

[54] **FLUID DAMPENED RAILWAY
BOLSTER SPRING**
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1969, abandoned.
[52] U.S. Cl. **105/197 B, 105/199 CB, 267/3,
267/35**
[51] Int. Cl. **B61f 3/02, B61f 5/10, B61f 5/14**
[58] Field of Search **105/199 R, 197 A, 197 B,
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267/35, 63 R, 64 R, 141, 3, 4, 118; 280/
124F; 293/88; 137/493.6, 513.3, 525.3;
138/45, 46; 213/223**

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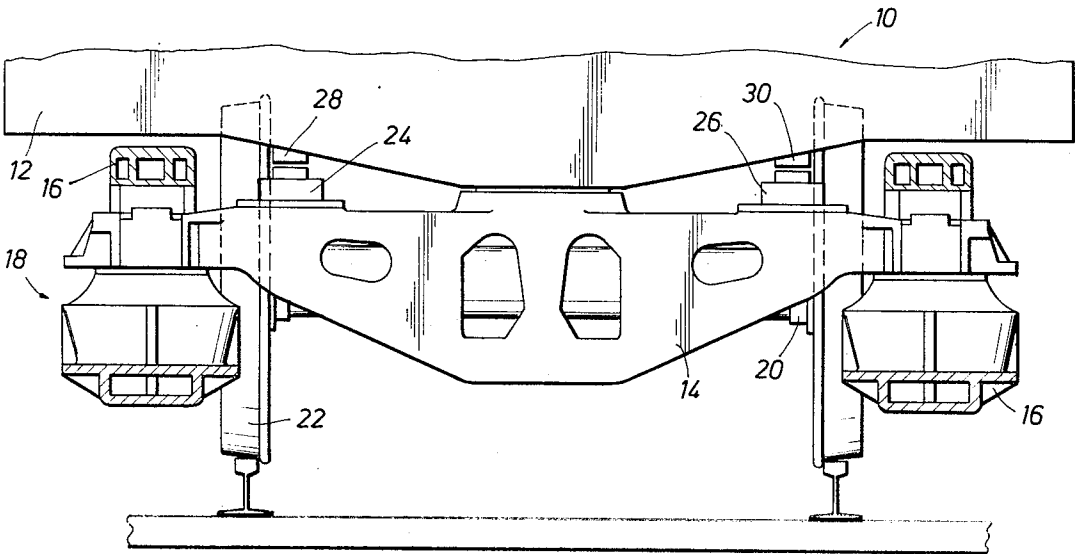
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[57] **ABSTRACT**

A fluid suspension system for railway vehicles having a uniformly varying spring rate to achieve a constant natural frequency in the vertical or bounce mode and to resist lateral or rocking motion of the railway car. The suspension system includes a damper supporting each end of a bolster on the side frame of a railway car truck. Each damper employs resilient material such as synthetic rubber in shear for hysteresis damping and utilizes metering of hydraulic fluid between upper and lower fluid metering chambers to provide hydraulic snubbing action during both compression and expansion of the suspension system to control vertical movement of the vehicle and to resist excessive rolling of the vehicle body. The fluid within the suspension system is maintained under a predetermined preload pressure to help support the load and to dissipate energy as the suspension system expands. Interfitting means between the bolster and the dampers maintain rotational alignment between the truck bolster and side frames.

4 Claims, 5 Drawing Figures



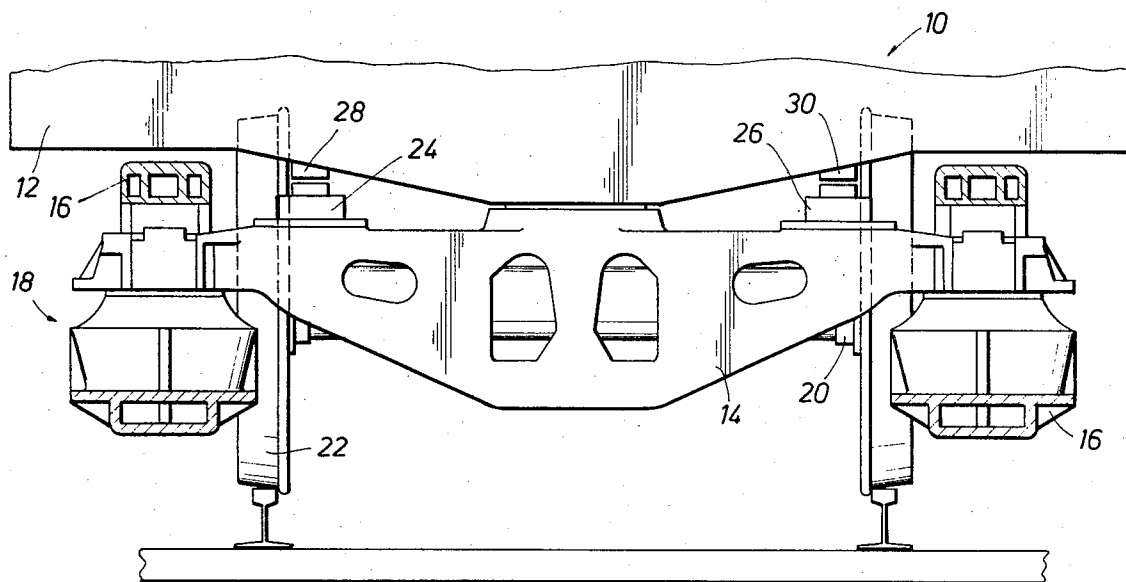


FIG. 1

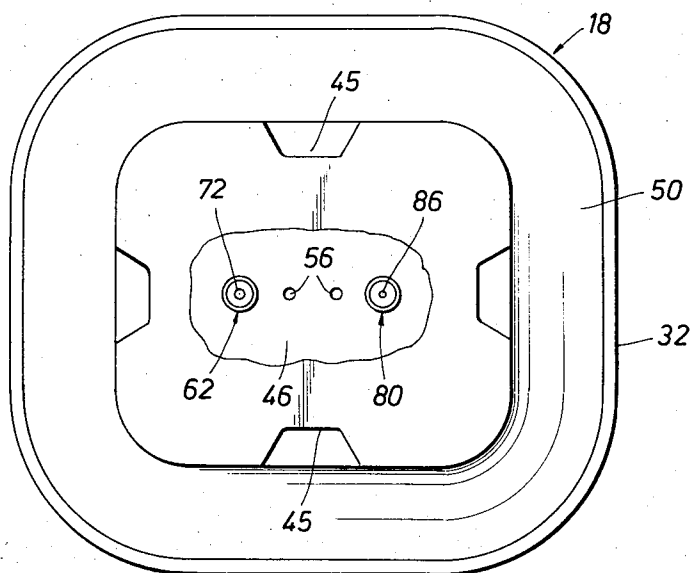


FIG. 3

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FIG. 2

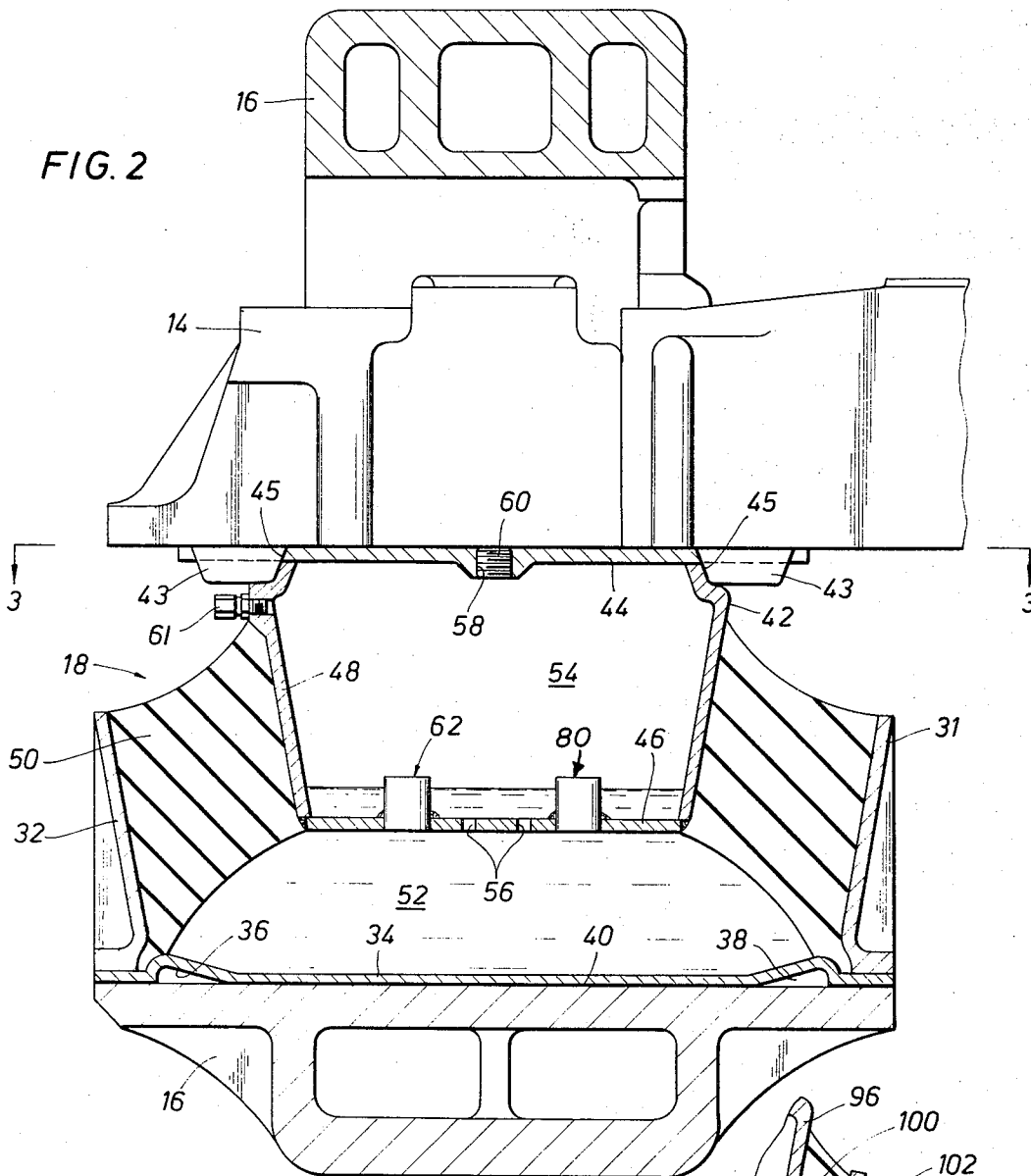
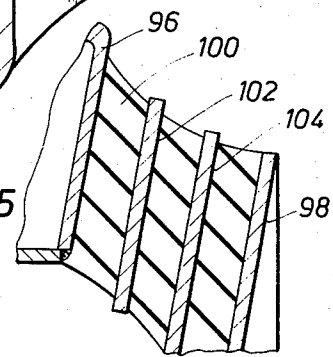
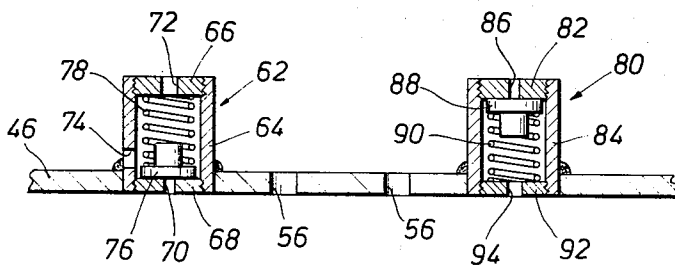


FIG. 5



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FIG. 4



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FLUID DAMPENED RAILWAY BOLSTER SPRING

This application is a continuation of my copending application Ser. No. 849,105, filed Aug. 11, 1969, now abandoned.

BACKGROUND OF THE INVENTION

This invention relates generally to railway vehicles and more particularly to an improved resilient suspension system for freight cars. Existing railway cars are almost exclusively provided with metallic coil springs to achieve cushioning and utilize supplemental friction (coulomb) damping elements for the purpose of eliminating excessive vertical oscillation at critical velocities. The combination of coulomb damping and metallic spring cushioning has been found to provide an acceptable ride control in the vertical or bounce mode, but such suspension systems have not been satisfactory in the development of resistance to lateral motion and rocking motion for some cars with certain configurations resulting in high centers of gravity and certain other parameters.

The metallic coil springs of present railway cars have a constant spring rate that results in changing natural frequencies of the railway car as the railway car loads are changed. It is desirable to provide a varying spring rate that allows the natural frequency of the railway car to remain unchanged even though the load within the car is changed.

It has been found that the friction damping systems of present railway cars do not dissipate a sufficient amount of energy to achieve effective damping of excessive car body roll and lateral motion which occurs in railway cars and especially in those cars having relatively high centers of gravity. It is desirable for a railway car suspension system to provide sufficient damping to prevent excessive car body roll and the accompanying lateral forces.

The metal coil springs presently employed have little resistance to lateral motion and in present railway vehicles, therefore, lateral forces are generally absorbed mechanically by lugs or gibs cast integrally into the car-truck side frames and bolsters and which interfit to allow limited lateral motion. Lateral loads are known to contribute to car, wheel, and truck component wear.

Accordingly, a primary object of this invention contemplates the provision of a novel suspension system for railway vehicles that is capable of providing cushioning and damping in both the vertical or bounce mode and the lateral and rocking mode.

It is a further object of this invention to provide a novel railway car suspension system provided with spring means having a variable spring rate which effectively enables the natural frequency to remain constant as the railway car loads are changed.

It is an even further object of this invention to provide a novel railway suspension system having a cushioning ability that may be varied as desired by changing the gas pressure within the suspension system.

Among the several objects of this invention is contemplated the provision of a novel railway vehicle suspension system that structurally interfits with the railway car truck and bolster geometry in such manner as to allow controlled lateral motion to reduce car, wheel, and truck component wear.

Another object of this invention involves the provision of a novel railway car suspension system providing

hydraulic damping, thus providing superior damping ability as compared to coulomb damping.

It is an even further object of this invention to provide a novel railway car suspension system which provides controlled lateral rigidity and damping to allow increased lateral motion while reducing the mechanical forces on the bolster and side frame gibs.

A still further object of this invention is to provide a novel railway car suspension system with capabilities for restraint of relative rotational motion about a vertical axis through the center of the suspension means, thereby providing a squaring force to the truck components that will contribute to reduction of wear upon such components.

Another important object, my invention involves the provision of a novel railway car suspension system providing both translational and rotational alignment means between the truck bolster and side frames, thus improving the truck squaring characteristics and reducing truck component and wheel wear.

Another possible object of this invention involves the provision of a novel railway car suspension system capable of eliminating friction damping elements and their attending costs from the truck system.

An important object of this invention is a provision of a novel railway car suspension system that is simple in nature, reliable in use, and low in cost.

Other and further objects, advantages, and features of this invention will become apparent to one skilled in the art upon consideration of the written specification, the attached claims and the annexed drawings. The form of this invention, which will now be described in detail, illustrates the general principles of the invention, but it is to be understood that this detailed description is not to be taken as limiting. Such description will be referred by reference characters in the drawings in which:

FIG. 1 is a partial end view in elevation of a railway car illustrating a railway car truck and car bolster assembly incorporating a suspension system constructed in accordance with the spirit and scope of the present invention.

FIG. 2 is a fragmentary end view in elevation of a truck frame and truck bolster assembly having parts thereof broken away and illustrated in section and showing the suspension system of FIG. 1 in section.

FIG. 3 is a plan view taken along lines 3—3 in FIG. 2 and having the top wall of the inner enclosure broken away to show the fluid metering system of the suspension system.

FIG. 4 is a fragmentary sectional view of the bottom plate structure of the inner chamber of FIG. 2 illustrating the fluid metering structure of the suspension system in detail.

FIG. 5 is a fragmentary sectional view in elevation of a modified embodiment of this invention and illustrating an elastomeric spring provided with vertical reinforcing structural elements.

With reference now to the drawings for a better understanding of this invention, in FIG. 1 a railway car is illustrated generally at 10. The railway car 10 includes a car bolster 12 that is pivotally supported on a railway car truck bolster 14 extending parallel to the car bolster 12. Each extremity of the bolster 14 is received within an opening provided therefor in a truck side

frame 16 and is supported for vertical movement by a suspension system or damper indicated generally at 18. An axle 20 is provided for each set of railway car wheels 22 and is journaled in bearings carried within the truck side frame 16. Side bearings 24 and 26 are fixed to the bolster 14 and engage bearing stops 28 and 30 to limit rocking motion of the railway car body relative to the truck bolster 14.

With reference now to FIG. 2, the suspension system designated generally at 18 includes an outer enclosure or housing 31 defined by inwardly tapering side walls 32 maintained in sealed assembly with a generally rectangular bottom wall structure 34 which forms a base. The side walls 32 and bottom wall 34 may be welded together as shown or may be connected in any other suitable manner. The bottom wall 34 is deformed to define recess structure 36 capable of receiving gibs or stop projections 38 fixed to the surface 40 of the truck frame 16. The gibs or projections 38 effectively prevent lateral shifting and rotary oscillation of the outer enclosure relative to the truck frame 16 as the suspension is subjected to operational movements.

The suspension system 18 is also provided with an inner enclosure or housing structure 42 having generally rectangular top and bottom walls 44 and 46, respectively, that are fixed in sealed relationship to inwardly tapering side walls 48. Mechanical connection between the top walls, bottom walls, and side walls of the inner enclosure may be provided by welding or by any other suitable method of connection as desired. The inner enclosure 42 is disposed substantially concentrically within the outer enclosure 31 and the inwardly tapering side walls of the inner enclosure are disposed in substantially parallel relationship with the inwardly tapering side walls 32 of the outer enclosure.

A generally rectangular mass of elastomeric material 50 that may be composed of any one of a number of suitable natural rubber, synthetic rubber, or plastic materials is bonded to the outer surface of the tapering walls 48 of the inner enclosure and bonded to the inner surface of the tapering walls 32 of the outer enclosure. The elastomeric mass 50, therefore, supports the inner enclosure in substantially concentric relation within the outer enclosure 31. The resilient material serves as an elastomeric spring and is placed in shear as the outer enclosure and inner enclosure are forced toward one another by forces applied through the truck frame 16 and bolster structure 14. The mass of elastomeric material 50 is also placed in compression as the inner enclosure 42 is moved laterally toward either of the tapered walls 32 of the outer enclosure under the application of lateral forces from the bolster 14 or truck frame 16.

Translational and rotational alignment of the inner enclosure 42 relative to the truck bolster 14 is maintained by a plurality of gibs or projections 43 that are connected to or formed integrally with the truck bolster and which are received within depressions 45 formed in the upper portion of the inner enclosure.

The generally rectangular mass of elastomeric material 50 also cooperates with the inner enclosure 42 and outer enclosure 31 to define a lower fluid chamber 52 that is separated from an upper fluid chamber 54 defined by the inner enclosure 42 by the bottom wall 46 of the inner enclosure. The bottom wall 46 serves as

a partition or orifice plate and is provided with a plurality of fixed metering orifices 56 which establish fluid communication between the upper and lower fluid chambers. A liquid substance that might be hydraulic fluid or any other suitable liquid is placed within the chambers through a filling opening 58 that is normally maintained closed by a filler plug 60. In the uncompressed condition of the suspension system, the liquid completely fills the lower fluid chamber and fills the upper fluid chamber to the level indicated in FIG. 2. Obviously, the level of liquid within the upper and lower fluid chambers may be varied as desired within the spirit and scope of the present invention. As compressive forces are applied to the suspension system 18, these forces will be resisted by the resiliency in shear of the elastomeric spring and by the metering of liquid from the lower fluid chamber to the upper fluid chamber. Compressive forces are also resisted by a pre-load pressure developed by a compressive medium, such as air or nitrogen gas disposed in the upper fluid chamber 54. The pre-load pressure may be controlled as desired through an inflation valve 61 connected, such as by threading, to an upper portion of the inner enclosure 42 which extends upwardly above side walls 32 of outer enclosure 31.

During dynamic action of the vertical oscillations of the bolster upon the suspension system, hydraulic fluid is metered through the fixed metering orifices 56 which are so sized as to effectively damp such vertical oscillations and to restrict the vertical oscillations to an acceptable level, especially at critical velocities. During periods of maximum car body roll, the relative velocity of closure or compression of the suspension system is several times greater than the velocity developed during vertical oscillation or bounce. In order to eliminate excessive pressures during maximum car body roll, the suspension system is provided with a normally closed compression metering valves 62 illustrated in greater detail in FIG. 4. The metering valve 62 may be welded to the bottom plate 46 of the inner enclosure 42 as illustrated or may be connected by threading or by any other acceptable means of connection. Metering valve 62 comprises a generally cylindrical housing 64 having upper and lower closures 66 and 68, respectively, threaded or otherwise connected thereto.

A metering orifice 70 is formed in the lower closure 68. The closure 66 and the valve housing 64 are provided with apertures 72 and 74, respectively, to allow relatively free passage of fluid therethrough. Within check valve housing 64 is provided a check valve member 76 that is biased by a compression spring 78 to a position closing the metering orifice 70. The check valve 76 will open upon reaching a predetermined pressure differential between the upper and lower fluid chambers determined by the degree of compression of the spring 78. The opening pressure of the check valve 76 may be varied by substitution of the compression spring or by adjusting the thickness of the closure 66. The purpose of the normally closed metering valve 62 is to increase the effective metering aperture dimension in response to predetermined increase and pressure differential to achieve effective damping without developing excessive pressure differentials.

At the right portion of FIG. 4 is disposed an expansion metering valve illustrated generally at 80 having a

closure 82 connected at the upper extremity of a generally cylindrical valve housing 84. The closure 82 is provided with a metering orifice 86 that is normally closed by a check valve 88 biased to its closed position by a compression spring 90. A lower closure member 92 is connected to the housing in any desired manner and serves primarily to support the compression spring 90. The closure 92 is also provided with an orifice 94 through which fluid flows freely upon opening of the check valve 88.

It is seen, therefore, that upon compression of the suspension system the metering valve 62 will be moved to its open condition upon reaching a predetermined pressure differential between the upper and lower chambers. Upon expansion of the suspension system, the metering valve 62 will remain closed and upon reaching maximum allowable pressure differential the expansion check valve 80 will open to increase the effective orifice dimension between the upper and lower chambers. The metering valves effectively enhance the varying spring rate of the suspension system.

With reference to FIG. 5, illustrating a modified embodiment of this invention, an inner closure 96 and an outer closure 98 are shown to be constructed essentially identical with respect to the corresponding enclosures 42 and 31, respectively, in FIG. 2. A mass of elastomeric material 100 is bonded to the outer walls of the inner enclosure 96 and to the inner walls of the outer enclosure 98 in similar manner as described above in connection with FIG. 2. At least one and preferably a plurality of reinforcing members are molded within the elastomeric mass and are disposed in generally parallel relationship with the walls of the inner and outer enclosures. The reinforcing members 102 and 104 may be simple plate-like metal structures provided on two sides of the generally rectangular resilient mass 100 or they may be rectangular reinforcing members extending throughout the mass 100 of resilient material. The strengthening members 102 and 104 effectively limit compression of the resilient mass 100 to provide lateral stiffness without materially changing the resiliency of the elastomeric mass in shear. The configuration of the elastomeric mass, therefore, may be altered in accordance with the design of a railway car to which it is applicable in order to achieve different cushioning characteristics.

Under normal operation, the suspension system 18, as illustrated in FIG. 2, upon being compressed will cause liquid to be metered from the lower fluid chamber 52 to the upper fluid chamber 54 through the fixed normally opened metering orifices 56. Resistance to compressive forces applied to the suspension system are controlled by the elastomeric mass 50, which is placed in shear. Compression of the suspension system is also resisted by the pressurized compressible medium disposed within the upper fluid chamber 54 and, of course, by the resistance offered by the metering orifices 56 as the suspension system is compressed. As described above, in the event the rocking motion or vertical oscillation should produce velocities sufficiently high to cause high pressure differential to be developed between the lower fluid chamber and the upper fluid chamber, the metering valve 62 will be forced to its opened position, thereby adding the dimension of the metering orifice 70 to the effective

metering orifice dimension of the suspension system. Under normal expansion movement causing the outer enclosure to move away from the inner enclosure, the compressive medium within the upper chamber 54 and the action of the elastomeric spring 50 will tend to accelerate the expansion movement. Such acceleration is controlled normally by the metering orifices 56 which will meter fluid from the upper fluid chamber into the lower fluid chamber 52 and provide resistance to expansion. In the event sufficient pressure differential occurs between the upper and lower fluid chambers, the expansion metering valve 80 will open thereby adding the dimension of the metering orifice 86 to the effective metering orifice dimension of the suspension system. Damping is effectively achieved not only during compression of the suspension system, but also during expansion thereof.

In view of the foregoing, it is quite clear that I have provided a novel suspension system for railway vehicles that is capable of providing cushioning and damping in both the vertical or bounce mode and the lateral or rocking mode. Through the novel design of my suspension system, it is possible to achieve a variable spring rate which effectively prevents the changing of resonant frequencies as railway car loads are varied. Railway car truck and wheel component wear is effectively maintained at a minimum level because the suspension system of my invention limits lateral forces to an acceptable level. In the event the particular railway car to which the unit is to be assembled is subject to severe lateral velocities, such velocities can be effectively controlled through the implementation of additional elastomeric spring stiffeners that control compressibility without adversely affecting the resiliency of the elastomeric spring in shear. My invention effectively achieves superior damping ability even though coulomb or friction damping may not be utilized. The structure of my invention effectively provides both translational and rotational alignment between the truck bolster and side frame thereby improving the truck squaring characteristics of the railway car so that truck component and wheel wear is reduced. The above-described invention, therefore, is quite capable of accomplishing all of the objects and advantages hereinabove set forth together with other objects and advantages that are inherent from the description of the apparatus itself.

Having thus described my invention, what is claimed to be new and what is desired to be secured by letters patent is:

1. In a railway car truck having a pair of side frames with openings therein receiving the ends of a truck bolster; a damper positioned in the opening of each side frame for supporting the bolster thereon each damper comprising, an outer enclosed housing mounted in supporting engagement on the associated side frame and having a circumferential side wall, an inner enclosed housing disposed in substantially concentric relation to said outer housing and having a circumferential side wall with an upper portion thereof extending upwardly beyond the side wall of said outer housing, and a top horizontal wall over the circumferential side wall of the inner housing having an upper surface in contact with an adjacent lower surface of the bolster, a mass of elastomeric material disposed

between and bonded to the walls of the inner and outer housings and cooperating with the inner and outer housings to define a lower fluid chamber, said inner housing defining an upper fluid chamber with a gaseous fluid therein and having a bottom wall defining a partition between said upper and lower fluid chambers, said partition having at least one normally closed metering valve being operable to open at a predetermined pressure differential between the upper and lower chambers to permit the flow of fluid therebetween, and a gas inlet valve in the upper portion of said side wall of the inner housing beneath the top horizontal wall in direct fluid communication with said upper fluid chamber to preload said upper fluid chamber to a predetermined gaseous pressure, said gas inlet valve being positioned at an elevation above the side wall of said outer housing thereby to be easily accessible.

2. In a railway car truck, a pair of side frames with openings therein, a bolster having ends fitting within the openings in said side frames, a damper positioned in the opening of each side frame for supporting the bolster thereon and comprising, an outer housing mounted in supporting engagement on the associated side frame and having a circumferential side wall, an inner enclosed housing disposed in substantially concentric relation to said outer housing and having a circumferential side wall with an upper portion thereof extending upwardly beyond the side wall of said outer housing, and a top horizontal wall over the circumferential side wall of the inner housing having an upper surface in contact with an adjacent lower surface of the

bolster, a mass of elastomeric material disposed between and bonded to the walls of the inner and outer housings and cooperating with the inner and outer housings to define a lower fluid chamber, said inner housing defining an upper fluid chamber with a gaseous fluid therein and having a bottom wall defining a partition between said upper and lower fluid chambers, said partition having at least one normally closed metering valve being operable to open at a predetermined pressure differential between the upper and lower chambers to permit the flow of fluid therebetween, and interfitting means on the lower surface of said bolster and on the adjacent upper surface of each of the inner housings cooperating to maintain translational and rotational alignment of the inner housings with the bolster.

3. In a railway car truck as set forth in claim 2, said interfitting means comprising projections extending downwardly from the underside of said bolster and depressions in said inner housings receiving said projections.

4. In a railway car truck as set forth in claim 2, a gas inlet valve in the side wall of each inner housing beneath the top horizontal wall in direct fluid communication with said upper fluid chamber to preload said upper fluid chamber to a predetermined gaseous pressure, said gas inlet valve being positioned at an elevation above the side wall of said outer housing thereby to be easily accessible.

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