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Russell-French

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[54] **RESILIENTLY MOUNTED RAILWAY VEHICLE TRUCK**

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[52] **U.S. Cl.** .....**105/224.1,** 105/182 R, 105/199 R, 295/36 R

[51] **Int. Cl.**.....**B61f 3/08,** B61f 5/30, B61h 13/00

[58] **Field of Search**...105/182 R, 197 R, 199 R, 208, 105/224.1; 295/11, 36 Z

[56] **References Cited**

UNITED STATES PATENTS

3,313,245	4/1967	Sundby	105/208
2,908,230	10/1959	Dean	105/182 R
2,138,449	11/1938	Hallquist	105/224.1 X
3,181,479	5/1965	Rumsey et al.	105/208 X
3,376,831	4/1968	Eaton et al.	105/199 R
3,443,528	5/1969	Lipsius et al.	105/199 R X
2,278,711	4/1942	Piron et al.	295/11

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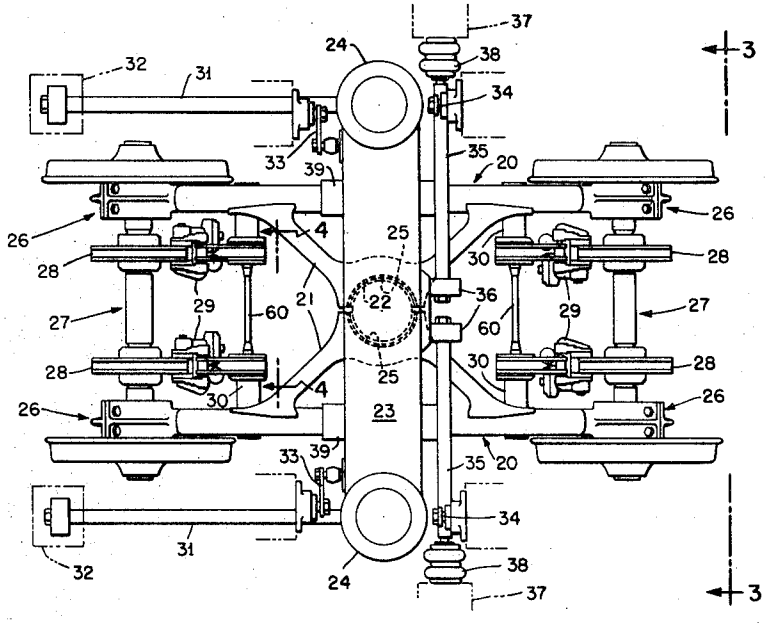
[57] **ABSTRACT**

This application discloses a railway vehicle truck having axle connections with the side frame members which provides adequate springing to isolate the unsprung wheel-axle units from the truck frame, together with auxiliary tie structure to prevent separation of frame side members independently of the axle connections; also means assisting the supporting air springs to improve the connection between the truck frame and vehicle body.

10 Claims, 7 Drawing Figures



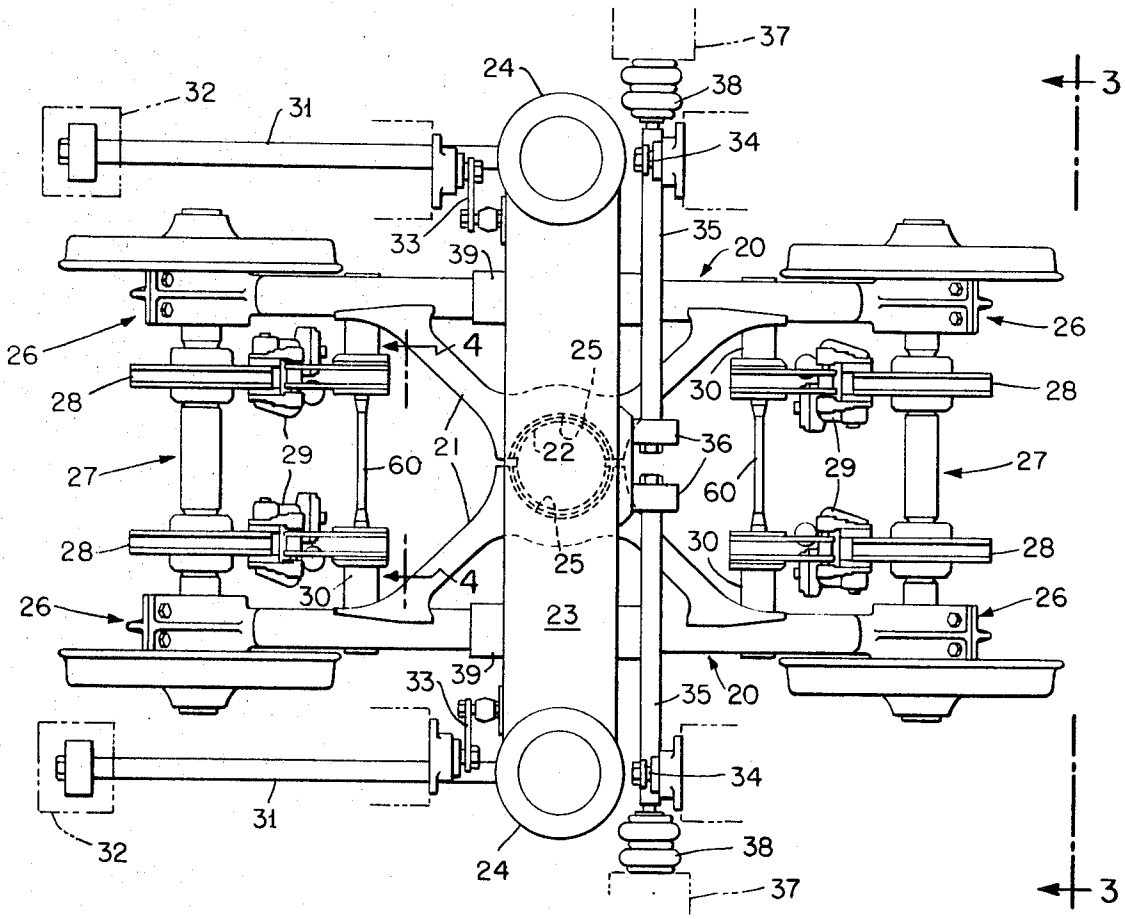


Fig.1

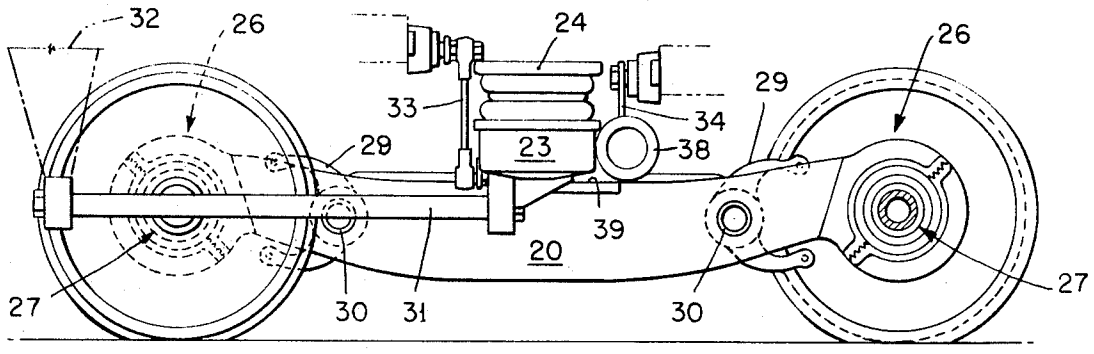


Fig.2

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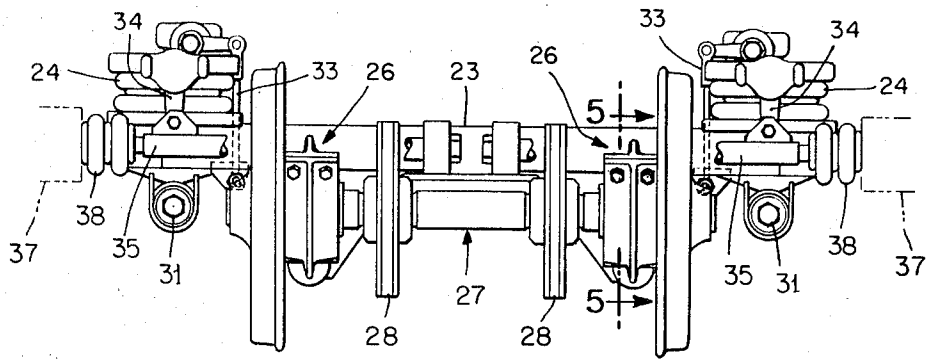

Fig. 3

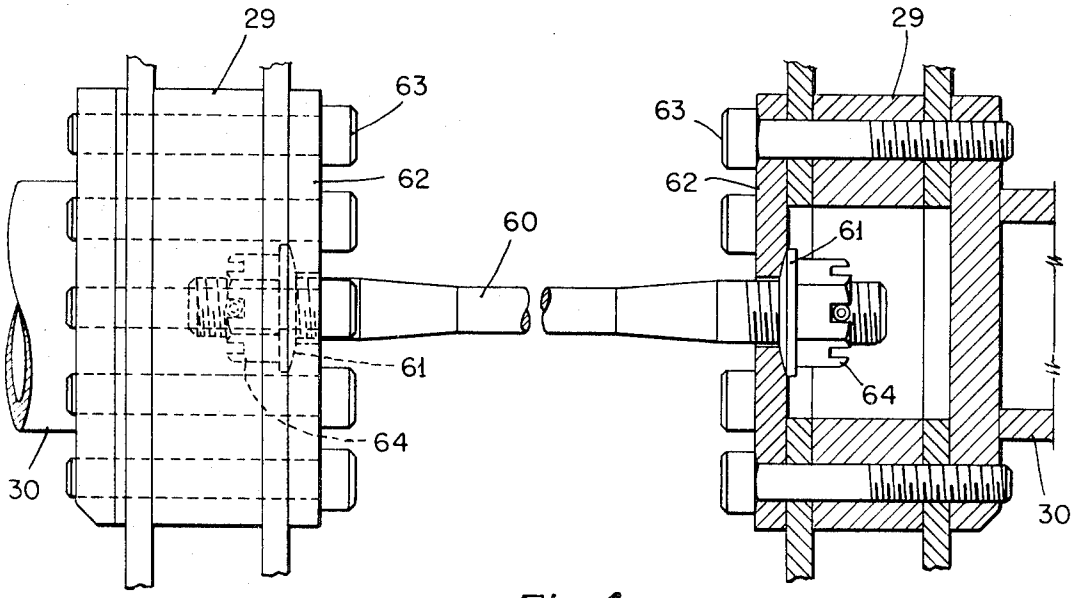

Fig. 4

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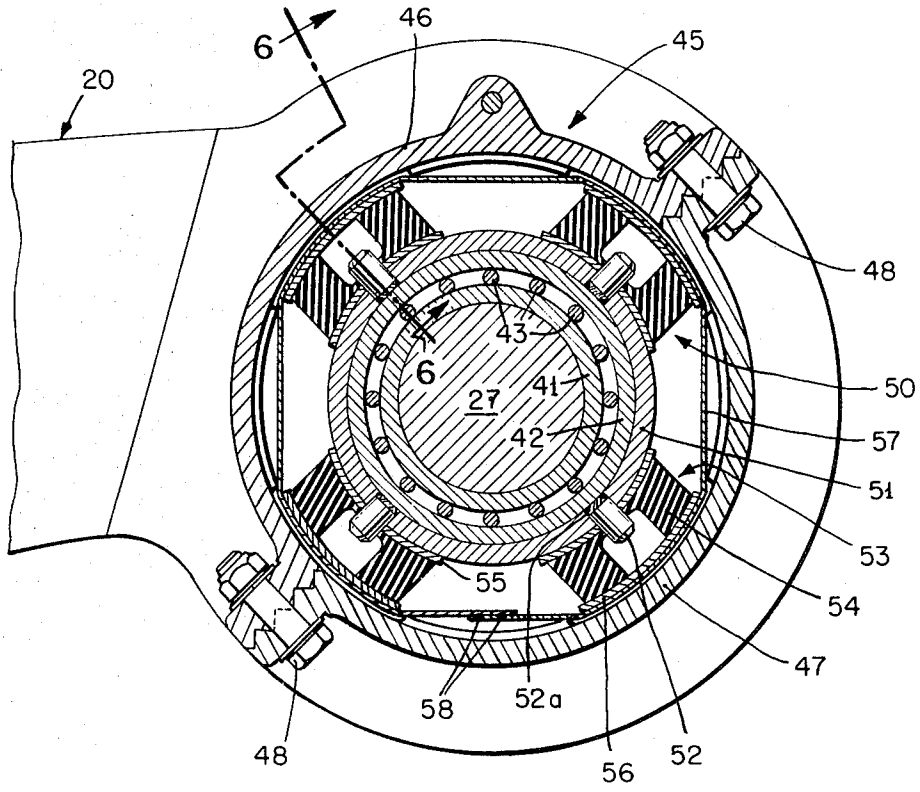

Fig. 5

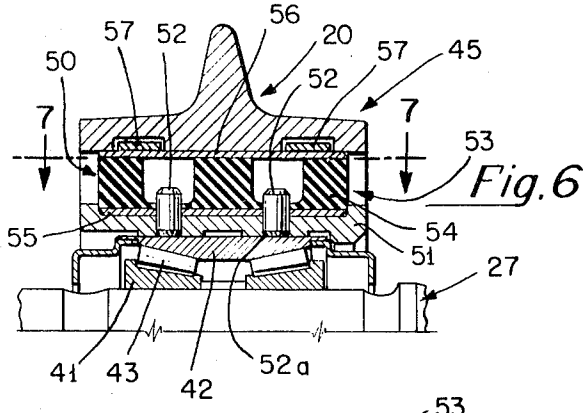

Fig. 6

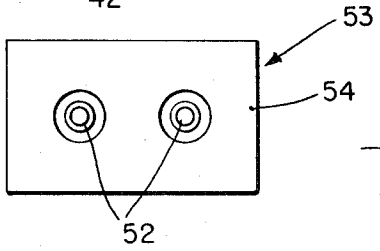

Fig. 7

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RESILIENTLY MOUNTED RAILWAY VEHICLE TRUCK

BACKGROUND OF INVENTION

The railway vehicle truck herein disclosed is similar though not limited to the general type of truck disclosed in U.S. Pat. No. 2,908,230, granted Oct. 13, 1959, in which separate side frame members are operatively connected in such manner as to have weaving motion relative to each other in various directions, the side frame members being retained against transverse separation in part by the axles of rigid wheel-axle units and being restrained against lateral movements relative to the supported vehicle body largely by the lateral stiffness of air springs.

In the truck of the patent referred to, the bearing assemblies between the axles and side frame members took substantially all of the lower transverse loads tending to separate the side frame members from each other and were provided with relatively non-springy sleeves of elastomeric material, like rubber which were just sufficient to provide the required weave between side frame members. End plates limited the uncontrolled possible ultimate amount of separation of the side frame members from each other in the axle region. These full sleeves had a very high spring rate, i.e., load in pounds/to deflection in inches, in the range of about 200,000 to 500,000, and had practically no effect as spring supports, merely reducing the transmission of high frequency vibrations and noise from the track into the truck frame and vehicle body. Because the sleeves were continuous circumferentially and longitudinally, their action was more like hydraulic action of a confined liquid than that of a real spring.

There have been proposals for reducing unsprung weight to a very low value by providing elastomeric connections between a wheel rim and the wheel disk, as in U.S. Pat. No. 2,278,711, granted Apr. 7, 1942, but this allows change in distance between the wheel rims on an axle for opposite tracks and tends to induce derailments or, at least, violent shocks.

It is presently being proposed that passenger rail vehicle speeds be increased to well over 100 m.p.h. and test designs are being sought for vehicle speeds up to 250 m. p. h. Trucks for such high speed vehicles must have the least possible unsprung weight, the greatest possible controlled inter-part movement, and the greatest possible freedom from shocks.

Movement between truck and vehicle body also needs more positive control than that furnished by support springs, especially if air springs.

SYNOPSIS OF INVENTION

According to the present invention the wheel-axle units are effectively isolated as unsprung weight of relatively small value for rapid rail conformation action and inhibited from transmitting shocks of higher vibration values into the truck and vehicle body by providing an elastomeric connection between the axle and the supported truck frame member which has a relatively low spring rate and relatively high yield displacement of the elastomeric elements. This elastomeric connection at each axle bearing comprises separate segmental elements or pads which have sufficient radial depth and sufficiently small area per segment, together with suitable composition or durometer value, to insure that a really effective spring system is provided between the wheel-axle units and the vehicle body, directly the truck frame.

The movement of the axle relative to the supported truck frame part is not closely confined by end plates, as in the former construction, thus eliminating possible sudden stops and shocks by transverse axle excursions; nevertheless, the distance between wheel treads on opposite tracks is not subject to any substantial change, the deflection in the wheel disks being the only variable and that being almost negligible, so that there is very smooth travel along the rails and almost no tendency toward derailment from wheel-axle travel.

The lateral excursions of the axle relative to the frame parts are kept within safe bounds, in case of elastic spring failure, by the relationship of the wheel hubs, brake assemblies, or other appropriate parts, to the sides of the frame parts adjacent the axle bearings and the elastomeric connections thereat.

The truck side frame elements are not left free to shift transversely relative to each other in the axle region, as in the prior construction where the rubber sleeves allowed some relative movement between axle and side bearing, but are solidly connected in the axle region by transverse tie bars or rod members; these tie members, however, having sufficient yield vertically and longitudinally, as by flexibility and universal end connections or both, to allow all required weave between the side frame members.

The secondary spring system, that is the spring system between the truck frame and the vehicle body, is improved by providing resilient lateral stay bars, as with controlled fluid spring units, between the truck frame bolster and the vehicle body in the secondary spring region.

DRAWINGS

The objects of the invention, as well as various features of novelty and advantages, will be apparent from the following description of an exemplary embodiment of the invention, reference being made to the accompanying drawings thereof, wherein:

FIG. 1 is a top plan view of a railway vehicle truck embodying the present invention, some of the vehicle body parts being indicated in phantom broken lines;

FIG. 2 is a side elevation of the parts shown in FIG. 1;

FIG. 3 is an end view, as on the line 3—3 of FIG. 1;

FIG. 4 is an enlarged plan view of an inter-frame tie bar connection taken in the region 4—4 of FIG. 1;

FIG. 5 is an enlarged partial vertical longitudinal section taken through an axle bearing support region on the line 5—5 of FIG. 3;

FIG. 6 is a partial radial section taken on the line 6—6 of FIG. 5;

FIG. 7 is a section taken on the line 7—7 of FIG. 6.

SPECIFIC DESCRIPTION

The truck comprises two rigid side frame members 20 of light strong rigid tubular construction which have inwardly projecting spider parts 21 which are loosely connected and restrained at a center joint with a depending stub journal or king post 22 of a transverse truck-borne bolster 23. The bolster at its ends supports a vehicle body through controlled bellows air springs 24. The spider parts have concave bearing elements 25

surrounding the stub journal, with friction material therebetween and movement-limiting retaining means similar to that shown in the patent and requiring no illustration for an understanding.

At each end each side frame member has a universal-movement bearing connection **26** with a wheel-axle unit **27**. With these bearing connections and the loose stub journal center connection, the side frame members have free weaving movement relative to each other so that the wheels are able to follow the track rails in the most effective manner.

The axles are provided with brake disks **28**, these here being inboard of the wheels and side frame members rather than outboard as in the patent, and these disks cooperate with power-actuated caliper-type brake shoe and operating assemblies **29** mounted on inwardly extending stub projections **30** rigidly secured to the side frame members.

The ends of the bolster **23** are connected by longitudinal stabilizing tie bars **31** with depending rigid elements **32** of the vehicle body, having free universal relative swinging movement as in the patent.

Vertical movement-damping shock absorbers **33** and lateral movement-damping shock absorbers **34** are provided between the bolster and vehicle body, as in the patent.

In the patent construction the side movements between the vehicle body and truck bolster were taken in the body supporting air springs. This is not adequate for the very high speeds now contemplated. According to the present invention, there are added lateral stabilizing tie bars **35** connected to the bolster by universal anchorages **36**, connected to body parts **37** at the other ends, and including controllable fluid spring units **38** having means for varying the fluid pressure to vary the spring rate as required.

The bolster **23** has load-bearing sliding friction saddle support near its ends on the side frame members at **39**, as in the patent construction.

Suspension means, not shown, are provided for supporting the bolster and truck with the vehicle if it is lifted or overturns.

The axles are provided with bearing assemblies comprising an inner race **41**, an outer race **42**, and tapered bearing rollers **43**, the inner race being made fast on the axle, as by a press fit or other convenient known means.

Each bearing assembly is carried by a side frame housing **45** comprising a fixed portion **46** of the side frame member and a cap **47** which is secured to the fixed portion, as by bolts **48**.

Between the outer race of the bearing and the inner surface of the housing there is carried the elastomeric spring assembly **50** which is a special feature of the present invention.

This elastomeric spring assembly comprises an inner base ring **51** which, prior to final assembly, is made fast on the outer bearing race, as by a forced fit or other known means. This base ring is provided with a plurality of radial studs **52** secured, as by screw threads, drive fit, plug welds **52a** in holes as shown, or other convenient manner where these studs may be desired for test purpose or usage interchange of parts to achieve different spring rates or different loadings. Upon these studs there are mounted in pre-assembly of the wheel-axle units, that is before securing the wheel-axle units in the frame housings, a plurality of elastomeric spring pad units **53**, each comprising elastomer spring pad elements **54** which are pre-bonded to an inner arcuate plate **55** and an outer arcuate plate **56**, the inner plate and elastomer pad having openings to receive the studs **52**.

The parts of these elastomeric spring assemblies are secured on the ring **51** with some desired pre-compression in the elastomeric spring pads, to firmly retain them and aid in disposing them in the side frame parts, by one or more retaining bands **57** which are wrapped in tension on the units while held in a compressing device and welded together, as by spot welds **58** in overlapped ends. These bands are preferably made of a strong non-corrosive material, such as stainless steel or other suitable known material. Two axially spaced bands are shown here, one near each end of the assembly, the space between and beyond them being used for the pre-compressing tool elements.

Four elastomeric spring pad units **53** are shown but the number is not fixed; there could be more or less, not under three, the stud pin arrangement being altered to suit. Pin location can be arranged or changed by drilling different pin holes in the ring **51** and this can be done even after it has been put on the bearing assembly on the axle. This would avoid removing the wheels to change rings **51** if such changes should be necessary or desirable.

After the pads have been secured on the base ring **51** by the bands **57**, the wheel-axle units are secured in the frame housings **45** by bolting on the caps **47** by bolts **48**. This will further compress the pads to some extent and ease the tension in the retaining bands **57**. About half of the total pre-compression is applied in banding and the rest in clamping in the housing. The housing, both the fixed part and the cap, are provided with circumferential grooves which receive the retaining bands **57** so as to allow full loading to be taken on the pad units, not the bands.

Tie rods **60** between the side frame members **20** in the axle region are shown in FIGS. **1** and **4**. If the brakes were located outboard of the wheels, as in the patent, these tie rods could be connected directly to the side frame members; but since the inboard brake mechanism supporting projections **30** are herein provided, the tie rods may conveniently be connected between the inner adjacent ends of these projections, as shown, The tie rod ends are secured by universal movement connections, comprising a spherical surface washer **61** fitting in a spherical socket of a plate **62** which is secured to a plate or other anchorage of the stub projection **30**, as by cap screws **63**. The washers are secured by locking nuts **64** on the threaded ends of the tie rod. This provides a laterally non-yielding connection between the side frame members but with tie rod flexibility and universal end connections allows vertical and longitudinal movements for free weave of the side frame members relative to each other. These connections between side frame members also assist in holding the spider projections against separation from the bolster journal **22**.

In the embodiment illustrated there are four elastomeric pad assembly units **53**, each about 6.25 inches long and about 3.5 inches to 4.0 inches wide in a

circumferential direction. The pads are arranged on diameters of the axle which are at right angles to each other. Also, as shown, the diameters are disposed at about 45° to vertical and horizontal diameters, the X–Y axes; but they can be turned circumferentially so as to have any desired location or orientation, depending on the location of base ring **51** and its studs **52**. If located on vertical and horizontal diameters, the vertical and longitudinal loadings may be more readily calculated or tested.

Also the thickness and composition of the elastomeric pads are subject to selective variation.

For example, with pads which have an area of about 6.25 inches long and 3.5 inches to 4.0 inches wide circumferentially with a thickness of three-fourths inch, the static spring rates for compositions of 80, 70, 60, 50, and 40 durometer, will be 155, 105, 85, 60 (all multiplied by 1000) respectively, in a radial direction; and the static axial spring rates will be 26, 17.5, 11.5, 8, and 7, respectively.

For pads which are 1 inch thick and the same durometer range, the static radial spring rates will be 85, 60, 50, 35, and 20, respectively; and the static axial spring rates will be 20, 13, 8, 6.5, and 5, respectively.

For pads which are 1.25 inches thick and of the same durometer range, the static radial spring rates will be 55, 37, 30, 20, and 15, respectively; and the static axial spring rates will be 15, 10.5, 7.5, 5.7, and 4, respectively.

For pads which are 1.5 inches thick and of the same durometer range, the static radial spring rates will be 40, 27.5, 20, 15, and 10, respectively; and the static axial spring rates will be 14, 10, 6.7, 5.2, and 3.5, respectively.

Summarizing, the static radial spring rates in the preferred range will vary from 10,000 to 150,000 lbs/in; and the static axial spring rate will vary from 3,500 to 26,000 lbs/in.

Thickness of the elastomeric pads can be varied by changing the thickness of the plates **55**, **56** to which the elastomeric pads are bonded; or a ring **51** of different thickness may be used; or the diameter of the housing space for the assembly may be changed.

The holes in the pads at the studs **52** are purposely made large, say about 1 inch diameter, to increase the bulge of material in compression and the deformation in axial shear and to aid in getting a full cure of the material. An elastomeric material designed for high temperature integrity and performance, such as silicone rubber, may be used.

It is thus seen that the invention provides effective springing for weaving truck side frame parts on wheel-axle units so as effectively limit the unsprung weight to that of the wheel-axle units while maintaining fixed distance of wheel treads on the track rails and fixed distance but with all needed weave between the side frame parts; also the lateral movement between the vehicle body and truck bolster is stabilized and sprung by controllable air springs in the stay rods between body and bolster to avoid sharp movements and shocks, to take loads off the secondary spring system between body and bolster, and ease lateral shocks on the primary spring system between axle and truck frame.

While one embodiment of the invention has been described for purposes of illustration, it is to be understood that there may be other embodiments and modifications within the general scope of the invention.

I claim:

1. A railway vehicle truck, comprising in combination, longitudinally spaced wheel-axle units, side frame members having bearing support at each end on a wheel-axle unit, elastomeric spring support units each comprising a plurality of uniformly circumferentially spaced elastomer pads surrounding the axle, said pads being disposed and secured on diameters of said axle which are at right angles to each other and secured on, and said pad being shiftable circumferentially to achieve a change in springing rate of the truck.

2. A railway vehicle truck as set forth in claim **1**, wherein each elastomer pad has a plate bonded to its radially inner and outer surfaces.

3. A railway vehicle truck as set forth in claim **2**, wherein each pad is supported by locating retaining means on an interior ring.

4. A railway vehicle truck as set forth in claim **3**, wherein all of said pads are retained on said ring by circumferential band means.

5. A railway vehicle truck as set forth in claim **4**, wherein said banded assembly of pads is clamped under pressure in a housing of the truck frame to relieve clamping tension in said band means.

6. A railway vehicle truck as set forth in claim **1**, wherein tie bar means are connected between said side frame members in the axle region.

7. A railway vehicle truck as set forth in claim **6**, wherein said tie bar means have universal end connections to provide weave between said side frame members while maintaining them at substantially a fixed distance apart.

8. A railway vehicle truck as set forth in claim **6**, wherein inwardly extending brake mechanism supporting projections are provided on said side frame members, said tie bar means being connected between said supporting projections.

9. A railway vehicle truck as set forth in claim **6**, wherein said side frame members are provided with spider projections loosely embracing a vertical journal for truck turning movement, said tie bar means assisting in retaining said spider projections biased toward said vertical journal.

10. A railway vehicle truck as set forth in claim **1**, wherein the bearing supports of the side frames each comprises a housing having a fixed part and a cap part, said housing having axially spaced circumferential grooves for pad binding bands, said spring support units comprising an inner pad-supporting ring disposed around the bearing, radial studs projecting from said ring at circumferentially spaced locations, elastomeric spring pad units having inner and outer metal plates and an elastomer pad bonded between the plates, the inner plate and elastomer pad having holes fitting over said studs to hold the pad units in circumferentially spaced relationship, axially spaced circumferential retaining bands secured in pre-tension over said pads and retaining them on said ring, said bands in final assembly fitting in the grooves in the housing and having tension relief when the cap is secured on the housing, transverse stay bars secured between the side frames in

the axle regions and holding the frame members at substantially fixed distance apart, said stay bars having universal connections at their ends to allow free weaving movement of said frame members relative to each other, a truck bolster mounted near its ends on slide supports on said side frame members and having air springs thereabove supporting a vehicle body, longitudinal stay bars connecting the ends of the bolster to the vehicle body, a depending center vertical truck journal post carried by said bolster, inboard projections on said side frame members loosely embracing and retained on said vertical journal post, and transverse stay bars connected between the bolster and the vehicle body, said transverse stay bars having controllable air springs between their ends.

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