United States Patent

Sundby

[15] **3,646,893**

[45] **Mar. 7, 1972**

[54] RESILIENT RAILWAY CAR TRUCK

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[22] Filed: **Oct. 2, 1969**

[21] Appl. No.: **863,039**

[52] **U.S. Cl.** .....**105/182 R**, 105/193, 105/197 B, 105/199 R, 105/208.2

[51] **Int. Cl.**.....**B61f 3/08**, B61f 5/10, B61f 5/12

[58] **Field of Search** .....105/180, 197 R, 197 A, 197 B, 105/199 C, 199 R, 224.1, 182 R, 193, 208.2

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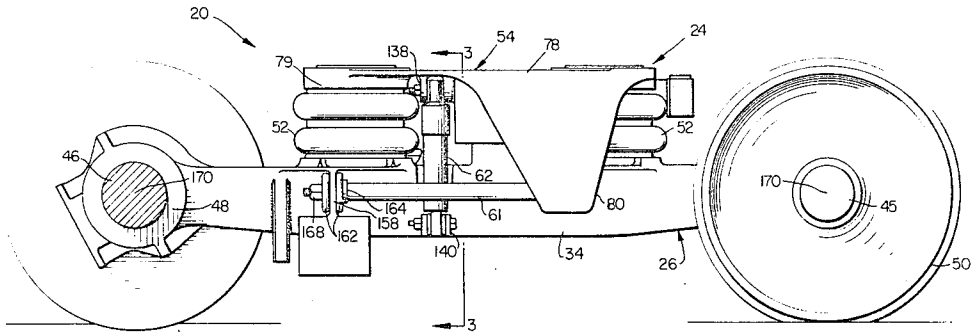
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[57] **ABSTRACT**

A railway car in which the car body is pivoted to a truck about a suspension adapter disposed in supporting relationship to its under side and in which the car body is in part supported directly from the truck frame and in part supported from the frame through the suspension adapter.

28 Claims, 9 Drawing Figures



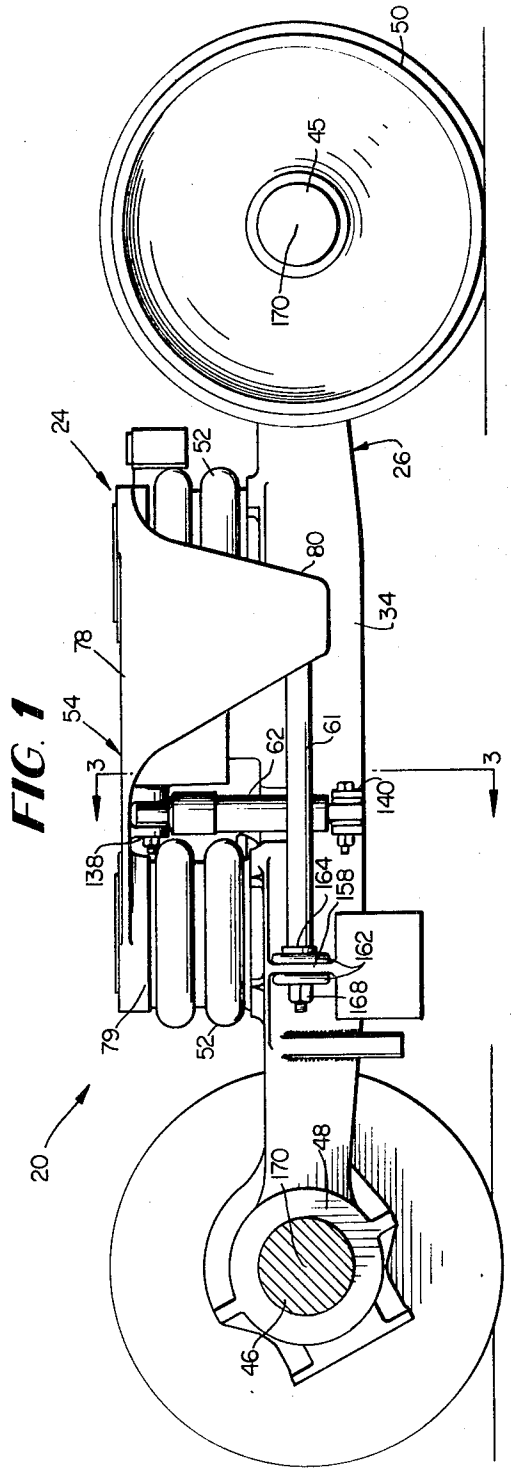


FIG. 1

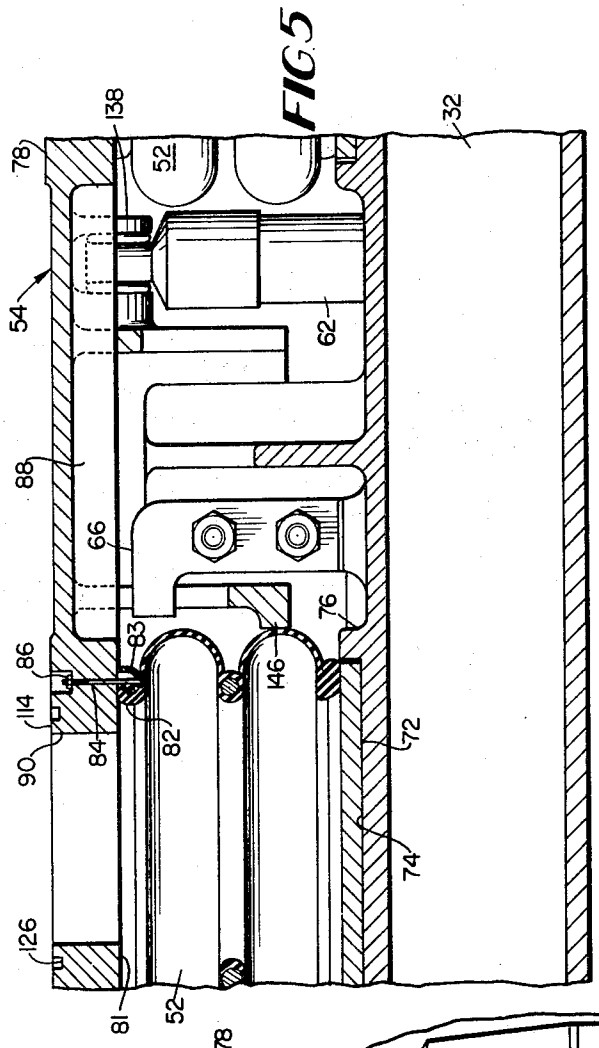


FIG. 5

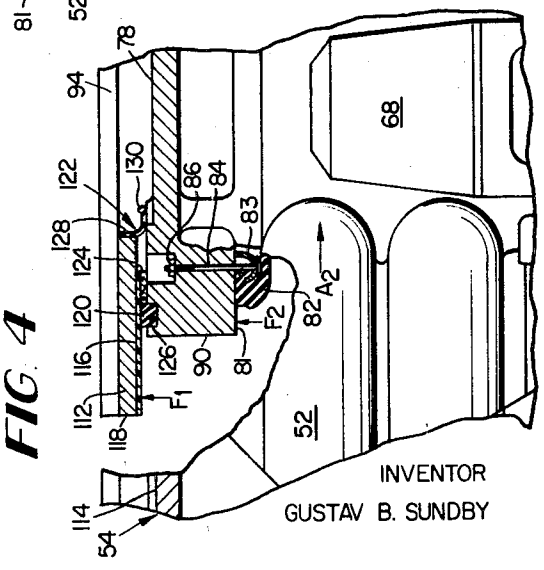


FIG. 4

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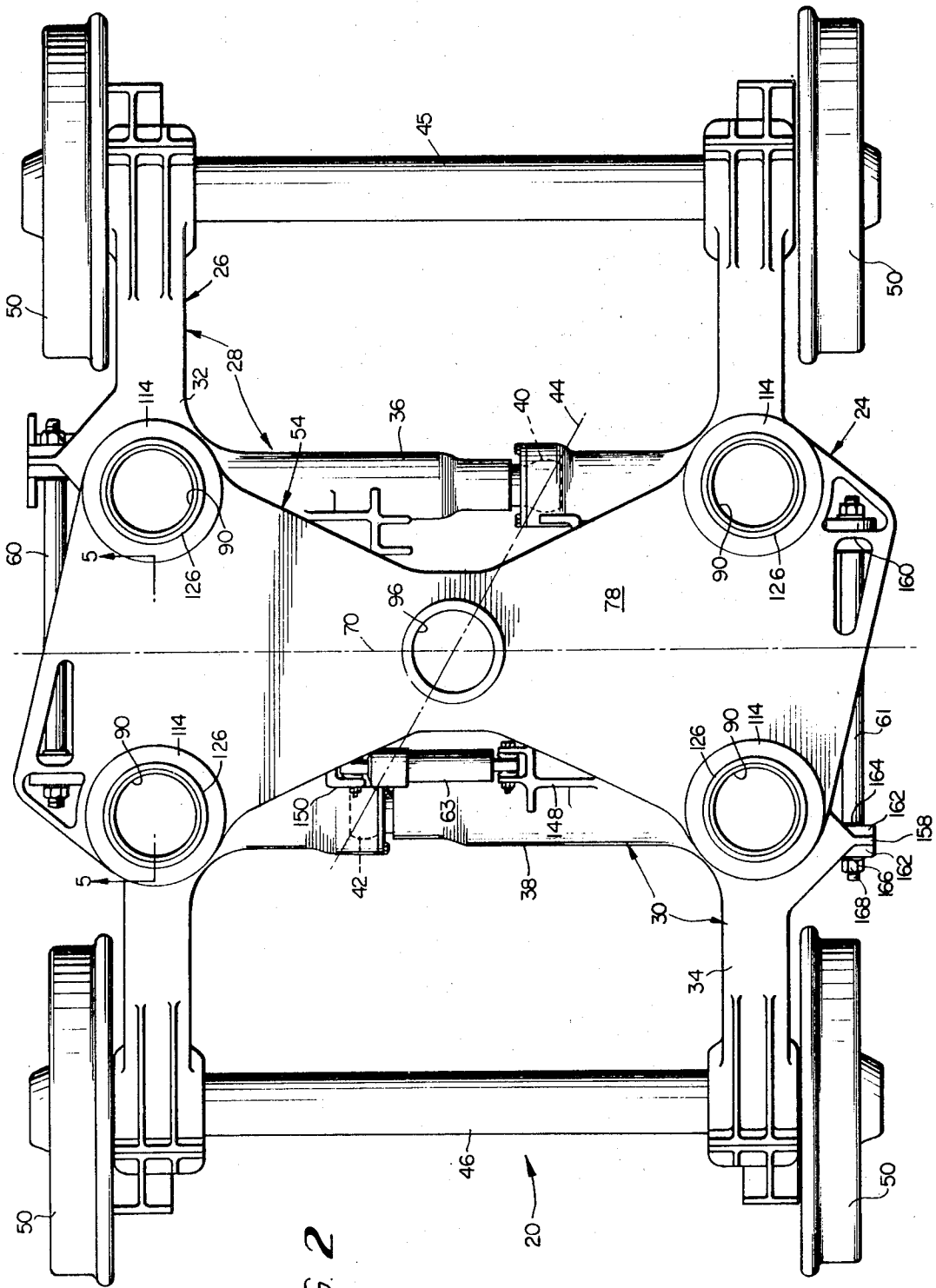


FIG. 2

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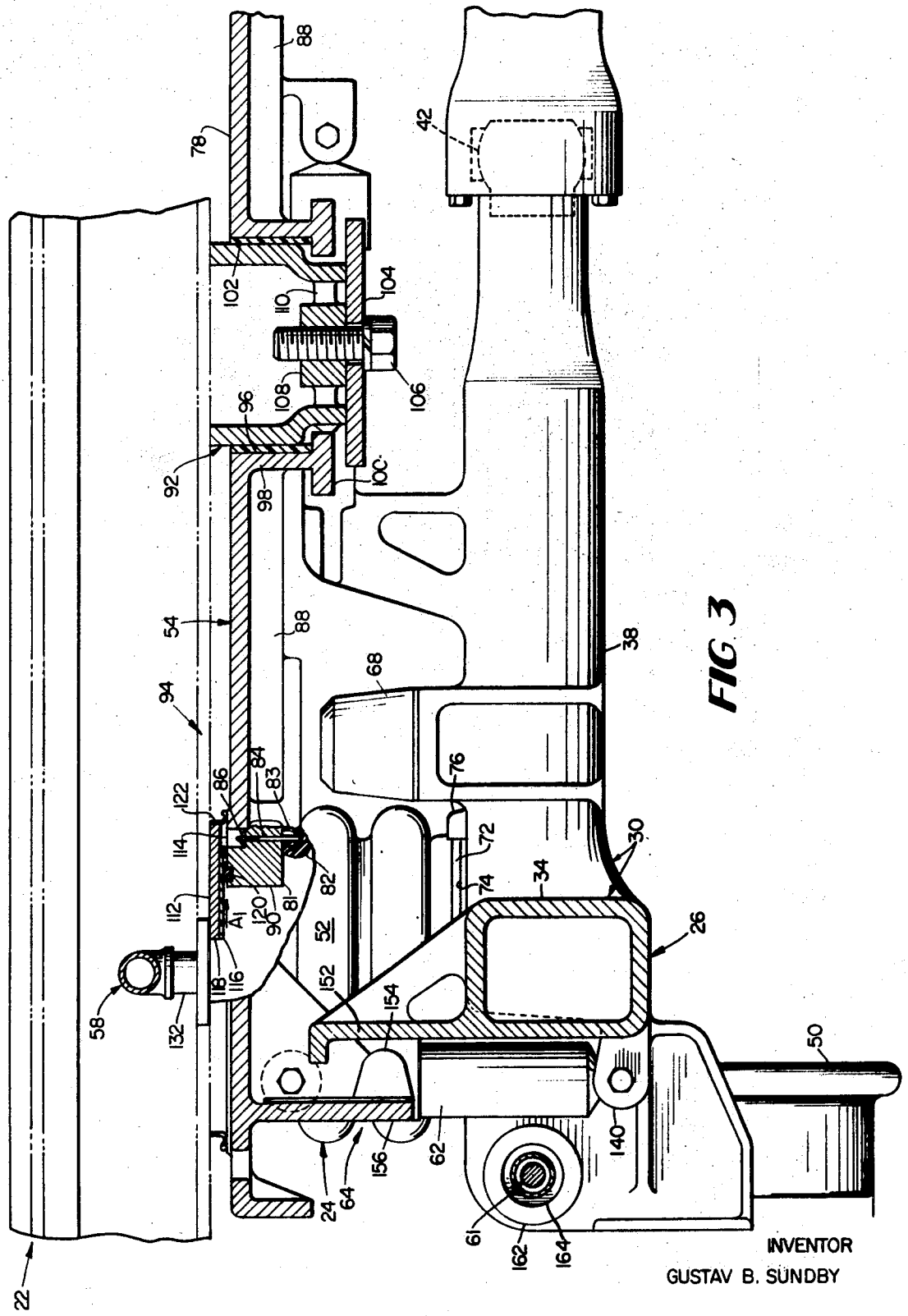


FIG. 3

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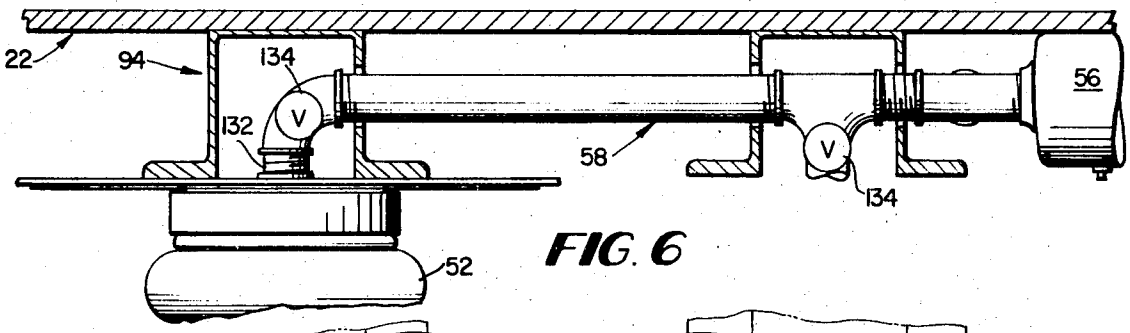


FIG. 6

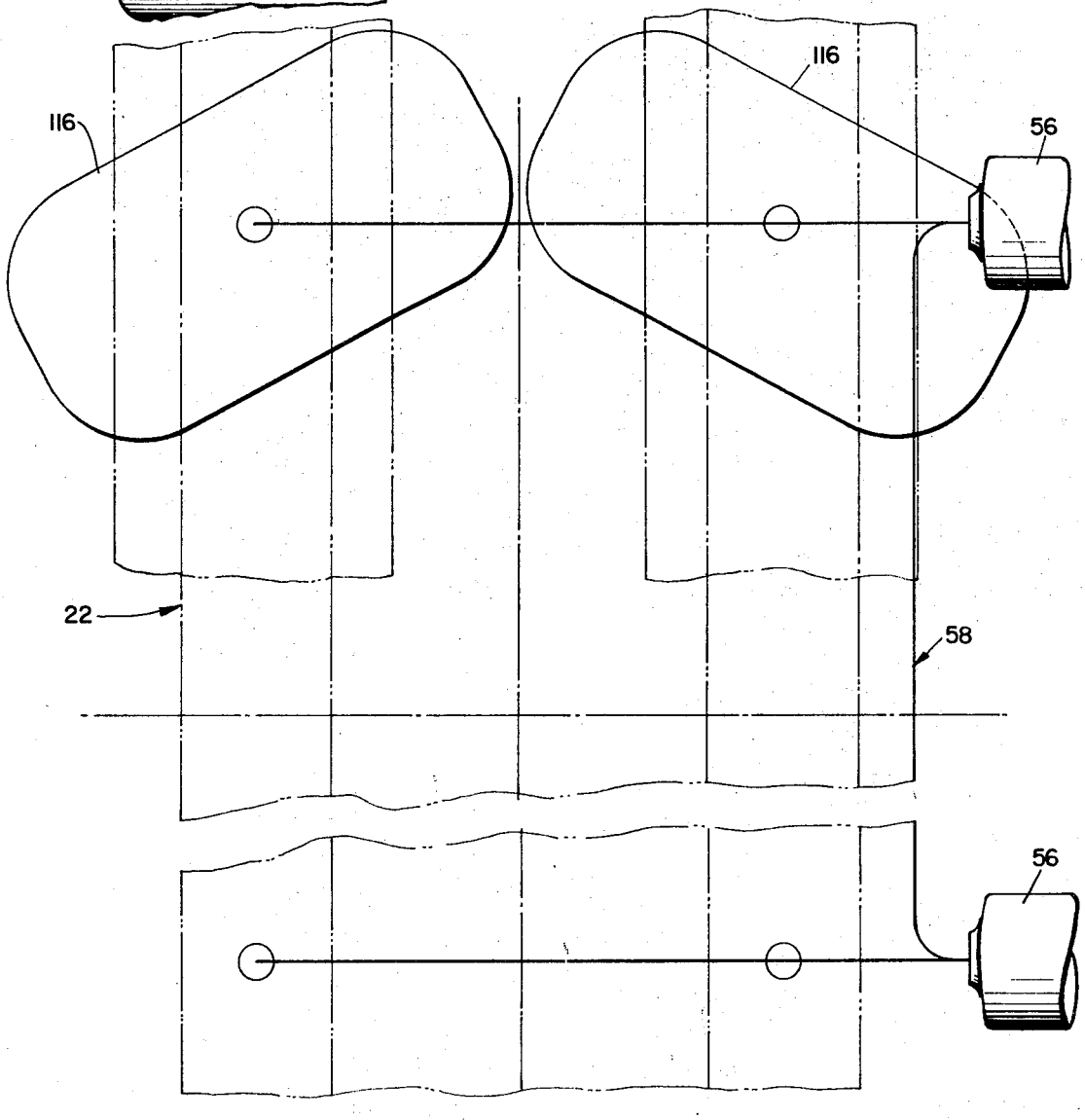


FIG. 7

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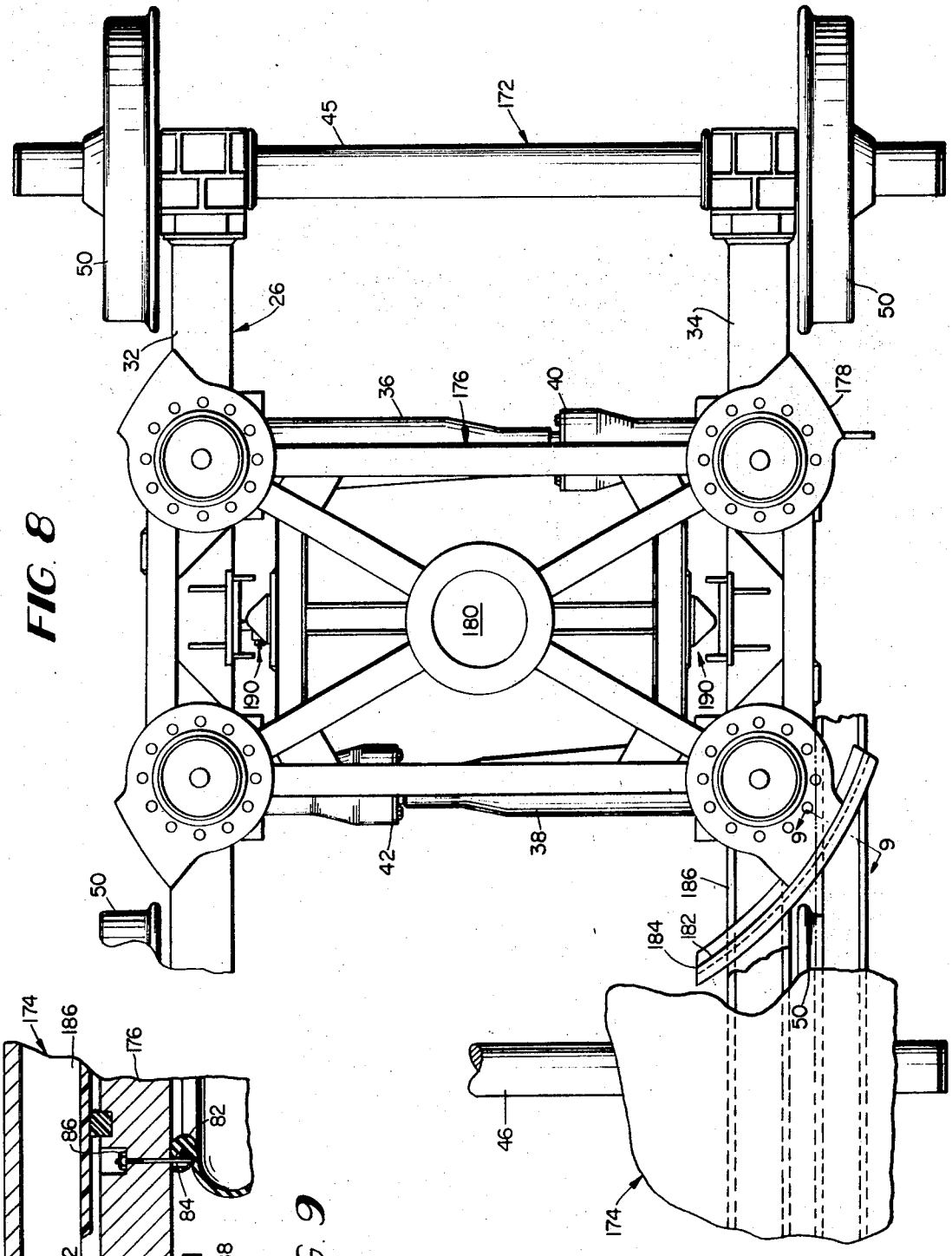


FIG. 8

FIG. 9

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RESILIENT RAILWAY CAR TRUCK

This invention relates to railway cars and, more particularly, to novel, improved railway trucks and to novel, improved systems for supporting the car bodies of rolling stock from such trucks.

At the present time purchasers of railways cars are employing specifications which are producing major changes in the design of such vehicles, particularly in the trucks on which the bodies of the cars are mounted. Among the more prominent of these specifications is an insistence upon weights which are much lower than can be attained by using conventional truck designs. This is particularly true in the burgeoning rapid transit market in which reduction in the weight of the rolling stock has received considerable attention.

In response to this demand for weight reduction a number of lightweight truck designs have been proposed. Exemplary of these are the designs disclosed in U.S. Pat. Nos. 2,758,549 issued Aug. 14, 1956, and 2,843,057 issued July 15, 1958.

Heretofore available lightweight trucks have, however, typically proved unsatisfactory because they are still unacceptably heavy or too expensive to produce, install or maintain, fail under the stresses encountered in revenue service, do not provide a ride of acceptable quality, or suffer from excessive wheel wear.

It is the primary object of the present invention to produce novel, improved, railway trucks which are free of the defects enumerated above and novel techniques of supporting car bodies from such trucks.

The novel trucks of the present invention, by which the foregoing and other advantages are obtained, preferably include independent side frames connected by transoms and spherical bearings in the manner described in U.S. Pat. No. 3,313,245[1] to provide equal wheel loading and to maintain the side frames in rectangular and vertical tram. Disposed above the side frames is a lightweight suspension adapter to which the car body is pivotally fixed. While the present invention is particularly useful in conjunction with the type of truck disclosed in the Sundby patent in producing a high-quality ride with a truck of minimum weight it is to be understood that the present invention is useful in trucks not incorporating the invention of the Sundby patent.

The suspension adapter and car body are resiliently supported from the side frames in a novel manner in which the car body is in part supported directly from the side frames and in part supported from the side frames through the suspension adapter. In the preferred embodiments of the invention the supports are bodies of compressed fluid supplied from pressure tanks or vessels mounted in the car bodies although other arrangements can be employed.

In the novel suspension systems of the present invention lateral loads are transferred to the truck frame through the suspension adapter and resilient supports with a shock absorber and a stop and bumper arrangement preferably being employed to cushion lateral loads and to limit lateral movements. Longitudinal loads are transferred to the truck frame by radius rods connected between the side frames and suspension adapter with resilient bushings being employed to cushion shock type loads. Vertical loads are transferred through the resilient supports with shock absorbers and up and down stops preferably being employed to cushion vertical loads and to limit upward and downward movement of the suspension adapter and car body.

One of the important advantages of the present invention is that only a fraction of the weight of the car body is imposed upon the suspension adapter. Accordingly, this member may be of much lighter construction than the heretofore employed car supporting bolsters, which must be of monolithic design since they support the entire weight of the car body. The net result is a significant weight reduction, resulting in trucks which are among the lightest available and have attributes not possessed by heretofore available trucks of comparable weight.

Other advantages also result from proportioning the car body supporting forces between the car body and the suspension adapter. Specifically, in designing a railway car, it is necessary to provide for pivotal movement between the car body and supporting trucks so that the car can freely negotiate curves as excessive wheel wear will otherwise occur. At the same time it is necessary to restrict this pivotal movement to an extent such that the truck will not hunt[2](2Hunting is a conventional term employed to describe the oscillatory movement of a truck about the pivot axis between the truck and a car body supported thereon in the absence of sufficient resistance to such rotation.) as the car proceeds along straight sections of track as hunting also produces excessive wheel wear as well as deterioration in ride quality. Also, it is necessary to provide adequate load-bearing capacity and a specified resistance to lateral loads.

By proportioning the supporting forces between the car body and the suspension adapter in accord with the present invention the freedom of pivotal movement needed for curve negotiation can be produced without creating a degree of freedom which will cause hunting. At the same time adequate load-bearing capacity and satisfactory resistance to lateral loads can also be provided. As a result, the novel suspension system of the present invention avoids excessive wheel wear and, at the same time, provides a high-quality ride.

In contrast, while other resilient support systems in which the car body is supported from the truck frames have heretofore been proposed in an effort to eliminate the weight of the conventional monolithic bolster (see the above-cited Markenstein patent), the entire weight of the car body has in these systems been supported directly from the truck frame. In this type of arrangement it has not proved possible to provide acceptable vertical load-bearing capacity, lateral load resistance, and resistance to hunting, and still obtain pivotal movement with a sufficient degree of freedom for curve negotiation without excessive wheel flange wear.

Another important advantage of the present invention is that, because of their simplicity and accessibility, simple load paths and low stresses, trucks in accord with the present invention can be produced at competitive prices, are easily installed ans serviced, and have low maintenance requirements.

From the foregoing it will be apparent that other important but more specific objects of the present invention reside in the provision of novel, improved railway trucks and suspension systems:

1. which are light in weight but do not have the disadvantages appurtenant to other lightweight trucks.
2. in which, in conjunction with the preceding object, the conventional monolithic bolster is eliminated.
3. which produce a superior ride.
4. in which independent side frames are employed together with an arrangement for so connecting the side frames as to equalize the loads on the truck wheels and minimize wheel wear by maintaining the side frames in rectangular and vertical tram.
5. in which provision is made for transferring vertical, lateral and longitudinal loads to the truck frame, for cushioning vertical, lateral, and longitudinal shock loads, and for limiting longitudinal, vertical, and lateral movement of the car body relative to the truck on which it is mounted.
6. in which provision is made both for sufficient freedom of pivotal movement between the truck and car body during curve negotiation to prevent excessive wheel flange wear and for sufficient restraint on such motion to prevent hunting on straight stretches of track.
7. which can be produced at competitive prices.
8. which can be readily installed and removed.
9. which have low maintenance requirements.

Other important objects and features and additional advantages of the present invention will become apparent from the appended claims and as the ensuing detailed description and discussion proceeds in conjunction with the accompanying drawing in which:

FIG. 1 is a side view of a railway truck constructed in accord with the principles of the present invention;

FIG. 2 is a plan view of the truck of FIG. 1;

FIG. 3 is a section taken substantially along line 3—3 of FIG. 1 of the truck and a portion of a car body supported by the truck;

FIG. 4 is a fragment of FIG. 3 to an enlarged scale;

FIG. 5 is a section through the truck of FIG. 1, taken substantially along line 5—5 of FIG. 2;

FIG. 6 is a fragmentary longitudinal section through the car body showing the car body mounted components of a novel system by which the car body is supported from the truck;

FIG. 7 is a schematic illustration of the connections between the car body mounted components of the suspension system;

FIG. 8 is a plan view of a second form of railway truck constructed in accord with the principles of the present invention; and

FIG. 9 is a section through the truck of FIG. 8, taken substantially along line 9—9 of the latter Figure.

Referring now to the drawing, FIGS. 1–3 depict a railway truck 20 embodying the principles of the present invention supporting a car body 22 by way of a novel suspension system 24 having components in both the truck and car body. The details of the car body are for the most part not part of the present invention. They will accordingly not be described further herein except as they relate to the present invention.

Truck 20 may be of the same basic construction as the novel truck described in the above-cited U.S. Pat. No. 3,313,245. The truck has a rectangular frame 26 consisting of two generally L-shaped, rigid subassemblies 28 and 30. These subassemblies are formed by longitudinally extending side frames 32 and 34 secured to or integral with laterally extending transoms 36 and 38.

Subassemblies 28 and 30 are interconnected at diagonally opposed points by spherical bearing assemblies 40 and 42 to permit relative pivoting between the L-shaped subassemblies about a diagonal axis 44 through the centers of the spherical bearings and the center of the truck.

Truck frame 26 is supported on axles 45 and 46 by roller bearing assemblies 48 which are resiliently mounted in frame 26. Axles 45 and 46 each have two railway wheels 50 secured thereto.

Because of the manner in which the frame subassemblies 28 and 30 are interconnected by bearing assemblies 40 and 42, there is only one type of motion therebetween. This is a pure pivotal movement of one subassembly with respect to the other about axis 44. Accordingly, as truck 20 rolls onto an uneven stretch of track on which one of the wheels 50 furthest from axis 44 is at a low point in the track, the associated frame subassembly tends to pivot downwardly about axis 44 to reestablish even wheel loading. Conversely, when a wheel furthest from the pivoting axis is on a high point on a rail, its frame subassembly pivots upwardly about axis 44 to reestablish even wheel loading.

Thus, the construction of frame 26 provides independent side frame action. However, as the spherical bearings do not permit longitudinal play between the frame subassemblies, the side frames of the truck 20 are rigidly maintained in rectangular tram. Further, as the spherical bearings do not permit vertical play between the ends of the transoms and the opposite side frames, the side frames are maintained in vertical tram. Finally, as the spherical bearings permit no lateral play between the transoms and the opposite side frames, they effectively rigidly transmit lateral forces from one side to the other.[3]([3]The axle bearing assemblies 48 provide the axial play and pivotal flexibility between the side frames and the axles needed to permit the side frames to independently follow track irregularities without binding the journal bearings.)

Referring now to FIGS. 1–5, the novel suspension system 24 by which car body 22 is supported from truck 20 includes four vertically extensible, tubular bellows 52 mounted on truck frame 26 and a suspension adapter 54 to which the upper ends of the bellows are fixed. Pressure tanks 56 (see FIG. 6) and a conduit system 58 in car body 22 supply compressed fluid to bellows 52 to resiliently support the car body and suspension adapter from the truck frame. Radius rods 60 and 61 transfer and absorb longitudinal loads, and shock absorbers 62 and 63 cushion vertical and lateral loads. Bumper and stop assemblies 64 limit lateral movement of the suspension adapter relative to the truck frame and up and down stops 66 and 68 limit vertical movement of the adapter relative to the frame.

Referring now to FIGS. 2, 3 and 5, two of the four bellows 52 are mounted on each of the side frames 32 and 34 of truck frame 26 at equal distances from and on opposite sides of the transverse centerline 70 of the truck. The lower end of each bellows is closed by a member 72 disposed in a seat 74 surrounded by an upstanding circular flange 76 on the side frame from which the bellows is supported.

As shown in the figures just mentioned, suspension adapter 54 has a horizontally oriented top portion 78 from which side flanges 79 depend and integral, depending support brackets 80 at the right front and left rear thereof as shown in FIG. 2.

Seats 81 are formed on the lower sides of flanges 79 as shown in FIGS. 3 and 4. The open upper ends of bellows 52 terminate in beads 82 which are sealed against seats 81 by circular clamps 83 fixed to the adapter by studs 84 and nuts 86.

Turning now to FIGS. 1, 2, and 5, the suspension adapter 54 to which bellows 52 are attached in the manner just described will typically be fabricated from cast metal since this material permits the use of sections which allow ready accessibility to other truck components for maintenance.

Ribs identified generally by reference character 88 (see FIG. 5) integral with the upper portion 78 of the adapter are located in areas most susceptible to stresses to reduce stress concentrations in these areas. The resulting member has the advantage of weighing much less than conventional monolithic bolster, which is its counterpart in heretofore available trucks.

As shown in FIGS. 4 and 5, an aperture 90 is formed through suspension adapter 54 above each of the bellows 52. As will be explained in detail hereinafter, the bellows 52 communicate through apertures 90 and conduit system 58 (see FIGS. 3 and 6) in car body 22 with pressure tanks 56 to provide the above-referred-to car body and suspension adapter supporting bodies of compressed fluid in the bellows.

Referring now to FIG. 3, car body 22 is pivotally fixed to suspension adapter 54 by a fitting 92 fixed in any suitable fashion to the under side of the floor supporting framework (or underframing) of the car body, which is identified by reference character 94. Fitting 92 is received in a recess 96 provided in suspension adapter 54 by a depending flange 98 terminating in a horizontal annular cap 100 at its lower end. A cylindrical bearing 102 is preferably disposed between fitting 92 and flange 98 to minimize wear therebetween.

In case of derailment upward movement of car body 22 relative to suspension adapter 54 is limited by a plate 104 attached to the fitting 92 below cap 100 by a bolt 106 threaded into a retainer 108 supported from fitting 92 as by ribs 110. As shown in FIG. 3, plate 104 is dimensioned to engage cap 100 and thereby limit the upward movement of the car body as it moves relative to the suspension adapter.

Referring now to FIGS. 3 and 4, as car body 22 pivots relative to suspension adapter 54, members 112 fixed to the under side of the car body underframing 94 slide across seats 114 formed on suspension adapter 54 above the four bellows 52. An apertured plate 116 of a material such as Teflon (see also FIG. 7) is fixed to the under side of each member 112 to reduce sliding friction between the car body and suspension adapter.

As shown in FIGS. 3 and 4, apertures 118 are formed in car body members 112 above the apertures 90 through suspension adapter 54. These apertures provide fluid communication between the pressure vessels 56 in the car body and the bellows 52. To provide a seal between each car body member 112 and the suspension adapter 54, a seal 120, a dirt shield 122, and a wiper 124 of felt or similar material are employed.

Seals 120, which are preferably fabricated of a material such as Neoprene, surround the associated openings 90 and 118 and are disposed in recesses 126 in seats 114. Dirt shields 122, which also surround apertures or openings 90 and 118, are of the spring type and include a vertical leg 128 fixed to the associated member 112 and a horizontal leg 130 spring biased against the associated seat 114 on the suspension adapter. Wipers 124 are ringlike members disposed between Teflon bearing members 116 and seats 114 adjacent Neoprene seals 120.

Referring now to FIGS. 3, 6 and 7, there are preferably two pressure tanks 56 in car body 22 for each truck 20. These tanks are mounted in the underframing 94 of the car body in any convenient fashion. Two tanks rather than one are employed since a single tank would typically be too large to be mounted in the space available beneath the floor of the car body.

As best shown in FIGS. 6 and 7, the two pressure tanks 56 are connected to each other through the conduit system 58. This system also provides fluid communication between the tanks 56 and the openings 118 through the car body above the bellows 52 through a nipple 132 sealed against the upper surface of each plate 112 above the opening 118 therethrough. Thus, there is communication from the pressure tanks 56 through conduit system 58, the openings 118 in car body members 112, and the openings 90 in suspension adapter 54 to the interior of the four bellows 52.

In operation the fluid system just described is pressurized. This provides in each of the four bellows 52 a body of fluid capable of exerting an upwardly directed force F_1 on car body 22 and a body of fluid capable of exerting an upwardly directed force F_2 on the suspension adapter 54 (see FIG. 4).

The car body supporting force F_1 is equal to the product of the area A_1 embraced by annular seal 120 and the pressure of the fluid in the fluid system. Suspension adapter supporting force F_2 is equal to the product of the pressure in the fluid system and an area which is the difference between the effective cross sectional area A_2 of the bellows 52 and area A_1.

As will be apparent from the foregoing, car body 22 is accordingly in part supported directly from side frames 32 and 34 by a column of air which exerts a force F_1 at each bellows and in part supported from the side frames through suspension adapter 54 by a force F_2 thereat. This novel method of supporting the car body is an important feature of the present invention. First, since only part of the weight of the car body is supported by the suspension adapter, this component may be of much lighter construction than the car body supporting bolsters heretofore employed. This provides a significant reduction in truck weight.

Also, by proportioning forces F_1 to forces F_2 in the proper ratio, adequate vertical load support and resistance to lateral loads can be provided. At the same time the sliding friction between car body 22 and suspension adapter 54 can be regulated to provide sufficiently low resistance for curve negotiation without excessive wear of wheels 50, and particularly the wheel flanges. On the other hand, the frictional force between the suspension adapter and car body can be kept sufficiently high to prevent the truck from hunting while it is negotiating straight sections of track.

The exact ratio of F_1 to F_2 will of course depend on the specific application of the principles of the present invention. For example, if the track on which a particular truck is to be employed consists primarily of curves, a different ratio may be used than if such track is straight. In one such application, however, highly satisfactory results were obtained by supporting approximately 53 percent of the load directly from the side frames and approximately 47 percent of the load from the side frames through the suspension adapter.

Referring now to FIG. 6, a valve 134 (only two of which are shown) is provided in fluid conduit system 58 adjacent each of the nipples 132. Valves 134 are pressure responsive and close if there is a significant decrease in the fluid pressure in the bellows 52 with which they are associated, isolating such bellows from the remainder of the fluid system. This novel arrangement eliminates the necessity of providing a mechanical backup system for the suspension system just described since, with the failed bellows isolated, the car body will be adequately supported by the remaining three bellows 52.

Turning now to FIG. 3, it was pointed out above that another important advantage of the present invention is that the load paths are extremely simple. Specifically, vertical loads are transmitted from the car body and suspension adapter through the four bellows 52 to the side frames. Sharp vertical loads are cushioned by the shock absorbers 62 mentioned above, which are of conventional construction (see FIGS. 1 and 5). One shock absorber 62 is employed on each side of truck 20. As best shown in FIG. 1, the upper ends of the shock absorbers are pivotally fixed to depending brackets 138 on suspension adapter 54. The lower ends of the shock absorbers are pivotally fixed to brackets 140 attached to side frames 32 and 34.

Downward movement of suspension adapter 54 and car body 22 relative to truck frame 26 is limited by the above-mentioned downstop 68, which extends upwardly from transom 38 and is positioned to engage and limit the downward movement of suspension adapter 54 (see FIG. 3). As shown in FIG. 5, upward movement of the car body and suspension adapter 54 relative to truck frame 26 is limited by previously mentioned up stops 66, which extend vertically from side frames 32 and 34. Up stops 66 are adapted to be engaged by stop members 146 depending from suspension adapter 54 as the latter moves upwardly relative to truck frame 26.

Referring again to FIGS. 2 and 3, lateral loads are also transmitted to truck frame 26 from car body 22 and suspension adapter 54 through the four bellows 52. Lateral oscillations are damped by the shock absorber 63 referred to above. This shock absorber, which is also of conventional construction, is pivotally fixed at one end to a bracket 148 on transom 38. The opposite end of the shock absorber is similarly pivotally connected to a bracket 150 on suspension adapter 54.

Lateral movement of the car body relative to truck frame 26 is limited by the bumper and stop assemblies 64 mentioned above. One of these assemblies is employed on each side of truck 20. The illustrated assembly (see FIG. 3) includes a stop 152 extending upwardly from side frame 34. A resilient, nonlinear bumper 154 is supported in laterally spaced relationship from lateral stop 152 by a bracket 156 depending from suspension adapter 54. The arrangement on the side of the truck not shown in FIG. 3 is in mirror image relationship to the illustrated assembly 64. Accordingly, the bumpers 154 are both on the opposite, outer sides of lateral stop members 152. Therefore, regardless of whether the suspension adapter and car body move to the left relative to truck frame 26 as shown in FIG. 3 or to the right the permissible distance, one of the two bumpers 154 will engage the associated lateral stop 152 to cushion and restrict further movement.

Referring now to FIGS. 1–3, longitudinal loads are transmitted from the car body and suspension adapter to truck frame 26 through the radius rods 60 and 61 referred to above, which also absorb some lateral load by displacements in bumpers 162. The rear end of radius rod 61 extends through a bracket 158 on side frame 34 of truck 20, and the forward end extends through a bracket 160 on one depending suspension adapter bracket 79. Shock load cushioning bumpers 162 are confined against the side frame and suspension adapter brackets 158 and 160 on opposite sides thereof by flanges 164 on radius rod 61 on one side of each bracket and a washer 166 and nut 168 on the opposite side thereof. Radius rod 60 is connected between truck side frame 32 and the opposite end of suspension adapter 54 in the manner just described except that its rear end is connected to the suspension adapter and its forward end to side frame 30.

In conjunction with the foregoing, it will be noted from FIG. 1 that radius rods 60 and 61 are disposed only slightly above

the centerlines **170** of axles **45** and **46**. The vertical location of the radius rods is of significance since, by disposing them in the manner just described, a more comfortable ride is produced. Also the transfer of vertical loads through wheels **50** in acceleration and braking of the vehicle are minimized.

Many modifications may of course be made in the embodiment of the invention described above. For example, with reference to FIG. **4**, it will be readily apparent that the car body and suspension adapter supporting forces F_1 and F_2 may be provided by properly dimensioned concentric coil springs rather than by compressed fluid. Also, it will be apparent that the principles of the invention can be applied to rigid side frame trucks and different types of independent side frame trucks, if desired.

FIGS. **8** and **9** illustrate another typical physical embodiment of the present invention. The major difference between the truck **172** illustrated in these figures and the truck **20** described above is in the manner in which the car body **174** is pivotally fixed to suspension adapter **176**.

More specifically, the truck **172** vertically oriented, arcuate bearing surfaces **178** having as their center the center **180** of the suspension adapter are provided at the four corners of the latter. These bearing surfaces **178** are embraced by surfaces **182** of matching concave configurations formed on fittings **184** fixed to the underframe **186** of the car body. Annular flanges **188** at the lower ends of members **184** are engageable with suspension adapter **176** to limit upward movement of the car body relative to the suspension adapter.

There are also a number of minor differences between truck **20** and truck **172**. For example, the components of the lateral movement limiting bumper and stop assemblies **190** are reversed relative to the positions they occupy in assemblies **64**. Also, the suspension adapter **176** is fabricated from structural members rather than being of cast construction like suspension adapter **54**. A number of similar modifications further illustrates the differences in physical appearance and construction different embodiments of the present invention may have.

As is implicit from the foregoing, still other modifications may be made in the present invention without exceeding the scope thereof. To the extent that such modifications are not expressly excluded from the appended claims, they are fully intended to be covered therein.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description; and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed and desired to be secured by Letters Patent is:

1. The combination of:
I. a car body and;
II. a railway truck comprising
a. longitudinally extending side frames;
b. a transverse suspension adapter disposed in supporting relationship to the underside of said car body and having side sections extending over said side frames, each of said side sections having an opening therein above said side frames and,
c. resilient support means for supporting said car body from said side frames including spring means mounted on each of said side frames, said spring means having first resilient support portions extending through said openings in said side sections of said suspension adaptor between said side frames and the underside of said car body and second resilient support portions extending between said side frames and said side sections of said suspension adaptor, whereby said car body is in part resiliently supported directly from said side frames and in part resiliently supported from said side frames through said suspension adaptor.

2. The combination of claim **1**, each spring means being a fluid spring providing a fluid pressure chamber with the upper end thereof communicating with the opening in the associated side section of the suspension adaptor, a first portion of the fluid in said chamber thereby passing through said opening in said side section and exerting a first upwardly directed force on the underside of said car body, and a second portion of the fluid in said chamber exerting a second upwardly directed force on the side section of said suspension adaptor.

3. The combination of claim **1**, wherein said car body and said suspension adaptor have means cooperating to constrain said car body to pivotal movement relative to said suspension adaptor.

4. The combination of claim **1**, together with means for absorbing vertical, longitudinal and lateral shock loads.

5. The combination of claim **4**, together with means for limiting movement of the suspension adaptor vertically, laterally, and longitudinally relative to said truck frame.

6. The combination of:
I. a car body; and
II. a railway truck comprising
a. side frames;
a transverse suspension adaptor having side sections extending over said side frames, said side sections having upper support surfaces disposed in supporting relationship to the underside of said car body; and
c. resilient support means for supporting said car body from said side frames including spring means mounted on each of said side frames, said spring means each having a first support portion for directly supporting said car body in part from said side frames and a second support portion for supporting said side sections of said suspension adaptor from said side frames, whereby said car body is in part resiliently supported directly from said side frames and in part resiliently supported from said side frames through said side sections of said suspension adaptor.

7. The combination of claim **6**, comprising means for pivotally connecting said car body to said suspension adaptor.

8. The combination of claim **6**, wherein there are openings in said side sections of said suspension adaptor above said side frames, said first support portions of said spring means extending through said openings between said side frames and the underside of said car body, and said second support portions of said spring means extending between said side frames and said side sections of said suspension adaptor.

9. The combination of claim **8**, each spring means being a fluid spring providing a fluid pressure chamber with the upper end thereof communicating with said opening in the associated side section of the suspension adaptor, a first portion of the fluid in said chamber thereby passing through said opening in said side section and exerting a first upwardly directed force on the underside of said car body, and a second portion of the fluid in said chamber exerting a second upwardly directed force on the side section of said suspension adaptor.

10. The combination of:
I. a car body; and
II. a railway truck comprising
a. side frames;
b. a transverse suspension adaptor having a central section and side sections extending over said side frames, said side sections having upper support surfaces disposed in supporting relationship to the underside of said car body;
c. means for pivotally connecting said car body to the central section of said suspension adaptor and;
d. resilient support means for supporting said car body from said side frames including spring means mounted on each of said side frames, said spring means each having a first support portion for directly supporting said car body in part from said side frames and a second support portion supporting said side sections of said suspension adaptor from said side frames, whereby said

car body is in part resiliently supported directly from said side frames and in part resiliently supported from said side frames through said side sections of said suspension adaptor.

11. The combination of claim 10, wherein there are openings in said side sections of said suspension adaptor above said side frames, said first support portions of said spring means extending through said openings between said side frames and the underside of said car body, and said second support portion of said spring means extending between said side frames and said side sections of said suspension adaptor.

12. The combination of claim 11, each spring means being a fluid spring providing a fluid pressure chamber with the upper end thereof communicating with said opening in the associated side section of the suspension adaptor, a first portion of the fluid in said chamber thereby passing through said opening in said side section and exerting a first upwardly directed force on the underside of said car body, and a second portion of the fluid in said chamber exerting a second upwardly directed force on the side section of said suspension adaptor.

13. The combination of:

I. a car body; and

II. a railway truck comprising:

a. a first frame section comprising a first side frame and a first transom rigidly fixed to said first side frame and extending laterally therefrom;

b. a second frame section comprising a second side frame and a second transom rigidly fixed to said second side frame and extending laterally therefrom;

c. the transoms of said first and second frame sections being spaced from each other longitudinally of said truck;

d. wheel and axle assemblies hournalled in said frame sections at opposite ends of the truck and providing wheels at locations corresponding generally to the four corners of said truck;

e. first and second means for so connecting said first frame section to said second frame section as to permit vertical displacement of any one of said wheels relative to the remaining wheels while maintaining said side frames substantially in rectangular and vertical tram, said first and second connecting means confining the relative movement between said first and second frame sections to an axis extending diagonally across said truck through said connecting means;

f. a suspension adaptor disposed in supporting relationship to the underside of said car body; and

g. resilient support means for supporting said car body from said first and second side frames, each of said resilient support means including a first support portion which directly supports said car body in part from said side frames and a second support portion which supports said car body in part through said suspension adaptor, so that the weight of said car body is in part supported directly from said side frames and in part supported from said side frames through said suspension adaptor.

14. The combination of:

I. a car body having a pressure vessel therein, there being openings through the under side of said car body and means providing fluid communication between said pressure vessel and said openings; and

II. a railway truck comprising:

a. side frames;

b. a suspension adaptor disposed in supporting relationship to the under side of said car body, there being an opening through said suspension adaptor above each of said side frames communicating with an opening through the under side of the car body;

c. means disposed between each of said side frames and said suspension adaptor providing a pressure chamber therebetween, there being an opening in the upper end of each of said pressure chambers in fluid communication through the opening in said suspension adaptor and the associated opening in the car body with the pressure vessel in the car body; and

d. the effective sizes of the openings through the car body relative to the effective cross-sectional areas of said pressure chamber providing means being such that fluid compressed in the pressure chambers will exert a first upwardly directed force on the suspension adaptor and a second upwardly directed force on the car body, whereby said car body is in part fluid-supported directly from said side frames and in part fluid-supported from said side frames through said suspension adaptor.

15. The combination of:

I. a car body comprising:

a. a floor supporting underframe;

b. members fixed to said underframe having apertures therethrough opening onto the under side of said car body;

c. at least one pressure vessel supported from said underframe; and

d. conduit means providing communication between the apertures through said members and the interior of the pressure vessel; and

II. a railway truck comprising:

e. a truck frame comprising laterally spaced, longitudinally extending side frames;

f. a suspension adaptor disposed in supporting relationship to the under side of said car body and engaging the apertured members, there being an opening in said suspension adaptor beneath each of the apertures through said members;

g. a vertically extensible tubular member having a closed bottom end extending from a side frame to said suspension adaptor beneath each of the openings in said adaptor

h. means providing a seal between each of said tubular members and said suspension adaptor around the associated opening in the adaptor whereby, when said pressure vessel is pressurized, there is compressed fluid in each of said tubular members producing a first upwardly directed force on the suspension adaptor and a second upwardly directed force on one of said apertured car body members, said car body thereby being in part supported directly from said side frame by the compressed fluid and being in part supported from said side frame by said compressed fluid through said suspension adaptor.

16. The combination of claim 15, wherein there is a member of a material having a low coefficient of friction disposed said adaptor suspension adaptor and each apertured member of the car body to reduce sliding friction between said suspension adaptor and said car body.

17. The combination of claim 15, wherein there is a dirt shield extending between the apertured car body member and the suspension adaptor around each of the apertures in such members.

18. The combination of claim 15, together with cooperating means on said car body and said suspension adaptor confining said car body to pivotal movement relative to said suspension adaptor comprising a depending flange providing a centrally located recess in said suspension adaptor a fitting fixed to the under side of said car body and depending into said recess, and a bearing in said recess between said fitting and said flange.

19. The combination of claim 18, together with a member abutting the lower end of said flange and fixed to the fitting to resist vertical movement of the car body relative to the suspension adaptor.

20. The combination of claim 15, wherein said suspension adaptor has a generally rectangular configuration and including cooperating means on said car body and said suspension

adaptor confining said car body to pivotal movement relative to said suspension adaptor comprising bearing surfaces formed on the suspension adaptor at the corners thereof, said surfaces being generally vertical and including segments of an arc having its center located at the center of the suspension adaptor and one or more fittings fixed to the under side of the car body, said fittings having depending portions engaging the bearing surfaces on the suspension adaptor.

21. The combination of claim **15**, together with an arrangement for absorbing and transferring longitudinal loads comprising a first longitudinally extending radius rod, means fixing the forward end of said radius rod to the front portion of said suspension adaptor at one side of said truck and the rear end of said rod to one of said side frames, a second longitudinally extending radius rod, means fixing the rear end of said second radius rod to the rear portion of said suspension adaptor on the other side of said truck, means for fixing the forward end of said second radius rod to the other of said side frames, and resilient members arranged to cushion longitudinal movement between the radius rods and the truck components to which they are fixed.

22. The combination of claim **15**, together with means for limiting lateral movement of the suspension adaptor relative to the side frames comprising stops extending vertically from said side frames and bumpers fixed to said suspension adaptor and disposed in laterally spaced relation to said vertically extending stops on opposed sides thereof.

23. The combination of claim **22**, together with a transversely oriented shock absorber connected between said truck frame and said suspension adaptor for cushioning lateral shock loads.

24. The combination of claim **15**, together with means for absorbing vertical shock loads comprising shock absorbers on opposite sides of the truck, the upper ends of said shock absorbers being pivotally fixed to said suspension adaptor and the lower ends of said shock absorbers being pivotally fixed to said side frames.

25. The combination of claim **24**, wherein said truck frame further includes transoms extending laterally between said side frames and including at least one down stop extending upwardly from one of said transoms for limiting the downward movement of said suspension adaptor toward said side frames.

26. The combination of claim **25**, together with an up stop on at least one of said transoms and a member depending from said suspension adaptor and engageable with said up stop to limit upward vertical movement of said suspension adaptor relative to said truck frame.

27. The combination of claim **15**, together with a valve means in said conduit means between said pressure vessel and each of the apertures in said apertured car body members capable of isolating the aperture from the pressure vessel upon a decrease in the pressure in the vertically extensible tubular member communicating with the aperture to thereby isolate said tubular member in the event of a failure thereof.

28. The combination of claim **15**, wherein there are two vertically extensible tubular members at each side of said truck, one of the tubular members at each side of the truck being beneath the forward portion of the suspension adaptor and the other being beneath the rear portion of the suspension adaptor.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,646,893 Dated March 7, 1972

Inventor(s) Gustav B. Sundby

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, after line 75, add:
"U.S. Letters Patent No. 3,313,245 issued April 11, 1967, which is hereby incorporated herein."

Column 2, line 40, after "stalled" change "ans" to --and--.
Column 4 , line 33, after "than" insert --the--.
Column 8, line 23, before "a" insert --b,--.
Column 9, line 35, change "hournalled" to --journalled--.
Column 10, line 54, after "disposed" insert --between--; after "said" delete "adaptor".

Signed and sealed this 29th day of August 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents

FORM PO-1050 (10-69)

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