AUTOMATICALLY POWER BANKED RESILIENT RAILWAY CAR TRUCK


Assignee: General Steel Industries, Inc., St. Louis, Mo.

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ABSTRACT

Railway vehicle suspensions are provided in which the vehicle body is supported directly on truck mounted spring devices for transverse tilting movement about a longitudinal central axis of the body. Transversely acting power means are provided to hold the body against such transverse tilting movements during tangent track operation and to cause such transverse tilting movements, or banking, when rounding curves. In one embodiment of the invention the spring devices at each side are supported from the truck frame by transversely swingable links whose projections intersect at the tilt axis and the vehicle body is supported by horizontal bearings on the spring devices. The truck frame mounts a transversely acting power device which is connected to the spring devices. In another embodiment, the spring devices are carried directly by the truck framing, and support the body by spherical section bearings whose common center is at the intersection of the truck swivel axis and the tilt axis. A transversely acting motor mounted on the body is connected at its ends to the spring devices to produce lateral and consequent tilting movements of the body on the spring devices.

21 Claims, 6 Drawing Figures
AUTOMATICALLY POWER BANKED RESILIENT RAILWAY CAR TRUCK

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to railway rolling stock and consists particularly in vehicle suspensions in which the vehicle bodies are supported directly on bolsterless trucks and have power banking means.

2. The Prior Art

Conventional railway passenger car trucks incorporate a transverse bolster, supported from the truck frame by transversely inwardly inclined swing hangers so arranged that when rounding curves the centrifugal force urges the car body radially outwardly which will also cause the body to tilt transversely toward the inside of the track curve. While at lower speeds, the conventional centrifugal force-responsive means is sufficiently responsive to eliminate some passenger discomfort; at higher speeds, e.g., in excess of 100 miles per hour, it is not sufficiently responsive to changes in track alignment to oppose adequately the effect of centrifugal force on the passengers themselves.

SUMMARY OF THE INVENTION

The invention provides a railway suspension in which the body is supported directly on truck-mounted spring devices at each side, with power means for opposing transverse tilting of the car body on tangent track and providing sufficient additional banking of the car body on curves to compensate for the effect on passengers of centrifugal forces.

It also provides power banking entirely separate from and in addition to lateral cushioning provided by transverse yieldability of the supporting spring devices. It further provides air bearings for supporting the body with reduced friction on the truck-mounted spring devices.

BRIEF DESCRIPTION OF THE DRAWINGS:

FIG. 1 is a plan view of a railway truck embodying the invention.

FIG. 2 is a side elevational view of the suspension of FIG. 1.

FIG. 3 is a transverse vertical sectional view of the suspension along lines 3—3 of FIG. 1.

FIG. 4 is a plan view of a railway truck embodying a modified form of the invention.

FIG. 5 is a side elevational view of the modified suspension of FIG. 4, partially sectionalized along line 5—5 of FIG. 4.

FIG. 6 is a transverse vertical sectional view along line 6—6 of FIG. 4.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the embodiment illustrated in FIGS. 1—3, the numeral 1 denotes railway flanged wheels mounted in axially spaced pairs on spaced parallel axles 3.

Truck structure includes a pair of transversely spaced longitudinally extending elongated side frames 5 mounted at their ends on axles 3 inboard of wheels 1 and a transverse frame consisting of transversely spaced longitudinally extending side members 7 joined by longitudinally spaced transversely extending transoms 9. Side members 7 are vertically aligned with side frames 5 and frame 7, 9 may be resiliently supported from side frames 5 by rubber and metal chevron spring devices 11.

Transoms 9 are extended transversely outwardly from frame side members 7 to form brackets 13 on the latter. Brackets 13 are arched upwardly from their connections to side members 7 and their extremities, which are substantially horizontal, are of inverted channel cross section having spaced vertical side webs 15.

Each bracket 13 mounts within its channel extremities a pair of depending swing links 17 and 19, which are pivotally supported in their respective bracket 13 for swinging movement transversely of the truck by pins 21 passing through the bracket webs 15.

At their lower ends links 17 and 19 support spring reservoirs 23, to the top of which, respectively, are secured upright type flexible wall pneumatic springs 25. As is best seen in FIG. 3, the relative lengths and spacings of links 17 and 19 are such that their projections intersect on an axis at a high level when reservoirs 23 are level.

At their upper ends each spring flexible wall 25 is sealingly secured to the bottom rim 27 of a cap member of generally inverted cup shape, the upper wall 29 of which is centrally apertured at 31. Apertures 31 are bounded by an upstanding elastomeric grommet 32, on which rest downwardly facing side bearing plates 33 secured to the underside of the body structure underframe U. By providing predetermined pneumatic pressure in reservoirs 23, and the chamber defined by flexible wall 25 and cap 27, 29, side bearing plates can be raised out of compressive engagement with grommets 32 by the pneumatic pressure exerted on plates 33 through openings 31 in the spring caps, thus facilitating relative horizontal movements of plates 33 and the body relative to the spring caps and the truck structure.

The purpose of the pneumatic bearing described above is to accommodate swivel movements of the truck relative to the vehicle body, since lateral movements of the body on the truck, to cushion the body from transverse track irregularities, is accommodated by shear in the flexible wall enclosed portions of the spring devices.

For transmitting longitudinal draft and braking forces between the truck and body underframe U, and at the same time permitting lateral cushioning movement of the underframe relative to the truck, truck frame transoms 9, 9 are connected to each other by a central longitudinal member 41, from which a vertical cylindrical pin 43 depends. A longitudinal draft link 45 has a cylindrical aperture 47 in its end, in which pin 43 is received, there being a compressed elastomeric bushing surrounding pin 43 within aperture 47 to permit transverse and longitudinal tilting of link 45 with respect to pin 43 and to prevent metal-to-metal contact and consequent wear therebetween.

At its opposite end, which may be vertically offset from the above described end to clear the axle and other truck structure, draft link 45 is similarly apertured at 49 to receive a pin 51 depending from body underframe U, which is elastomERICALLY bushed at 53 where it passes through aperture 51. The ends of link 45 are supported respectively on pins 43 and 51 by suitable collars 55 on the pins.
Spring caps 27, 29 are formed with outboard brackets 57, to which are pivotally secured longitudinal anchor links 59, the opposite ends of which are pivotally secured, respectively, to outboard extensions of frame brackets 13, so that the caps can move vertically and transversely with respect to truck frame 7, 9, 13, but are restrained against relative longitudinal movement with respect to the truck frame.

Spring caps 27, 29 are formed with fore and aft longitudinally extending ears 61, to which are pivotally connected, by pins 62, the outer ends of generally transverse anchor links 63. To provide for arcuate movement of spring caps 27, 29 about the restricted swivel axis S through the body, while leaving the middle of the underframe unobstructed, links 63 are inclined toward each other in the horizontal plane so that their projected axes converge on the vertical swivel axis, and are respectively pivotally connected at 65 to the underframe at points uniformly spaced transversely outward from swivel axis S.

With the structure described above, the truck is free to swivel about center pin 43, which is coaxial with swivel axis S when the truck is centered laterally of the body, and body B is permitted to move laterally on the truck, through transverse deflection of spring flexible wall portions 25, such movement being accommodated by swinging of draft link 45 about underframe pivot pin 51. During swivel movements of the truck, links 63 cause spring caps 29 to move arcuately (principally longitudinally) of body side bearing plates 33, this movement being accommodated with reduced friction by reason of the air pressure exerted on plates 33 through spring cap apertures 31, which reduces the pressure created by plates 33 on grommets 32.

For maintaining the spring device reservoirs 23 in their normal horizontal positions, as best shown in FIG. 3, when the vehicle is operating on tangent track, and for banking the vehicle about banking or tilt axis T, a fluid motor 71, preferably of the pneumatic screw type, is supported at the center of the truck frame from a longitudinal member 73 mounted on and extending between transoms 9. Each output rod 75 of motor 71 is pivotally connected at its end at 77 to a transverse banking link 79, which in turn is pivotally connected at its outer end at 81 to the respective reservoir 23 so that, when the motor is actuated, one of the banking links 79 will pull its associated spring device reservoirs inboard and the other banking link will push its reservoir outboard, causing the reservoirs to be inclined on their supporting swing hangers and produce corresponding inclination on banking of body B about banking axis T.

Means for energizing and deenergizing motor 71 may include a reversing valve 83 mounted on the underframe and connected to a source of compressed air by conduit 85 and to pneumatic motor 71 by flexible conduits 87, and a sensing device, preferably comprising a damped pendulum shown schematically at 89, responsive to vehicle speed, direction and degree of track curvature, and amount of track supererelevation. Pendulum 89 is operatively connected to valve 83 to cause the same to maintain output rod 75 of motor 71 centered when the car is operating on tangent track and to cause the output rod to move radially outwardly with respect to the direction of track curvature when the car is on curved track.

In the embodiment illustrated in FIGS. 4-6, side frames 5 are similar to those of the previous embodiment and a main frame comprising a pair of hollow transverse transom members 90 spaced apart longitudinally of the truck and rigidly connected to each other by transversely spaced longitudinally extending tubular elements 91, which are aligned with side frames 5. Portions 93 of transoms 90 projecting transversely outward of side frames 5 are enlarged at the end at 95 to mount at each side of the truck a pair of upright flexible wall pneumatic springs 96 which are spaced apart longitudinally of the truck.

For supporting the car body B through its underframe U on springs 96, at each side of the track a common spring cap 97 extends longitudinally between and rests on top of springs 96. Cap 97 is hollow and communicates with the hollow interior of springs 96 which in turn communicate, via transom tips 93, with tubular elements 91 which function as reservoirs for the springs.

For supporting underframe U on spring caps 97, the latter are formed at their centers with upwardly and inwardly faced openings 99 of generally rectangular shape, the boundaries of which define a section of a concave sphere, the center of which is at the intersection T of the vertical swivel axis of the truck and the transverse tilt axis of the car body.

To provide a seal, an elastomeric grommet 101 is secured to the margin of each opening 99, and underframe U is formed with a pair of convex spherical section bearing surfaces 103 which are normally centered transversely and longitudinally of the truck with respect to spring cap openings 99 so that, when predetermined pressure is maintained in the spring devices compressing springs 96, caps 97 and openings 99, the underframe bearing surfaces 103 will be partly supported by the air column, thus reducing friction between the underframe bearing surface and the grommets and thus accommodating transverse tilting of body B about a longitudinal axis through point T and swivel of the truck about the vertical swivel axis through this point without excessive friction resistance between spring caps 97 and underframe bearings 103.

It is essential that the spring caps be held against longitudinal movement with respect to the truck frame 90, 91, 93 and to this end, longitudinal anchors 105 are pivotally secured at one end to brackets 109 on the inboard sides of springs caps 97 and at the other end to brackets 109 on transom extensions 93.

The pivotal connections of anchors 85 to the respective spring caps and transom extensions permits transverse and vertical cushioning movements of the spring caps with respect to the truck frame as are accommodated by the vertical and horizontal yieldability of flexible wall spring members 96.

To prevent undesired rocking movements of body B on bearings 99, 101, 103, while facilitating swiveling movement of the truck with respect to the body on the same bearings, and for banking the body about tilt axis T, a transversely acting motor 107, which may be of the pneumatic screw type, is secured to underframe U at the center of the truck. Motor 107 has a double-ended operating rod 109, each end of which is provided with a longitudinally extending crossbar 111, to the ends of each of which are pivotally secured on horizontal axes
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3. A railway vehicle suspension according to claim 2 wherein said spring devices include seats directly supported by said swing hangers and caps mounting said horizontal bearings, said transverse connecting means holding said caps against movement relative to said body structure other than arcuate movement about the vertical swivel axis of the truck structure.

4. A railway vehicle truck according to claim 3 wherein said transverse connecting means comprises link devices effectively connected to the body framing at the center of the truck structure.

5. A railway vehicle truck according to claim 4 wherein said link devices comprise pairs of links pivotally connected at their outer ends at points spaced apart longitudinally to said spring caps and extending generally transversely inwardly therefrom, being pivotally connected at their inner ends to said vehicle body structure with their projections converging on the central vertical axis of said truck structure.

6. A railway vehicle suspension according to claim 5 wherein said truck framing includes longitudinally spaced transverse projections at each side embracing the corresponding spring device and providing a mount for said swing links.

7. A railway vehicle suspension according to claim 6 wherein said transversely acting power device is mounted on said truck structure, there being transversely extending link members pivotally connected at their inner ends to said power device and at their outer ends respectively to said spring device seats.

8. A railway vehicle suspension according to claim 7 wherein said spring devices are fixedly mounted on said truck structure and are formed with upwardly facing concave spherical section bearings having their centers at the intersection of the vertical swivel axes of said truck structure and said longitudinal axis, said body structure being formed with correspondingly centered downwardly facing convex spherical section bearings in opposed relation with said upwardly facing bearings.

9. A railway vehicle suspension according to claim 8 wherein said power means is mounted on said body structure and said transverse connecting means forms the connections between said power means and said spring devices.

10. A railway vehicle suspension according to claim 9 wherein said power means is located centrally with respect to said truck structure and has transversely projecting operating members, said transverse connecting means comprising link means pivotally connected at their inner ends to said respective connecting members and at their outer ends to said respective spring devices.

11. A railway vehicle suspension according to claim 10 wherein said link means connecting each spring device to said power means operating members comprises a pair of links, the inward projections of which converge on the swivel axis of said truck structure.

12. A railway vehicle suspension according to claim 11 wherein each said spring device comprises a pair of upright springs spaced apart longitudinally of said truck structure and a common spring cap seated on said springs, said upwardly facing bearing being on said spring cap.

13. A railway vehicle suspension according to claim 12 wherein said spring devices are of the flexible wall pneumatic type.
14. A railway vehicle suspension according to claim 13 wherein said springs are yieldable horizontally, said longitudinal retaining means comprising cooperating parts on said truck structure and said spring device caps.

15. A railway vehicle suspension according to claim 1 wherein said spring devices are flexible wall pneumatic springs including downwardly facing bearings on said body structure and upwardly facing bearings on said spring devices, said upwardly facing bearings being formed with apertures communicating with the interiors of said pneumatic springs, resilient sealing means surrounding said apertures and forming a pneumatic seal between said upwardly facing bearings.

16. A railway vehicle suspension according to claim 2 wherein said spring devices are pneumatic springs and said spring device bearings are formed with apertures communicating with the interiors of said springs, there being resilient sealing means surrounding said apertures and forming a pneumatic seal between said opposed bearings.

17. A railway vehicle suspension according to claim 8 wherein said spring devices are pneumatic springs and said concave bearings are formed with apertures communicating with the interior of said springs, there being resilient sealing means surrounding said apertures and forming a pneumatic seal between said convex and concave bearings.

18. A railway vehicle suspension comprising longitudinally spaced wheeled axles, truck structure supported thereon, vehicle body structure, upright spring devices carried by said truck structure at the opposite sides thereof and underlyingly supporting said body structure, bearing surface means on one of said structures, each of said spring devices being fixedly secured at one end to the other of said structures and having bearing means at its other end in slidable engagement with said bearing surface means, said bearing means being vertically apertured to permit pressurized air from said spring devices to bear directly against said bearing surface means, and separate reservoir means in said other structure in fixed continuous communication with said springs respectively.

19. A railway vehicle suspension according to claim 18 wherein said one structure is the body structure and said other structure is the truck structure.

20. A railway vehicle suspension according to claim 19 wherein said bearing surface means are downwardly facing horizontal plates on said body structure.

21. A railway vehicle suspension comprising longitudinally spaced wheeled axles, truck structure supported on said axles, separate upright spring devices carried by said truck structure at each side thereof, body structure supported on said spring devices, said spring devices being secured at one end to one of said structures and horizontally slidably related at their other end to said other structure, and a pair of generally transverse links at each side pivotally connected at their outer ends to the spring device at each side, and at their inner ends to said other structure at points spaced apart longitudinally of said other structure but with the projections of their longitudinal axes converging transversely in-board of said last-named points.