United States Patent [19]

Sundby

[11] **3,795,203**

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[54] **ROLL DAMPENING RAILWAY TRUCKS**

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[73] Assignee: **Rockwell International Corporation,** Pittsburgh, Pa.

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[52] **U.S. Cl.**..... **105/182 R,** 105/164, 105/199 R, 105/218 A

[51] **Int. Cl.**..... **B61f 3/08,** B61f 5/24, B61f 5/36

[58] **Field of Search**.... 105/176, 182 R, 193, 199 R, 105/194, 218 A, 224 R, 164; 280/124 F

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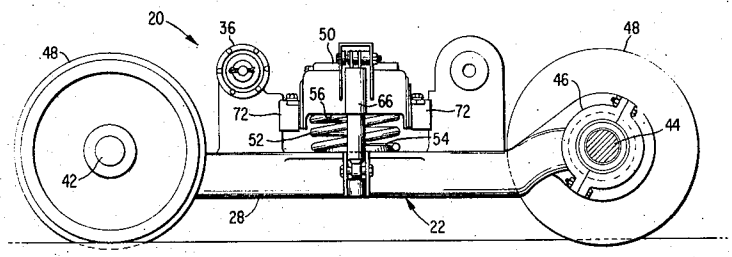
[57] **ABSTRACT**

Railway trucks including frame sections consisting of a side frame and a transom extending transversely therefrom; spherical bearings connecting the frame sections for relative movement about an axis extending diagonally of the truck; wheel and axle assemblies connected to the side frames by pivoted journal arms; air bellows between the journal arms and side frames for adjusting the height of the side frames relative to the rails on which the truck is riding; a bolster supported from the side frames by bolster spring assemblies; lateral and vertical shock absorbers connected between the bolster and the truck frame sections; and snubbers for limiting longitudinal and lateral movement of the bolster relative to the truck frame sections.

9 Claims, 6 Drawing Figures

PRIOR ART



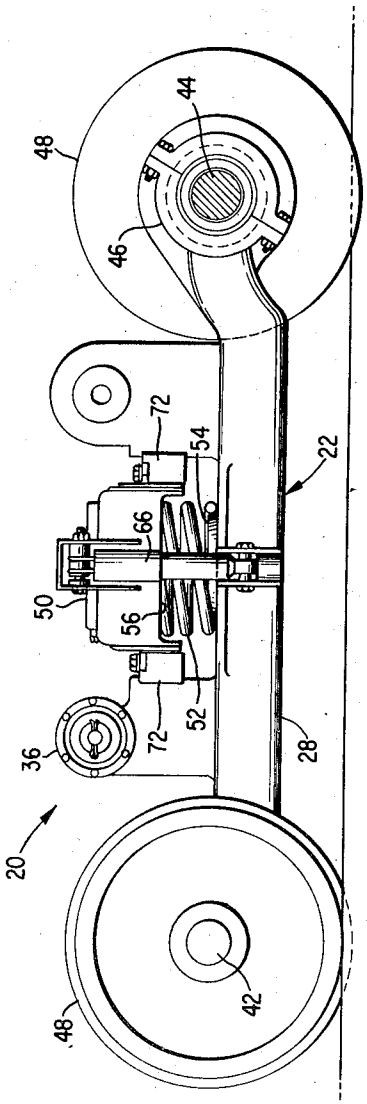


FIG. 1
PRIOR ART

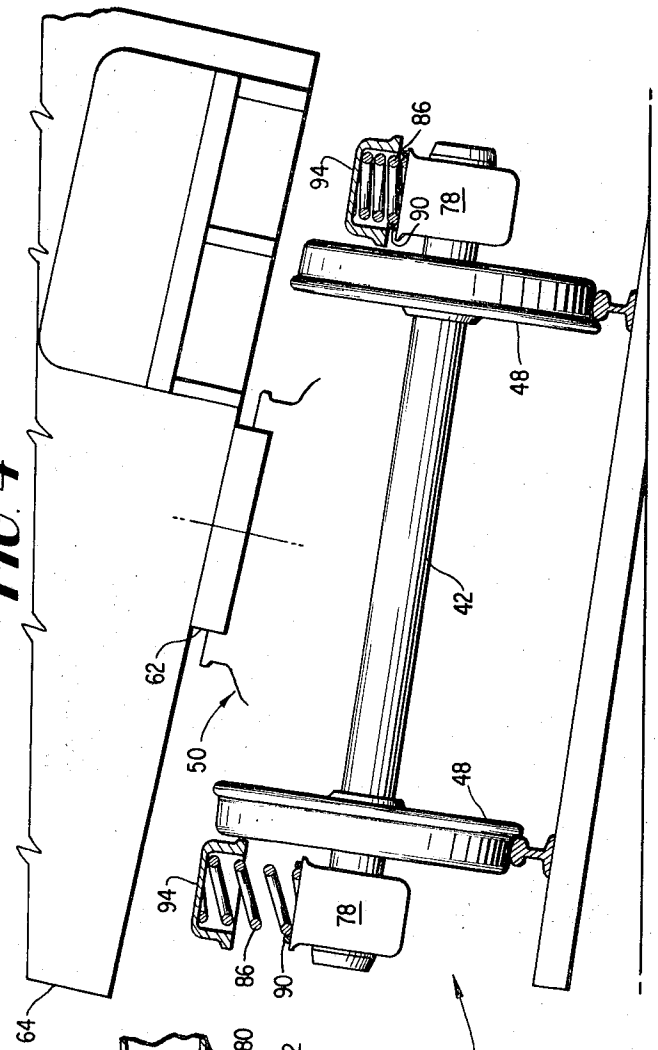


FIG. 4

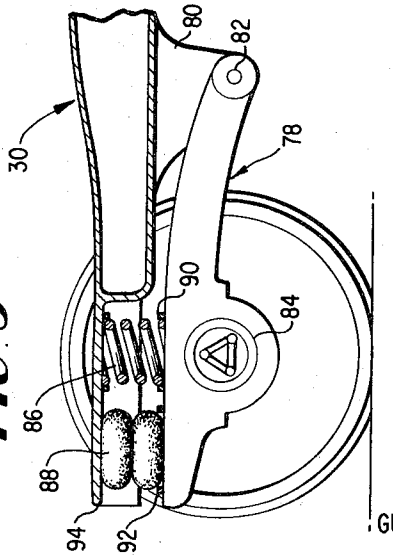


FIG. 3

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FIG. 5

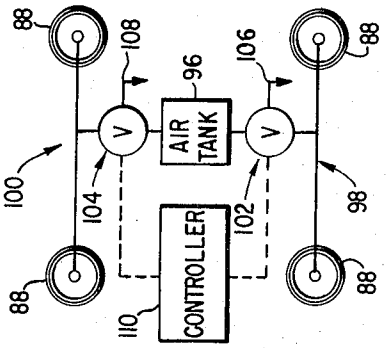


FIG. 6

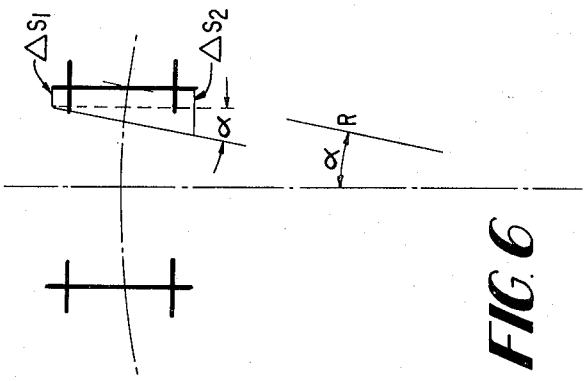
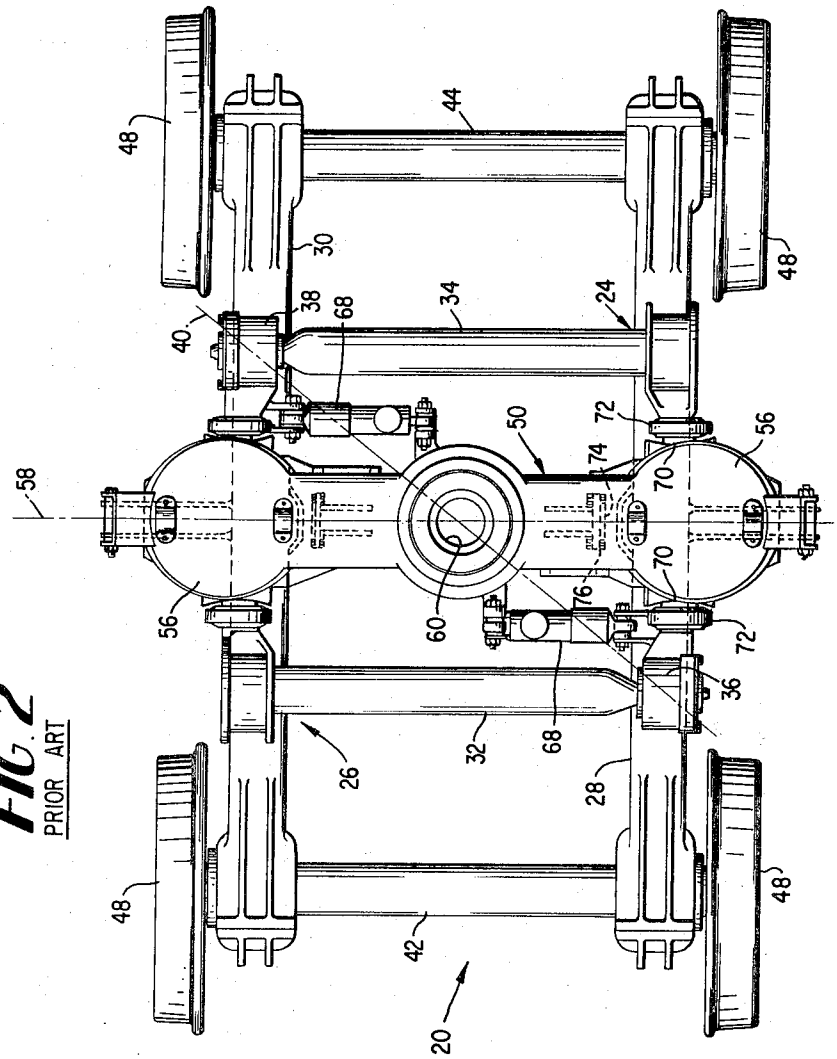


FIG. 2
PRIOR ART



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ROLL DAMPENING RAILWAY TRUCKS

This invention relates to railway trucks and, more specifically, to railway trucks capable of producing increased passenger comfort, improved adhesion to the rails, and decreased wheel flange and tread wear during curve negotiation.

In conventional railway trucks, the front and rear axles are parallel during curve negotiation. Therefore, as a conventional truck rounds a curve, the wheels negotiate the curve by a combination of rolling and sliding motion. More specifically, the inner and outer wheels are fixed to the same axle and therefore rotate at the same speed; and the outer wheels follow a longer path than the inner wheels. Therefore, during curve negotiation, the inner wheels slide in the direction the truck is moving while the outer wheels slide in the opposite direction. In addition, the wheels are not tangent to the truck; and they therefore slide laterally as the truck rounds a curve.

The sliding motions just described produce truck wheel tread and flange wear. Also, sliding motions decrease the frictional forces between the truck wheels and the rails during curve negotiation. This is important as the consequence is a loss of adhesion and traction as the truck rounds a curve.

Furthermore, curves in railway tracks are designed for negotiation at a specific speed. At a lower speed a railway car will lean excessively toward the inside of the curve, causing discomfort to passengers in the car. Conversely, at speeds in excess of the design speed, the bank or lean of the car will be insufficient; and the passengers will, again, experience discomfort.

It is one important and primary object of the present invention to provide railway trucks which do not have the just-enumerated disadvantages of heretofore available railway trucks.

In the novel railway trucks of the present invention, by which the foregoing and other important objects are achieved, the side frames are supported from wheel and axle assemblies by pivoted journal arms at the four corners of the trucks; and extensible bellows are mounted between the free ends of the journal arms and the side frames of the trucks. These bellows are connectable to a compressed air source and to atmosphere through appropriate piping and valving so that the bellows can be pumped up to extend them and bled to collapsed them.

In a typical curve negotiation, air is admitted to the bellows on both the inside and outside of the curve to extend them with more air being supplied to those on the outside of the curve so that their extension is greater. This increases the elevation of the side frame on the outside of the curve relative to the elevation of the side frame on the inside of the curve.[1] (1. Depending upon the curve being negotiated, air may be bled from the bellows on the inside of the curve rather than being supplied to them to produce the height differential relative to the track of the truck side frames.) As a result, the bank or lean of the car supported from the truck is increased, making the negotiation of the curve more comfortable for the passengers.

A further advantage of adjusting the elevation of the truck side frames in the manner just described is that the speed with which the curve can be safely negotiated is increased by twenty percent or more. This is advantageous for obvious reasons.

Also, in railway trucks in accord with the present invention, the pivot axes of the journal arms are below the axes of rotation of the truck wheels. Accordingly, as the side frames on the outside and inside of the curve are raised, the spacing between the outer wheels is increased to a greater extent than that between the inner wheels and the axles of the truck are displaced from their normal positions in which they are at right angles to the side frames of the trucks so that the axles are aligned at least closely along radii of the curve. This eliminates or at worst greatly reduces sliding motions of the wheels relative to the rails. Consequently, tread and flange wear is reduced; and traction between the wheels and the rails is improved.

To illustrate another circumstance in which the present invention provides a decided advantage, it was pointed out above that railway curves are designed for negotiation at one specific speed and that, at considerably lower speeds, cars lean excessively toward the inside of the curve. In this case the sequence described above can be reversed. That is, the elevation of the side frame on the outside of the curve can be reduced relative to that of the side frame on the inside of the curve to decrease the lean of the car and increase passenger comfort during the negotiation of the curve.

One primary object of the invention has been identified above. Another primary and related object of the invention is the provision of novel, improved railway trucks capable of providing increased passenger comfort and traction and of reducing wheel tread and flange wear during curve negotiation.

Other important but more specific objects of the invention are to provide novel, improved railway trucks:

1. which can be adjusted to regulate the degree of lean or bank of a car supported from the truck during curve negotiation independently of the superelevation of the track.

2. which can be adjusted during curve negotiation so that the axles of the truck lie at least approximately along radii of the curve.

3. in which the adjustments specified in objects 1 and 2 above can be made independently of the load in a carbody supported from the truck.

4. which include side frames supported from fore and aft wheel and axle assemblies by pivoted journal arms, bellows between the free ends of the journal arms and the side frames, and a system for selectively admitting air to and bleeding it from various ones of the bellows to alter the height of the side frames above the rails on which the truck is riding.

Other important objects and features and further advantages of the 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 prior art railway truck;

FIG. 2 is a top view of the railway truck of FIG. 1;

FIG. 3 is a partial side view of the truck of FIGS. 1 and 2 modified for improved curve negotiation in accord with the principles of the present invention;

FIG. 4 is a generally diagrammatic rear view of a railway car supported by trucks constructed in accord with the principles of the present invention as the car negotiates a curve;

FIG. 5 is a schematic illustration of a compressed air system for trucks in accord with the present invention; and

FIG. 6 is a schematic representation of the manner in which the truck axles are oriented during curve negotiation.

Referring now to the drawing, FIGS. 1 and 2 depict a railway truck 20 of a type which may be readily modified in accord with the principles of the present invention to provide improved curve negotiation and the other advantages of the invention discussed above.

Truck 20 has a rectangular frame 22 consisting of two generally L-shaped, rigid subassemblies or frame sections 24 and 26. These subassemblies are formed by longitudinally extending side frames 28 and 30. Laterally extending transoms 32 and 24 are secured to or made integral with the side frames. Subassemblies 24 and 26 are interconnected at diagonally opposed points by spherical bearing assemblies 36 and 38 to permit relative pivoting between the L-shaped subassemblies about a diagonal axis 40 through the centers of the spherical bearings and the center of the truck.

Truck frame 22 is supported on axles 42 and 44 by roller bearing assemblies 46 which are resiliently mounted in side frames 26 and 28. Axles 42 and 44 each having two railway wheels 48 secured thereto.

Because of the manner in which the frame subassemblies 24 and 26 are interconnected by bearing assemblies 36 and 38, there is only one type of motion therebetween. This is a pure pivotal movement of one subassembly with respect to the other about axis 40. Accordingly, as truck 20 rolls onto an uneven stretch of track on which one of the wheels 48 furthest from axis 40 is at a low point in the track, the associated frame subassembly tends to pivot downwardly about axis 40 to re-establish even wheel loading. Conversely, when a wheel furthest from the pivot axis is on a high point on a rail, its frame subassembly pivots upwardly about axis 40 to re-establish even wheel loading.

Thus, the construction of frame 22 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.[2] (2. The axle bearing assemblies 46 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.)

A transversely extending bolster 50 is supported from truck frame 22 by bolster spring assemblies 52, which extend from platforms or seats 54 on side frames 28 and 30 upwardly into spring caps 56 at the ends of the bolster. As shown in FIG. 2, the bolster spring assemblies may be located slightly outboard of truck side frames 28 and 30 with each spring assembly being on the same side of the transverse centerline 58 of the truck as the spherical bearing assembly 36 or 38 on the same side of the truck. This location of the spring assemblies in a diagonally hinged truck of the type depicted in FIGS. 1 and 2 keeps wheels 48 from unloading as they pass over high and/or low spots in a track.[3] (3. Much the same result can be achieved by locating the spring assemblies inboard of the truck frames and on the opposite side of centerline 58 from the spherical bearing assembly on the same side of the truck.)

As shown in FIGS. 2 and 4, bolster 50 has the usual centrally located recess 60 into which a kingpin 62 secured to the underside of a carbody 64 depends to pivotally secure the carbody to the truck. Also, bolster 50 is connected to the side frames 28 and 30 of truck frame 22 by conventional vertical and lateral shock absorbers 66 and 68 to keep vertical and lateral shock loads from being transmitted to carbody 64. Longitudinal forces are absorbed by snubbers or bumpers 70 in mounts 72 on the truck frame on opposite sides of the bolster at each end thereof. Similar snubbers or bumpers 74 in mounts 76 on the under side of bolster 50 are engageable with co-operating stops (not shown) on side frames 28 and 30 to limit lateral movement of the bolster relative to the side frame.

The details of truck 20 are described in U.S. Pat. No. 3,313,245 issued Apr. 11, 1967, to G. B. Sundby for RAILWAY TRUCK, which is hereby incorporated herein. As the forementioned components are described in the Sundby Patent and as their details are not part of the present invention, they will not be described further herein except as they relate to the present invention.

In the present invention axles 42 and 44 are suspended from truck frame 22 by pivoted journal arms 78 rather then directly from the side frames of the truck as in the prior art truck described above. More specifically, journal arms 78 are pivotally connected at one end thereof to mounts 80 depending from side frames 28 and 30 by transversely extending pivot pins 82 at levels below those at which the centerlines (or axes of rotation) of axles 44 lie. Axles 42 and 44 extend through journal arms 78 adjacent the free ends thereof and are rotatably supported in the journal arms as by bearings 84.

As shown in FIG. 3, addition of the journal arms just described to the truck 20 illustrated in FIGS. 1 and 2 requires minor modifications in the configuration of side frames 28 and 30. The precise manner in which the configuration of the side frames is altered is of no consequence, however, and will vary from application to application of the invention.

Referring again to FIG. 3, a coil type cushioning spring 86 and an air bellows 88 are disposed between each journal arm 78 and the associated side frame 28 or 30. The spring 86 and bellows 88 are confined at their lower ends in seats 90 and 92 and in caplike portions 94 at the ends of the associated side frames 28 and 30 at their upper ends.

Referring now to FIG. 5, the air bellows 88 on one side of the truck are connected to a source of compressed air or tank 96 through a system of diagramatically illustrated conduits identified by reference character 98. The air bellows on the opposite side of the truck are similarly connected to air tank 96 through conduit system 100. The flow of air to and from the bellows 88 on the first-mentioned side of the truck is controlled by a three-position valve 102, and the flow to and from the bellows on the other side of the truck is controlled by a similar valve 104.

In one active position, the valves connect the associated bellows 88 to air tank 96. In the other active po-

sition, the valves connect the associated bellows to atmosphere through lines **106** and **108.** In the third position the bellows are isolated both from the air tank and from atmosphere.

The positions of valves **102** and **104** are regulated by a controller **110.** This controller may be of conventional construction and can be operated manually for example by means of manually operated switches which control electric motors adapted to selectively position the valves **102** and **104,** or automatically for example by inertial devices responsive to centrifugal forces developed during curve negotiations, all of which are well known in the art.

As a carbody supported by trucks constructed in accord with the present invention rounds a curve, controller **110** is manually or automatically activated to position the valves **102** or **104** so that compressed air will flow from tank **96** to the bellows **88** on the outside of the curve, pumping up or extending these bellows. At the same time, the controller positions the other valve so that air also flows to the bellows **88** on the inside of the curve, extending these bellows but not to the same extent as those on the outside of the track. As a result, the side frame on the outside of the curve will be elevated to a greater extent with respect to the track than the side frame on the inside of the curve as shown in FIG. **4.**[4] (4. As indicated above, air may instead be bled from rather than supplied to the bellows on the inside of the curve to collapse or shorten them if dictated by the nature of the curve being negotiated.) The carbody will accordingly be tilted toward the inside of the curve to a degree greater than that resulting simply from the superelevation of the track. Thus the degree to which the carbody is tiled during curve negotiation, commonly referred to in the art as "roll," may be controlled.

By adjusting the length of the bellows on the outside and on the inside of the curve in the manner just described, axles **42** and **44** can also be positioned during curve negotiation so that they lie along or approximately along radii of the curve.[5] (5. As the negotiation of the curve is completed, valves **102** and **104** are positioned to allow air to bleed from belows **88** through lines **106** and **108,** collapsing them to their normal degree of extension in a typical curve negotiation. In other cases air has to be supplied to the bellows on the inside of the curve to extend them to their normal length.) As the bellows on the outside of the curve are extended relative to those on the inside of the curve, the distance between the wheels on the outside of the curve becomes greater than that between the wheels on the inside of the curve. And both the inside and outside wheels are shifted (see FIG. **6**) so that axles **42** and **44** lie along radii of the curve.

This minimizes or even eliminates skewing or sliding of the wheels through the curve, reducing both wheel tread and flange wear. In addition, due to the elimination or minimization of sliding, frictional forces between the wheels and the rails are in the direction of the rails. Accordingly, there is greater adhesion between the wheels and the rails and, consequently, better traction through the curve.

Further, by adjusting the tilt of the carbody in the manner just described, curve negotiation may be made more comfortable for the passengers.

Yet another advantage is that curves can be negotiated at a higher speed then they can be with a truck of conventional design. The following example illustrates the increase in curve speed negotiation which may be realized by utilizing the present invention:

Static deflection of springs **86**	4.5 in
Distance between the rolling circles of wheels **48**	59 in
Wheel base of the truck	102 in
Distance between the pivot axes **82** of the fore and aft journal arms **78**	77.5 in
Superelevation of the track	8 in
Vertical displacement of the axles **42** and **44** on the inside of curve	1.0 in
Vertical displacement of the axles **42** and **44** on the outside of curve	2.5 in
Longitudinal displacement of the axles **42** and **44** on the inside of the track (ΔS2 in FIG. **6**)	0.2216 in
Longitudinal displacement of the axles **42** and **44** on the outside of the track (ΔS1 in FIG. **6**)	0.2216 in

Without banking the balancing speed for a 1940 foot curve is 62 miles per hour. By banking or tilting the trucks as just described, this speed is increased to 76 miles per hour.

At speeds lower than that at which a curve is designed to be negotiated, the carbody may lean excessively toward the inside of the curve. In addition to truck wheel tread and flange wear, this can cause considerable discomfort to the passengers. Excessive lean can be eliminated when trucks in accord with the present invention are employed by pumping up and extending the bellows on the inside of the curve relative to those on the outside of the curve to produce the correct lean of the carbody for slower speeds of curve negotiation.

It is also important, in conjunction with the foregoing, that the performance changes obtained by banking the trucks are independent of the load in the car supported from the trucks. This greatly simplifies the task of correctly banking the trucks for correct curve negotiation.

It will be obvious to those skilled in the arts to which the present invention pertains that the principles of the invention are applicable to many different types of railway trucks and that other techniques may be used to elevate the side frames of the trucks. To the extent that such applications of the invention 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 embodiment is 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. In a railway car, the combination of a carbody; a truck comprising side frames; means for supporting said carbody on said truck; fore and aft wheel and axle assemblies; means supporting said side frames from said wheel and axle assemblies at locations corresponding generally to the four corners of the truck; and selec-

tively operable means for independently altering the position of either of said side frames relative to the wheel and axle assemblies from which they are supported during curve negotiation to control the roll of the carbody supported from the truck and also adjust the longitudinal spacing between the fore and aft wheels on opposite sides of the truck.

2. A railway truck or the like, comprising fore and aft wheel and axle assemblies; side frames; means supporting said side frames from said wheel and axle assemblies at locations corresponding generally to the four corners of the truck; and selectively operable means for independently altering the position of either of said side frames relative to the wheel and axle assemblies from which they are supported during curve negotiation to control the relative vertical position of the side frames to thereby adjust the longitudinal spacing between the fore and aft wheels on opposite sides of the truck.

3. The railway truck of claim **2** in which said means supporting said side frames from said wheel and axle assemblies includes journal arms, one end of each journal arm being pivotally attached to one of said side frames and the other end thereof having journalled thereon the associated one of said wheel and axle assemblies.

4. The railway truck of claim **3** in which said journal arms are pivotally attached to said side frames for movement about an axis parallel to and below the axis of rotation of the associated wheel and axle assembly.

5. The railway truck of claim **3** in which said journal arms are the sole means between the side frames and the wheel and axle assemblies for guiding the vertical movement of said side frames with respect to said wheel and axle assemblies.

6. A railway truck or the like, comprising fore and aft wheel and axle assemblies; side frames; means supporting said side frames from said wheel and axle assemblies comprising journal arms at locations corresponding generally to the four corners of the truck and means attaching each said journal arm at one end thereon to one of said side frames for pivotal movement about an axis extending transversely of the truck and located below the longitudinal centerlines of the wheel and axle assemblies, said axles being journalled on said journal arms at locations toward the free ends of said arms; and selectively operable means for altering the position of either of said side frames relative to said wheel and axle assemblies during curve negotiation to control the relative vertical position of the side frames to thereby adjust the longitudinal spacing between the fore and aft wheels on opposite sides of the truck, said means comprising an extensible bellows associated with each journal arm, one end of each bellows being mounted on the free end of the respective journal arm and the other end of each bellows supporting the associated side frame; a compressed air source; and means for connecting each said bellows to said compressed air source to extend said bellows and raise the associated side frame and for exhausting air from said bellows to thereby collapse said bellows and lower the associated side frame.

7. The railway truck or the like of claim **6,** together with resilient support means between each of said journal arms and the associated side frame, the resilient support means being positioned at a location between the bellows on the same journal arm and the location at which the journal arm is pivotally fixed to the associated side frame.

8. A railway truck comprising a first frame section comprising a first side frame and a first transom rigidly fixed to said first side frame and extending laterally therefrom; a second frame section comprising a second side frame and a second transom rigidly fixed to said second side frame and extending laterally therefrom, the transoms of said first and second frame sections being spaced from each other longitudinally of said truck; wheel and axle assemblies journalled in said frame sections at opposite ends of the truck and providing wheels at locations corresponding generally to the four corners of said truck; 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; means supporting said frame sections from said wheel and axle assemblies comprising journal arms at locations corresponding generally to the four corners of the truck and means attaching each said journal arm at one end thereof to one of said side frames for pivotal movement about an axis extending transversely of the truck and located below the longitudinal centerlines of the wheel and axle assemblies, said axles being journalled in said journal arms at locations toward the free ends of said arms; and selectively operable means for altering the position of either of said side frames relative to said wheel and axle assemblies during curve negotiation to control the relative vertical position of the side frames to thereby adjust the longitudinal spacing between the fore and aft wheels on opposite sides of the truck, said means comprising an extensible bellows associated with each journal arm, one end of each bellows being mounted on the free end of the respective journal arm and the other end of each bellows supporting the associated side frame; a compressed air source; and means for connecting each said bellows to said compressed air source to extend said bellows and raise the associated side frame and for exhausting air from said bellows to thereby collapse said bellows and lower the associated side frame.

9. The railway truck of claim **8,** wherein said carbody supporting means includes a transversely extending bolster means and including bolster spring assemblies supporting said bolster means from said side frames, the vertical axes of said bolster spring assemblies being disposed transversely of the truck with respect to the longitudinal centerlines of the journal arms supporting the frame sections of the truck from the wheel and axle assemblies.

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