearing supporting each end of each said axle;
- elastic means for interconnecting at least one axle bearing of one wheel-set with at least one axle bearing of the other wheel-set; and
- said elastic interconnecting means in response to movement of said wheel-sets to non-parallel or non-aligned positions producing restoring forces to restore said wheel-sets to their parallel and aligned positions.

2. The combination of claim 1 wherein said elastic interconnecting means interconnects each axle bearing of one wheel-set with the diagonally opposite axle bearing of the other wheel-set.

3. The combination of claim 1 wherein said elastic interconnecting means interconnects each axle bearing of one wheel-set with both axle bearings of the other wheel-set.

4. The combination of claim 3 wherein said elastic interconnecting means comprises a strut which is mounted at its ends to the axle bearings through vertical pivots.

5. The combination of claim 4 wherein the elasticity is imparted to said strut by resilient material forming part of the length of the strut.

6. The combination of claim 5 wherein vibration damping means is provided in the length of said strut.

7. The combination of claim 3 wherein said elastic interconnecting means comprises a fluid interconnection whose elasticity is provided by a fluid spring.

8. The combination of claim 7 wherein said fluid interconnection comprises two hydraulic fluid displacers each acting on a respective axle bearing and interconnected by ducting including an air spring which provides the elasticity of said interconnection.

9. The combination of claim 8 wherein said fluid displacers are actuable in response to an external signal whereby to vary the operative length of said interconnection.

10. The combination of claim 1 wherein said elastic interconnecting means comprises rods extending longitudinally of the vehicle from diagonally opposite axle bearings and connecting with a torque tube which extends transversely of the vehicle and provides the elasticity.

11. The combination of claim 1 wherein said running gear further includes a truck having side frames each of which extends longitudinally of the truck and is mounted at each end on a respective axle bearing in a manner permitting horizontal rotational movement of said axles relatively to said side frames and movement of one axle longitudinally of said truck relatively to the other axle whereby the side frame is required to support only vertical loading, a bolster extending between said side frame and supported thereon through vertical springing, and vertical pivot means for supporting the vehicle body on said bolster.

12. The combination of claim 1 which further includes vertical spring means for supporting the vehicle body directly on said axle bearing.

13. The combination of claim 12 which further includes a

housing for each said axle, and a beam extending along the central longitudinal vertical plane of the vehicles between the axles, and vertical pivot means for operatively connecting each end of said beam to a respective one of said axle housings.

14. The combination of claim 13 in which vertical springing means supports the vehicle body on said beam.

15. Running gear for two articulated railway vehicles comprising in combination:

at least two wheel-sets each including a live axle;

an axle bearing supporting each end of each said axle;

elastic means for interconnecting at least one axle bearing of one wheel-set with at least one axle bearing of the other wheel-set; and

said elastic interconnecting means in response to movement of said wheel-sets to non-parallel or non-aligned positions producing restoring forces to restore said wheel-sets to their parallel and aligned positions.