

April 11, 1967

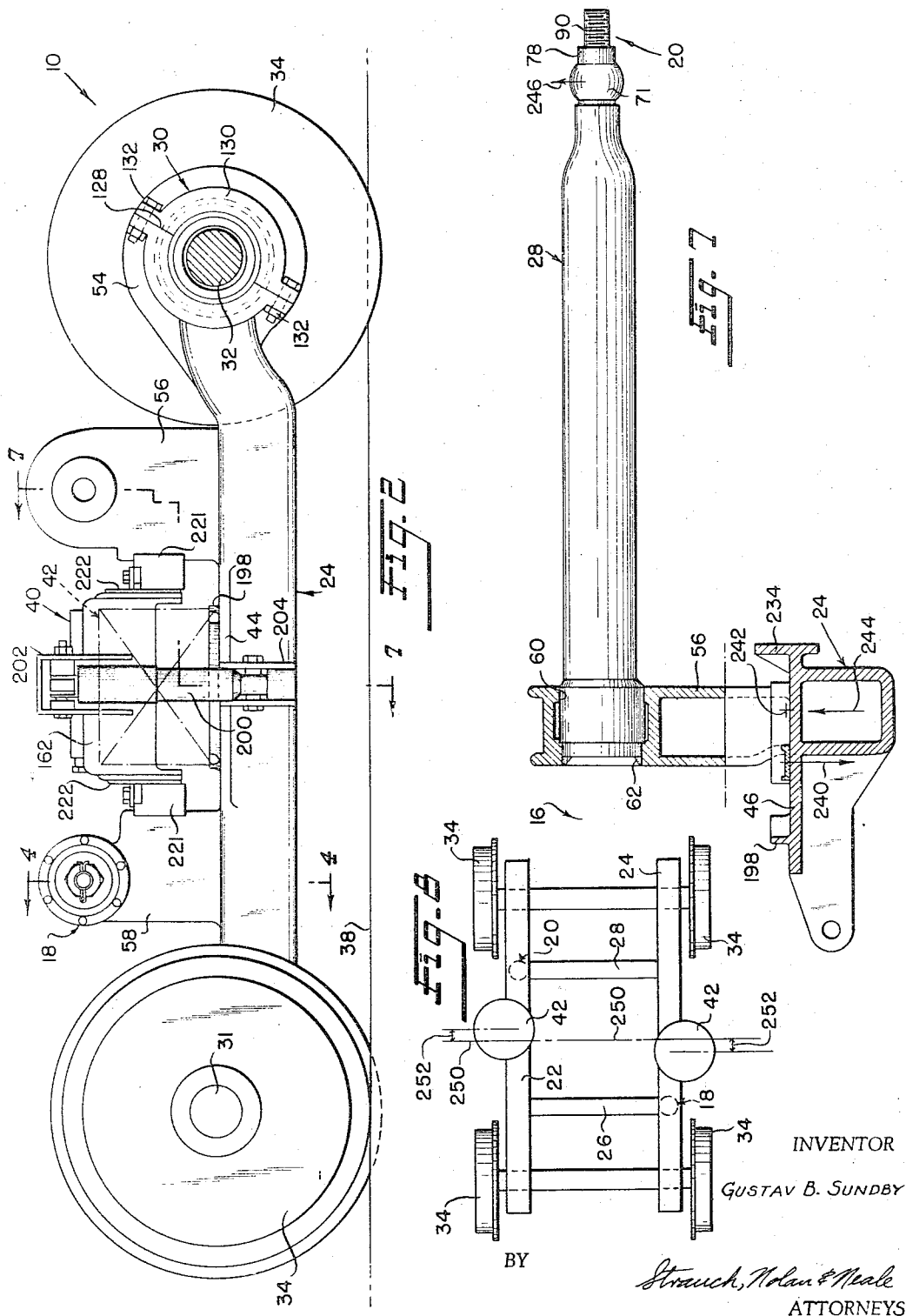
G. B. SUNDBY

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RAILWAY TRUCKS

Filed Aug. 10, 1964

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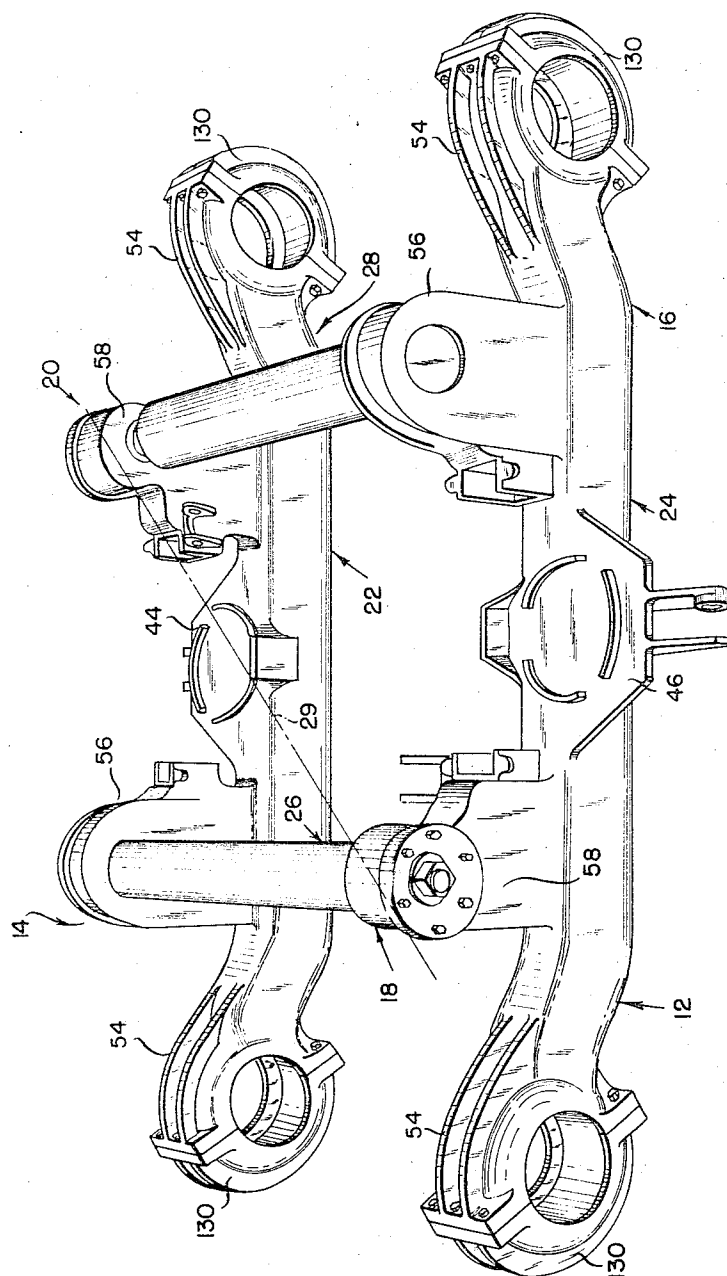
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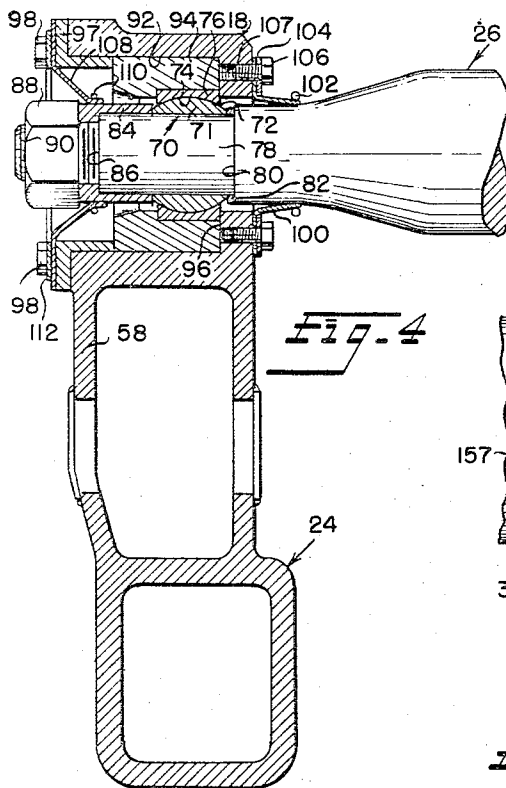
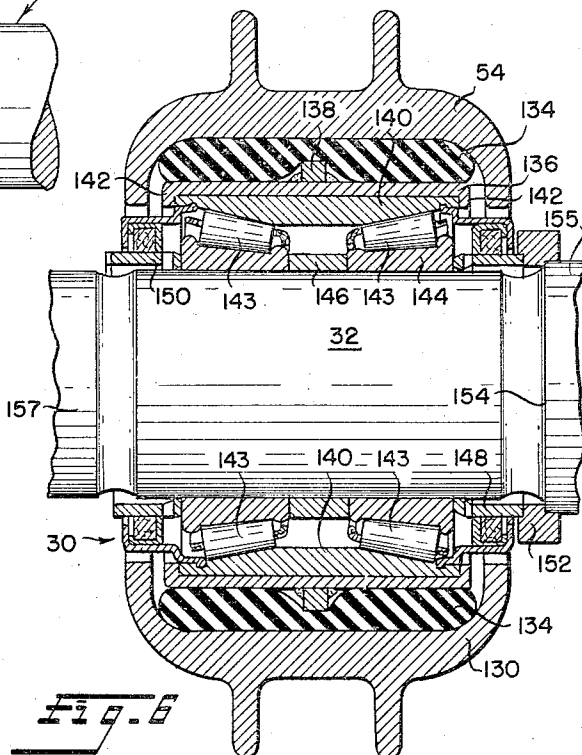
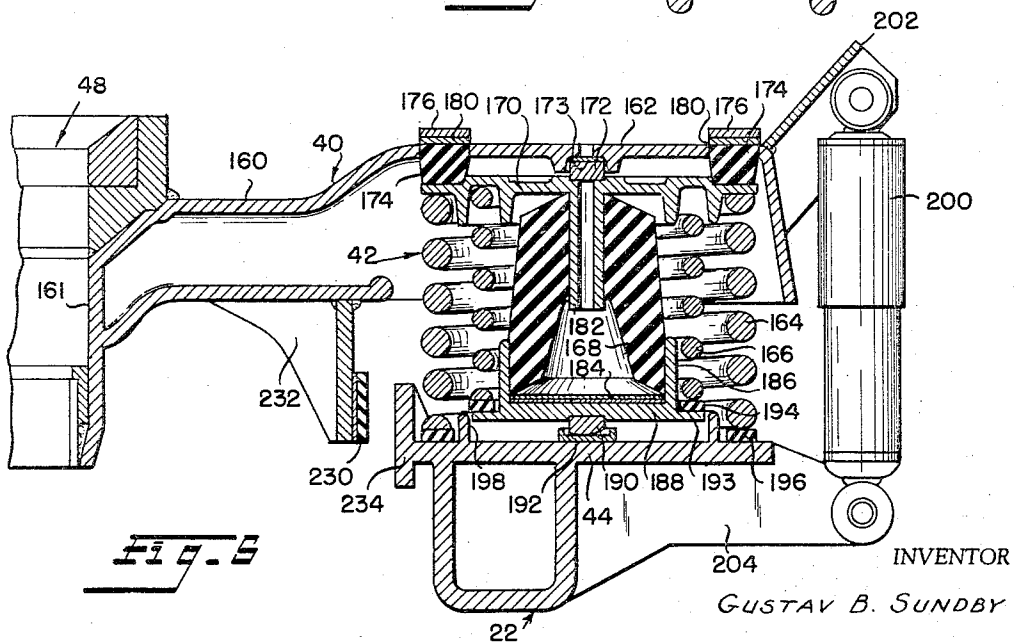
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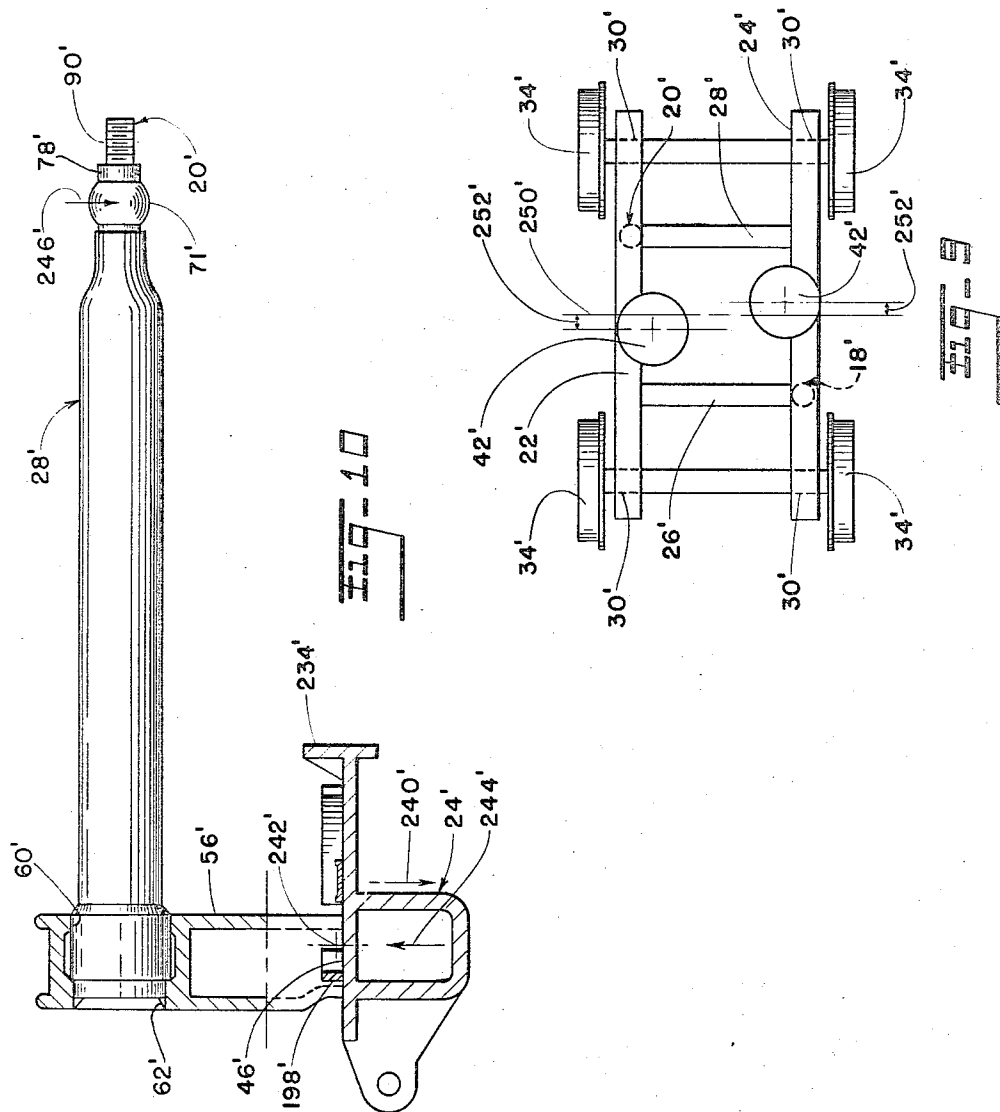
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5 Sheets-Sheet 5



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3,313,245

RAILWAY TRUCKS

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9 Claims. (Cl. 105—197)

This application is a continuation-in-part of my co-pending application Ser. No. 337,572, filed Jan. 14, 1964, now abandoned; this invention relates to railway-car trucks and more specifically to improved independent side frame trucks.

There are two basic, conventional designs for railway truck frames: the monolithic frame and the independent side frame. In trucks having a monolithic frame, if the wheel axles are rigidly journalled in the frame, the wheels are unable to following irregularities in the track, and unless the track is perfectly flat, a four-wheel, monolithic frame truck of this kind would be supported entirely by two diagonally opposite wheels while the remaining wheels would be unloaded and at least one of them would be out of contact with a rail. To obviate such uneven wheel loading, axle bearing springs or journal box springs and their necessary vertical bearing guides or pedestals are conventionally provided between each axle bearing and the rigid monolithic frame. Additionally, the conventional bolster spring system must also be provided to resiliently support the railway car upon the truck frame and to control the car's dynamic characteristics. Thus, monolithic frame railway trucks have suffered from the disadvantages accruing from the expense, complexity, and maintenance requirements of two separate spring systems in addition to the possible difficulties created by the dynamic interaction of the two systems.

The second basic, conventional truck type is the independent side frame design in which the axles are relatively fixedly journalled, albeit in resilient bushings, in a longitudinally extending frame on each side of the truck, but the side frames are not rigidly interconnected thereby permitting the railway wheels to follow the irregularities of the track while maintaining substantially uniform loading on each wheel. However, some interconnecting structure must be provided between the side frames to distribute lateral loads between the side frames and to limit or control unwanted types of motion therebetween. For example, it is necessary to keep one side frame from moving ahead of the other (called skewing) to prevent the flanges of the wheels from striking and rubbing along the rails thereby causing undesirable lateral jolts and excessive wheel flange and rail wear. As this undesired relative longitudinal motion between side frame distorts the rectangular outline formed by the side frames and the axles, as seen in a top view, into the shape of a parallelogram, this desired longitudinal alignment relationship between the side frames is referred to as rectangular tram.

A second type of alignment problem, called vertical tramming, results since a completely unrestrained independent side frame can tilt out of its normal vertical position about a longitudinal tilting axis between its axle bearings. If the side frames are not maintained in vertical tram (a truck is in vertical tram when the vertical surfaces of the side frames are perpendicular to the axles), the resilient bushings located at each axle bearing can be excessively distorted and will transmit destructive overloads to the roller rows in the bearings.

It has been suggested in the prior art, as for example, United States Letters Patent No. 2,976,819 to Rossell, that independent side frames should be connected for diagonal flexibility by a pair of transverse members each rigidly connected at one end to a respective side frame

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and flexibly connected by rubber bushings at the other end to the opposite side frame. However, this interconnection arrangement between independent side frames is not satisfactory because the resilient bushings incorporated by Rossell have inherent three dimensional flexibility and are inadequate to maintain the side frames in tram. Further, these rubber bushings are inadequate to effectively transmit and distribute side loads or thrusts between the two side frames. Finally, a diagonally flexible independent side frame truck as shown in Rossell, when used with a conventional bolster to support the railway car, can result in an inherent uneven wheel loading as described hereinafter.

Accordingly, it is a primary object of this invention to provide a railway truck having the advantages of both the conventional monolithic frame design and independent side frame design while eliminating the respective disadvantages associated therewith.

To accomplish this objective, the present invention provides a unique frame assembly for railway trucks which includes a pair of side frames with a pair of cross members or transoms extending therebetween each rigidly connected to or integral with one side frame to form two rigid, frame subassemblies which are interconnected by universal joints or spherical bearings at diagonally opposed points thus allowing only one type of motion between the side frame subassemblies; that is, pivotal movement about the diagonal axis passing through the center of each spherical bearing.

This side frame interconnection arrangement functions to rigidly maintain the side frames in rectangular and vertical tram and rigidly transmit lateral loads from one side frame to the other. Further, to obviate the above mentioned uneven wheel loading which normally results from such a diagonally flexible truck frame, the frame is adapted to receive the load of the railway car at a point on each side frame which is diagonally displaced from the transverse centerline plane of the truck as more fully described hereinafter.

Further objects of the present invention include:

(1) The provision of a simplified independent side frame type of truck wherein a unique, diagonally flexible interconnection between the side frames is incorporated to maintain the side frames in rectangular and vertical tram and to rigidly transmit lateral loads between the side frames; and

(2) The provision of a diagonally flexible independent side frame truck having an improved design to ensure even static loading of all wheels.

These and other objects of the present invention will appear from the following description and the appended claims when read in conjunction with the accompanying drawings wherein:

FIGURE 1 is a top view of a diagonally flexible railway truck according to the present invention;

FIGURE 2 is a partially sectioned side view taken on line 2—2 through the truck of FIGURE 1;

FIGURE 3 is a perspective view of the diagonally flexible frame of the truck of FIGURE 1;

FIGURE 4 is a fragmentary, transverse, vertical section taken on line 4—4 of FIGURE 2 through one of the diagonally located spherical frame bearings of the present invention;

FIGURE 5 is a fragmentary, transverse, vertical section taken on line 5—5 through the bolster of the truck of FIGURE 1;

FIGURE 6 is a fragmentary, transverse, vertical section taken on line 6—6 through one of the axle bearings of the truck of FIGURE 1;

FIGURE 7 is a transverse, vertically sectioned view of a transom and side frame subassembly of the truck of FIGURE 1 taken on line 7—7;

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FIGURE 8 is a schematic view of the truck of FIGURE 1;

FIGURE 9 is a schematic view, similar to FIGURE 8, of a modified form of the truck of FIGURE 1 in which the line of action of the bolster support springs lies in-board of the centers of the axle bearings and the bolster spring seats are diagonally offset oppositely from the offset of the spring seats of FIGURE 8 to compensate for the excess loading of the wheels adjacent the spherical bearings; and

FIGURE 10 is similar to FIGURE 7 showing the in-board location of the bolster spring seat and resultant static load distribution in the second embodiment.

As shown in FIGURES 1 to 3, truck 10 of the present invention has a generally rectangular (as seen in top view) frame 12, shown separately in FIGURE 3, comprising two generally L-shaped rigid subassemblies 14 and 16 each respectively formed by one of two longitudinally extending side frames 22 and 24 respectively rigidly secured to or integral with one of a pair of laterally extending transoms 26 and 28. The frame subassemblies 14 and 16 are interconnected at diagonally opposed spherical bearing assemblies 18 and 20 to permit relative pivoting between the L-shaped subassemblies about a diagonal axis 29 through the centers of the spherical bearings.

Diagonally flexible truck frame 12 is supported on axles 31 and 32 by roller bearing assemblies 30 which are resiliently mounted in frame 12. Axles 31 and 32 each have two railway wheels 34 secured thereto to ride on rails 38 (FIGURE 2). Frame 12 in turn supports a transverse bolster 40 having a pair of bolster spring assemblies 42 in contact with spring platforms 44 and 46 on side frames 22 and 24 respectively. Bolster 40 also includes a central socket 48 to receive a king pin (not shown) depending from and supporting one end of a railway car.

Truck frame 12

As described above and as further shown in FIGURES 1 to 3 and 7, frame 12 includes the two generally L-shaped side frame subassemblies 14 and 16 each formed by a side frame and a transom. Side frames 22 and 24 are integrally cast, elongated members terminating in upwardly offset axle bearing housings 54 and each has a pair of intermediate, short, vertically upstanding, transom connecting columns 56 and 58 and a horizontal bolster spring platform 44 approximately centrally located therebetween. The transom of each frame subassembly is rigidly fitted in a transverse bore 60 (FIGURE 7) provided in the upper end of column 56 of its respective side frame and is secured therein by means of a thermal shrink fit and a weld 62 or can be integral with the column.

As best shown in FIGURE 4, the opposite end of each transom is universally pivoted in the upper end of the column 58 of the opposite side frame by means of spherical bearing assemblies 18 and 20. Assembly 18 includes a self aligning spherical bearing 70 comprising an inner annular bearing member 71 having an external, convex spherical surface 72 in contact with an internal, concave spherical surface 74 on an outer bearing member 76. Inner bearing member 71 is mounted on cylindrical end portion 78 of transom 26 and is spaced from a shoulder 80 at the inboard end thereof by means of one or more annular shims 82. Member 71 is retained in position on end portion 78 by a spacer collar 84 which fits over the end portion to abut a terminal shoulder 86 at the outboard end thereof and is retained thereon by a cotter keyed nut 88 engaging a threaded extension 90 of the transom.

Spherical bearing 70 is mounted in a transverse bore 92 provided in the upper end of side frame column 58 by an adapter 94. The adapter concentrically positions outer bearing member 76 in bore 92 and retains it against a bore end wall 96. Adapter 94 is secured in bore 92

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by an annular flange 97 which is securely mounted on column 58 by means of screws 98.

To protectively enclose spherical bearing assembly 18, resilient, flexible, inner annular seal 100 is tightly mounted upon transom 26 by a circumferential retaining spring 102 and is sealingly retained on column 58 by an annular retaining collar 104 and screws 106 extending there-through into threaded holes 107 in column 58. The outer end of spherical bearing assembly 18 is similarly protected by an annular, flexible, resilient seal 108 retained on spacer collar 84 by a circumferential spring 110 and is sealingly mounted on flange 97 by a retaining collar 112 and screws 98.

Frame flexibility

Because the frame subassemblies 14 and 16 are interconnected by the diagonally opposed universal joints or spherical bearing assemblies 18 and 20, they are limited to only one type of motion therebetween. This motion is a pure pivotal movement of one subassembly with respect to the other about axis 29 extending through the centers of spherical bearing assemblies 18 and 20. As truck 10 rolls onto an uneven stretch of track on which one of the wheels 34 furthest from the diagonal pivoting axis 29 (FIGURE 1) is at a low point in the track, its associated frame subassembly tends to pivot downwardly about axis 29 to re-establish 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 29 to re-establish even wheel loading.

Thus frame 12 ensures independent side frame action, but as the spherical bearings do not permit longitudinal play between the frame subassemblies, the side frames of the truck 10 are rigidly maintained in rectangular tram. Further, as the spherical bearings do not permit any vertical play at either spherical bearing between the end of one transom and the opposite side frame, each side frame is rigidly maintained in 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.

Axle bearings and axles

The generally semi-cylindrical axle bearing housings 54 are provided at the ends of side frames 22 and 24 to mate along an inclined surface 128 (FIGURE 2) with matching semi-cylindrical bearing housing caps 130 retained thereto by screw and nut assemblies 132. As best shown in FIGURE 6, the axle bearing housings 54 and caps 130 retain axle bearing assemblies 30. The bearing assemblies include a resilient annular sleeve or bushing 134 which is preferably a rubber member formed in two semi-cylindrical halves and in one specific embodiment is approximately 1 inch thick.

An annular bearing retainer 136 having a central annular rim 138 secured thereto is mounted within the resilient bushing 134 and retains the outer race 140 between inwardly turned radial flanges 142. Outer race 140 of the axle bearing assembly contacts journal bearings 143 which in turn contact and roll upon a pair of inner races 144 which are mounted directly on axle 32 and are rigidly separated by an annular spacer 146.

Inner races 144 are axially positioned on axle 32 by annular collars 148 and 150; collar 148 axially abuts annular ring 152 which is mounted upon axle 32 against an outboard facing shoulder 154 at one end of the central axle portion 155, and collar 150 similarly abuts one of the railway wheels 34 (not shown in FIGURE 5) mounted on axle end portion 157.

Because of the resilient rubber bushing 134, the axle bearing assemblies 30 allow the necessary amount of axial play and pivotal flexibility between the side frames and the axles to permit the side frames to independently follow track irregularities without binding upon the journal bearings.

As shown in FIGURES 1, 2, and 5, bolster 40 includes an integrally cast transverse member 160 having a vertical central opening 161, to suitably receive the king pin socket 48, and a pair of inverted spring receiving cups 162, one located at either end thereof. Bolster spring assemblies 42 fit in the bolster cups 162 and support the bolster upon the spring platforms 44 of side frames 22 and 24. As best shown in FIGURE 5, each spring assembly includes an outer coil spring 164, an inner coil spring 166, and a central rubber spring 168. The upper ends of all three springs abut a disc like spring cap 170 having central rocking bearing 172 in contact with a bearing seat 173 at the center of the lower surface of spring cup 162. Spring cap 170 also bears against plug like rubber balancing springs 174 retained in bolster cups 162 by plate like retainers 176 and cap screws 178 (FIGURE 1). Adjusting shims 180 are provided between retaining plates 176 and balancing springs 174.

The central rubber spring 168 is mounted on a tubular extension 182 of spring cap 170, and is supported at its lower end within a cup-like portion 186 of lower spring cap 188 upon shims 184 positioned therein. Lower spring cap 188 is rockingly supported by a bearing 190 in a bearing element 192 welded to the spring platform 44 of side frame 22. Inner coil spring 166 bears upon an outer annular flange 193 of the lower spring cap 188 through an annular vibration pad 194 whereas outer coil spring 164 bears directly on spring platform 44 on the outside of an annular upstanding flange 198 on the spring platform through a similar vibration pad 196.

Bolster 40 is further connected to the side frames by means of vertical shock absorbers 200 (FIGURES 2 and 5) extending between bolster cup mounts 202 and side frame mounts 204 and by lateral shock absorbers 206 (FIGURE 1) extending between bolster mounts 208 and side frame mounts 210.

Longitudinal accelerating forces, as occur in railway trucks according to the present invention incorporating drive motors (not shown) or brakes (not shown), are transmitted between the bolster and the truck frame by rubber snubbers or bumpers 220 (FIGURE 1) retained in mounts 221 on the side frame columns 56 and 58 to bear against chafing plates 222 mounted at the front and back of spring cups 162 of bolster 40.

Although bolster spring assemblies 42 and the bumpers 220 between chafing plates 222 create considerable resistance to restrain lateral movement of bolster 40 upon the side frames, a rubber snubber or stop 230 (FIGURE 5) is additionally provided on a suitable mount 232 on the bottom of bolster 40 to engage an integral stop lug 234 on the side frames to positively limit such movement.

Static truck loading forces—(outboard bolster spring seats)

The static load of the weight of one end of a railway car is applied by the king pin (not shown) to bolster 40 and is distributed equally to the two side frames 22 and 24 through the bolster spring assemblies 42. As shown in FIGURE 7, this bolster spring load is represented by a vector 240 applied at the center of spring platform 44. Side frame 24 is supported at either end by an axle bearing assembly 30, the centers of which in a transverse plane are indicated in FIGURE 7 by cross 242.

The load on the side frame is supported by the load supporting reaction force of the wheels which is transmitted to the side frame from the axles through the bearing assemblies 30. This reaction force of the wheels is represented by vector 244 passing through the center 242 of bearing assemblies 30 as shown in FIGURE 7. Since the roller bearings are mounted on the side frame through resilient bushings 134, a limited amount of relative pivotal motion between the side frames and the wheel roller bearings (and axles and wheels) is possible. When the load on the bolster 40 represented by vector 240 is applied

to the side frame at a point outboard of the transverse center 242 of the bearing assemblies 30 as in the first embodiment of this invention, a counterclockwise (as viewed in FIGURE 7) moment about the longitudinal line through center bearings 242 is created. Thus the lever system comprising side frame 24-column 56 and transom member 28 tends to rotate about the line through centers 242 producing an upward force represented by vector 246 at the spherical bearing 20. This upward thrust is applied to the opposite side frame 22 at a point between the spring platform 44 and the upper right hand wheel 34 in FIGURE 1, and is in opposition to the force normally applied to the side frame 22 and wheels due to the load on the bolster. Thus the moment of the load applied to the side frame 24 represented by vector 240 (FIGURE 7) results in an upward thrust 246 which tends to unload the upper right hand wheel 34 of FIGURES 1 and 8 causing the upper right and upper left hand wheels to be unequally loaded. In the same manner, the load from the bolster normally transmitted to the side frame 22 through the spring assemblies 42 outboard of the longitudinal centerline of the wheel bearings causes a vertically upward thrust on the lower left hand wheel of FIGURES 1 and 8 and a consequent inequality in the total loads between the lower left and lower right hand wheels.

To compensate for this tendency of the outwardly located bolster springs 42 to create a vertically upward thrust in the opposite side frames, the position of the spring platforms 44 and 46 may be located so that the vertical centerlines of bolster spring assemblies 42 are offset respectively toward the spherical bearings 20 and 18 from a transverse line 250 which is equidistant between the front and rear axles. This offset is shown schematically in exaggerated form in FIGURE 8 and identified by reference character 252 and has the effect of placing a greater proportion of the primary load from the bolster on the lower left and upper right hand wheels of FIGURES 1 and 8 to counteract the upward thrust created by location of spring assemblies 42 outboard of the centerline of the wheel bearings which has an unloading effect on these wheels.

Static truck loading forces—(inboard bolster spring seats)

In the embodiment of FIGURES 9 and 10 the static load of the weight of one end of a railway car is applied by the king pin (not shown) to bolster 40 and is distributed equally to the two side frames 22' and 24' through the bolster spring assemblies 42'. As shown in FIGURE 10, the line of action or centerline of this bolster spring load is represented by a vector 240' applied at the center of spring platform 44'. Side frame 24' is supported at either end by an axle bearing assembly 30', the centers of which in a transverse plane are indicated in FIGURE 10 by cross 242'.

The load on the side frame is supported by the load supporting reaction force of the wheels which is transmitted to the side frame from the axles through the bearing assemblies 30'. This reaction force of the wheels is represented by vector 244' passing through the centers 242 of bearing assemblies 30' as shown in FIGURE 10. Since the roller bearings are mounted on the side frame through resilient bushings, a limited amount of relative pivotal motion between the side frames and the wheel roller bearings (and axles and wheels) is possible. When, as in the second embodiment of this invention, the load on the bolster represented by vector 240' is applied to the side frame at a point inboard of the longitudinal line through the transverse centers 242' of the bearing assemblies 30' on a given side of the truck, a clockwise (as viewed in FIGURE 10) moment about the line through the centers 242' is created. Thus the lever system comprising side frame 24'-column 56' and transom member 28' tends to rotate clockwise, as viewed in FIGURE 10, about the line through the centers 242' producing a downward force represented by vector 246' at the spherical bearing 20'.

This downward thrust is applied to the opposite side frame 22' at a point between the spring platform 44' and the upper right hand wheel 34' in FIGURE 9, and augments the force normally applied to the side frame 22' and wheels due to the load on the bolster. Thus the moment of the load applied to the side frame 24' represented by vector 240' (FIGURE 10) results in a downward thrust 246' which tends to load the upper right hand wheel 34' of FIGURES 9 and 10 causing the upper right and upper left hand wheels to be unequally loaded. In the same manner, the load from the bolster normally transmitted to the side frame 22' through the spring assemblies 42' inboard of the longitudinal centerline of the wheel bearings causes a vertically downward thrust on the lower left hand wheel of FIGURE 9 and a consequent inequality in the total loads between the lower left and lower right hand wheels.

To compensate for this tendency of the inwardly located bolster spring assemblies 42' to create a vertically downward thrust in the opposite side frames, the position of the spring platforms 46' may be located so that the vertical centerlines of each bolster spring assemblies 42' are offset respectively away from the spherical bearings 20' and 18' from a transverse line 250' which is equidistant between the front and rear axles. This offset is shown schematically in exaggerated form in FIGURE 9 and has the effect of placing a greater proportion of the primary load from the bolster on the lower right and upper left hand wheels of FIGURE 9 to counteract the downward thrust created by location of spring assemblies 42' inboard of the centerline of the wheel bearings which has an unloading effect on these wheels.

In summary, the independent side frame railway truck 10 of the present invention is provided with a diagonally flexible frame 12 which incorporates oppositely disposed universal joints or spherical bearing assemblies 18 and 20. These universal joints ensure the desired independent action of the side frames but positively restrict undesirable interframe movements so that rectangular and vertical tram of the truck is accurately maintained and so that lateral loads are distributed between the two side frames. The side frames are further adapted to support the truck bolster springs at positions offset from the transverse centerline plane of the truck so that the uneven wheel loading inherent in diagonally flexible frames from either inboard or outboard location of the bolster spring lines of action is obviated.

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 United States Letters Patent is:

1. A vehicle truck assembly, 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 journaled 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 independent non-resilient means for so connecting said first frame section to said second frame section as to permit vertical displacement

ment of any one of said wheels relative to the remaining wheels while substantially maintaining said side frames substantially in rectangular tram and substantially preventing lateral tilting of said side frames;

- (f) said first and second connecting means comprising means confining the relative movement between said first and second frame sections to an axis extending diagonally across said truck adjacent the ends of said first and second transoms.

2. The truck assembly as defined in claim 1, together with resilient bearing means operatively interposed between said side frames and the axles of said wheel and axle assemblies.

3. The truck assembly as defined in claim 2, together with a laterally extending bolster and spring assemblies supporting said bolster from said side frames, said spring assemblies being mounted outboard from said bearing means.

4. The truck assembly as defined in claim 2, together with a laterally extending bolster and spring assemblies supporting said bolster from said side frames, said spring assemblies being mounted inboard from said bearing means.

5. The truck assembly as defined in claim 1, together with a laterally extending bolster so disposed that a vertical line through the midpoint thereof intersects the line along which said frame sections are hinged and first and second spring assemblies supporting said bolster from said first and second side frames, respectively, said first spring assembly being spaced from a lateral line through said midpoint and being on the same side of said line as said first connecting means and said second spring assembly being on the opposite side of said line and spaced therefrom.

6. The truck assembly as defined in claim 1, wherein said connecting means each include a spherical member fixed to one of the truck assembly components joined by the connecting means and means providing a socket having substantially the same diameter as said spherical member fixed to the other of the truck assembly components joined by the connecting means.

7. The truck assembly as defined in claim 1, together with a laterally extending bolster supported by said side frames, said bolster including at the center thereof means providing a vertical axis about which a car supported by said truck assembly is adapted to pivot relative to the truck assembly, said transoms being so spaced relative to said bolster that a plane including said pivot axis passes through the pivot points of both of said connecting means.

8. The truck assembly as defined in claim 1, together with:

- (a) bearing means interposed between said side frames and said axles;
- (b) a laterally extending bolster; and
- (c) first and second bolster spring assemblies mounted inboard from said bearing means and supporting said bolster from the side frames of said first and second frame sections respectively, each of said spring assemblies being displaced longitudinally of the truck relative to the other in a direction away from the means connecting its respective frame section to the transom of the other of said frame sections.

9. The truck assembly as defined in claim 1, together with:

- (a) bearing means interposed between said side frames and said axles;
- (b) a laterally extending bolster; and
- (c) first and second bolster spring assemblies mounted outboard from said bearing means and supporting said bolster from the side frames of said first and second frame sections respectively, each of said

spring assemblies being displaced longitudinally of the truck relative to the other in a direction toward the means connecting its respective frame section to the transom of the other of said frame sections.

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