Dec. 8, 1959 R. P. HAMMOND 2,915,990

WHEEL SUSPENSIONS FOR RAILWAY CARS

Filed Sept. 27, 1957 2 Sheets-Sheet 1

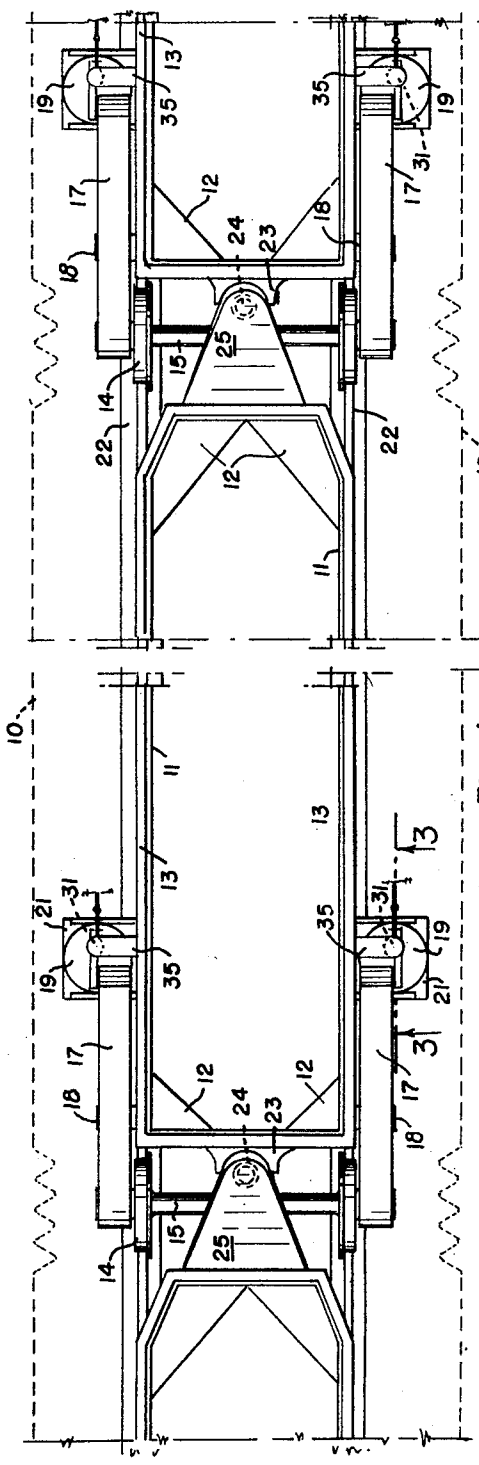


Fig. 1

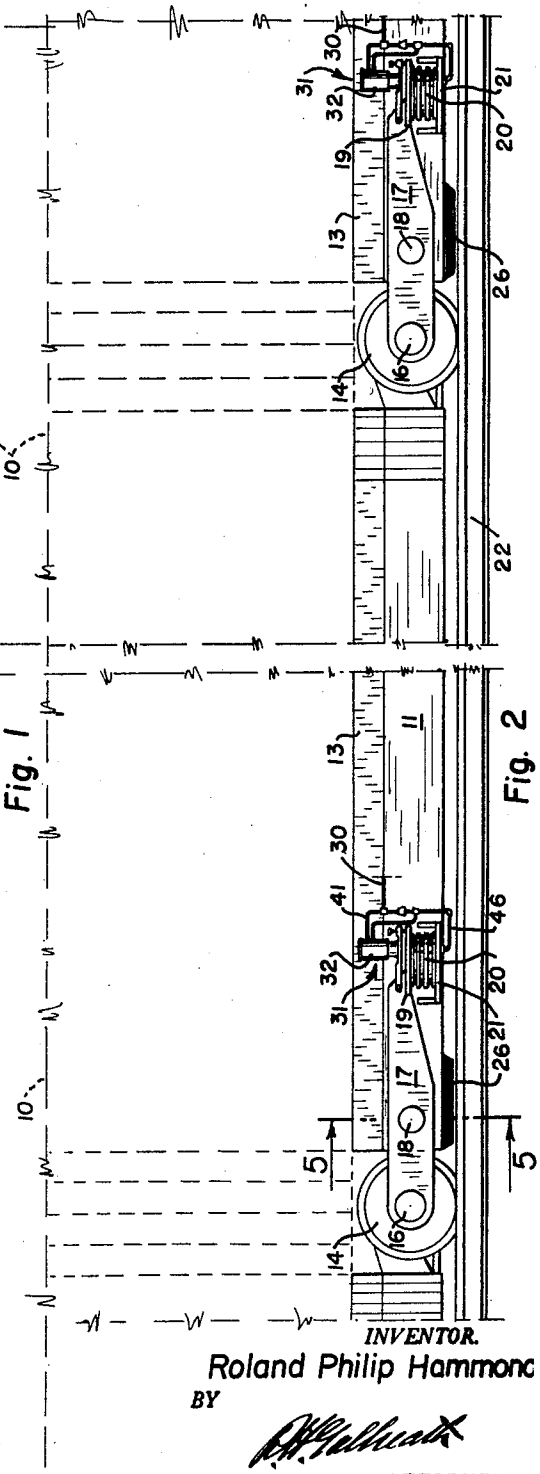


Fig. 2

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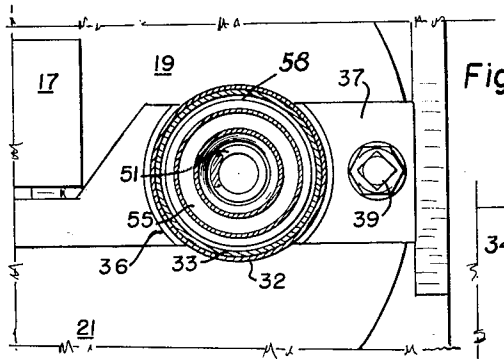


Fig. 4

Fig. 3

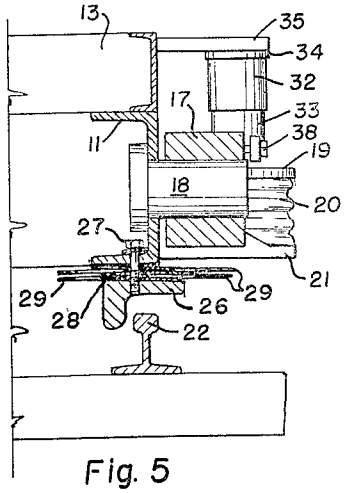


Fig. 5

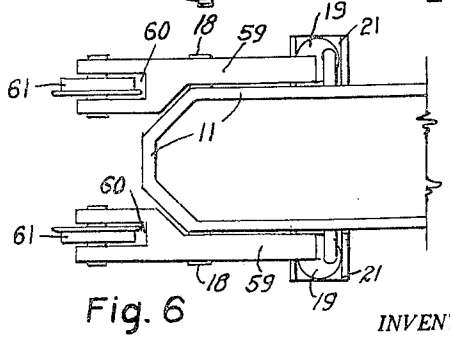


Fig. 6

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WHEEL SUSPENSIONS FOR RAILWAY CARS

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Application September 27, 1957, Serial No. 686,752

12 Claims. (Cl. 105—216)

This invention relates to a railway train and more particularly to a train of the type known as an "articulated train," that is, a train in which the car aisle is substantially continuous, without vestibules, throughout the entire length of the train, and in which the train is supported upon wheels positioned at the coupling points between the cars throughout the length of the train.

The principal object of the invention is to provide a highly efficient means for mounting the wheels from the cars at the axes of articulation of the train, and to replace the usual mechanical springs with highly efficient, self-leveling air springs or pneumatic cushioning devices which will automatically maintain the train in a preset level plane regardless of variations in loading and regardless of transversely-acting forces such as wind, centrifugal forces, etc.

Another object of the invention is to incorporate a track-engaging braking mechanism which will eliminate the usual wheel brakes and their operating elements, and which will act to lower the entire train into simultaneous braking engagement with the tracks throughout its entire length so as to obtain a maximum braking action with a minimum of stress upon the train structure and to incorporate the braking elements with the wheel suspension elements so that the latter will serve to both efficiently and resiliently support the train during normal running, and which will serve to apply a braking or retarding action on the train when required.

Other objects and advantages reside in the detail construction of the invention, which is designed for simplicity, economy, and efficiency. These will become more apparent from the following description.

In the following detailed description of the invention, reference is had to the accompanying drawing which forms a part hereof. Like numerals refer to like parts in all views of the drawing and throughout the description.

In the drawing:

Fig. 1 is a fragmentary plan view of a typical portion of the undercarriage of the improved train;

Fig. 2 is a side view of the portion of the undercarriage of Fig. 1;

Fig. 3 is an enlarged vertical section through one of the air springs employed in the wheel suspension of the improved train, taken on the line 3—3, Fig. 1;

Fig. 4 is a horizontal cross-section through a compensating valve mechanism, the section being taken on the line 4—4, Fig. 3;

Fig. 5 is an enlarged detail section through a brake shoe as employed in the improved train, the section being taken on the line 5—5, Fig. 2; and

Fig. 6 is a fragmentary plan view illustrating an alternate method of mounting wheels upon the improved wheel suspension.

In Figs. 1 and 2 the train car bodies have been eliminated for the sake of clarity. The bodies may be of desired type or design. They and their connecting diaphragms will occupy positions on the undercarriage as indicated by the broken line outlines 10.

The car bodies are supported upon an elongated rectangular undercarriage frame 11 preferably, but not necessarily, formed from structural channel members having their flanges turned inwardly and suitably braced such as indicated by the gusset plates 12. A body frame 13 of any suitable construction is superimposed and mounted on the undercarriage frame 11 to support the car bodies thereon.

The wheels of the train, indicated at 14, unitarily mounted on a conventional axle 15, are positioned between the adjacent undercarriage frame 11 of the adjacent cars of the train. The journals of each axle 15 extend into suitable journal bearings 16, each of which is mounted in and adjacent to the rear extremity of a tiltable wheel lever beam 17. The wheel lever beams are pivotally mounted upon pivot studs 18 which are affixed to, and extend oppositely outward from, each side of the undercarriage frames 11 adjacent the rear of the latter. The pivot studs 18 could be welded to the members of the undercarriage frame or could be the extremities of a pivot shaft extending completely across the undercarriage frame.

The pivot points of the wheel lever beams are positioned in closer relation to the rear extremities of the lever beams than to the forward extremities thereof so as to provide a relatively short rear lever arm and a relatively long forward lever arm on each wheel lever beam.

The long forward lever arm of each wheel lever beam 17 terminates in a pad 19 which rests upon a compressible air spring or sealed accordion like chamber which will be herein designated as a "pneumatic" 20. The pneumatic 20 is supported upon a suitable ledge bracket 21 mounted on the undercarriage frame 11. Air is supplied to the pneumatics 20, as will be later described, so that the trailing extremity of each car will be pneumatically supported from the track rails, indicated at 22.

The forward extremity of the undercarriage frame of each car is supported from the rear extremity of the undercarriage frame of the preceding car by means of a coupling device, which forms no part of the present invention and which is more completely illustrated and described in applicant's co-pending application, Serial No. 692,860.

Briefly, the coupling device comprises a pivot bracket 23 bolted or otherwise secured at the middle of the trailing extremity of each undercarriage frame. Each pivot bracket is provided with a vertical coupling socket into which a pivot lug 24 downwardly extends. Each pivot lug is formed on or carried by a tongue member 25 affixed to and extending forwardly from the middle of the forward extremity of the undercarriage frame of the adjacent following car. Each tongue member 25 supports the forward extremity of a car from the pivot bracket 23 of the next preceding car. Adjacent cars can move horizontally relative to each other about the axis of the pivot lug 24 which is positioned substantially vertically over the axle 15. Thus it can be seen that each set of wheels 14 supports substantially one-half the weight of a preceding car and one-half the weight of a following car, and that the total weight is resiliently biased by the pneumatics 20 through the action of the wheel lever beams 17.

It can be seen that if the weight in the cars increases or the pressure of the air in the pneumatics 20 decreases, the undercarriage frames 11 will tend to descend toward the rails 22. The tendency to descend is compensated for by automatically increasing the air pressure in the pneumatics, as will be later described. Advantage is taken of this descending action for applying a braking or retarding action on the train.

The braking action is accomplished by mounting straight, flat, renewable, flanged brake shoes 26 under each undercarriage frame below each of the pivot studs 18 thereon and directly over the rails 22. The brake shoes may be secured to the channel sides of the under-

carriage frame in any desired manner, such as by means of suitable attachment bolts 27. The shoes are preferably provided with cushioning pads 28 of suitable resilient construction which may be provided with projecting cooling fins 29.

It can be seen that, if the pneumatics 20 are allowed to collapse sufficiently, the undercarriage will descend to bring the brake shoes into frictional engagement with the rails to exert a retarding or braking action on the train.

Air is simultaneously and continuously supplied to all of the pneumatics 20 on the train from a train air line under the control of the locomotive engineer. A train line pipe 30 leads from the train air line to each of the wheel mountings of the train. The train line pipe 30 supplies air under pressure to the expansible pneumatic 20 through a telescoping compensating valve, designated in its entirety by the numeral 31, which consists of an inverted upper valve cup 32 telescopically fitted over a lower valve cup 33. The upper valve cup 32 rests in an inverted retaining socket 34 attached to a bracket arm 35 secured to and extending outwardly from the carriage frame 11. The lower valve cup 33 rests in an annular retaining flange 36 formed on a vertically adjustable platform plate 37 the rear extremity of which is pivotally mounted for vertical adjustment. As illustrated, the platform plate is pivoted as shown at 38 upon the forward extremity of one of the wheel lever beams 17 above the wheel lever pad 19 thereon. The forward extremity of the platform plate 37 is adjustably supported upon a suitable adjusting screw 39 which is threaded through the plate into contact with the pad 19.

Air is fed from the train line pipe 30 to an air passage 40 in the upper cup 32 by means of a first air tube 41. Air flows from the passage 40, through a valve port 42, controlled by a vertically acting needle valve 43, to a valve chamber 44 in the upper cup 32. Air discharges from the valve chamber 44 through a second air tube 45 leading to a pneumatic air pipe 46 which communicates through the ledge bracket 21 and through the bottom of the pneumatic 20 with the interior of the latter. A bypass return pipe 47 is connected between the pneumatic air pipe 46 and the train line pipe 30 and a conventional check valve 48 is incorporated in the return pipe 47 and positioned to prevent air from flowing directly to the pneumatic from the train line yet to allow air to flow in the reverse direction. An orifice disc 49 is incorporated in the pneumatic air pipe 46. The disc is provided with a measured bleed orifice 50 which constantly bleeds a minimum measured quantity of air from the pneumatic 20 to the atmosphere. Thus, when the needle valve 43 is open air can flow from the train line directly into the pneumatics 20 to expand the latter, and when the valve 43 is closed air will slowly discharge from the pneumatics to allow the latter to contract. Therefore, control of the pneumatics resides in the needle valve 43.

The needle valve 43 is constantly urged toward its seat in the port 42 by means of a valve spring 51 which rests upon a spring disc 52 in the lower valve cup 33. The spring 51 acts to resiliently force a valve stem 53 against the needle valve 43 to urge the latter to its seat. The disc 52 is supported in the lower cup upon a compression disc spring 54 of greater compressive resistance than the spring 51.

From the structure thus far described it can be seen that as the wheel lever pad 19 descends, the lower valve cup will move downwardly to decrease the compressive force in the spring 51. Eventually a point will be reached where the compression in the valve spring 51 will be insufficient to retain the valve 42 closed and air will flow by the latter to prevent further contraction of the pneumatic. Therefore, as long as there is air in the train line the pneumatics will maintain the cars at a predetermined elevation, regardless of changes in load conditions in the cars.

The predetermined elevation can be adjusted by adjusting the screw 39 to preload the valve spring 51 with any desired compression. Under static load conditions just sufficient air will pass the valve 43 to compensate for the loss through the bleed orifice 50 and the cars will remain vertically stationary.

For brake application services, an annular expansive chamber 55 is suspended in the lower valve cup 33 from a top ring flange 56 fixed in the top of the cup 33. The expansive chamber 55 is secured to both the flange 56 and the spring disc 52 and has an inherent tendency, when not inflated, to exert a lifting action on the spring disc, assisted by the disc spring 54. The upward motion of the disc 52 is limited at a definite position in any desired manner, such as by means of a limit ring 58 positioned upon the peripheral portion of the disc 52 so as to come in contact with the top ring flange 56. The stiffness of the spring 54 is chosen so that a pressure of air sufficient in the pneumatics to lift a fully loaded car is insufficient in the annular expansive chamber 55 to move it downward away from its compressed position or stop. The expansive chamber 55 is, however, normally inflated at train line pressure, substantially higher than the pressure in the pneumatics, through a flexible tube 57 in constant communication with the air passage 40 in the upper valve cup 32. This train line pressure is sufficient to move the disc 52 downward against the resistance of the spring 54. The position assumed will be lower at higher train line pressures, and vice-versa.

As long as the train line pressure remains uniform, the spring disc will remain vertically stationary against the bias of the contracting tendency of the chamber 55 and the compression of the spring 54. However, a reduction in the train line pressure will allow all of the spring discs on the train to move upwardly to increase the compression in the valve springs 51 so that the wheel lever beams 17 and their pads 19 may move further downward without opening the valves 43 and thus establish a different controlled position for the lever beams. Sufficient reduction of train line pressure in this way will establish a control position for the lever beams such that the brake shoes 26 contact the rail 22, providing a mild braking action. Still further reduction in train line pressure can increase the braking action to any extent desired, since still further lowering of the control position of the beams will be attained only after the escape of air through the orifice 50 has lowered the pressure in the pneumatics to less than that which can fully support the weight of the car or truck. Thus, the weight of the car or truck becomes divided between the wheels 14 and the brake shoes 26, and the degree of such division, and hence the amount of braking effort, is controllable by adjusting the pressure in the train air line.

It is clear from the foregoing that in such a brake application, called a "service application," the air pressure in the train line is always higher than in the pneumatics, so that the check valves 48 remain closed. For an emergency brake application, however, the train air line is completely vented to the atmosphere. When this is done, the pressure in the supply pipes 30 soon falls below that in the pneumatics 20, and the check valves 48 will be forced open by the pressure differential to instantly reduce the pressure in the pneumatics essentially at atmospheric pressure.

Thus, all of the pneumatics instantly and simultaneously contract to allow the brake shoes to descend into frictional engagement with the rails for train retardation purposes. The brake shoes can be released by simply returning the train line pressure to the normal running pressure. The increase in pressure in the train line closes the check valves 48 and returns all of the spring discs 52 to their preset compensating position, through expansion of the expansive chambers 55 to their "running" position.

Thus, it can be seen that all of the compensating valves 31 can be preset in any desired manner, such as by regu-

lating the adjusting screws 39 to level the entire train at a given distance above the tracks, and that this level will be automatically maintained, regardless of variations in loading and regardless of the centrifugal tendency of the cars to tilt when rounding curves at high speeds.

It can also be seen that by the operation of a simple three-way valve in the locomotive, the entire train can be lowered to exert a controlled and uniform braking action on the rails throughout the entire length of the train so that no strains are imposed upon draw bars, cars, and couplings.

The only elements which might require servicing are the compensating valves 31. The latter are unattached, other than by the air tubes 41 and 45, and can be quickly lifted from the retaining flanges 36 and dropped from the sockets 34 for quick replacement at junction points while the train is in transit.

The platform plate 37 could, if desired, be positioned at any point along the lever beam 17 between the pivot stud 18 and the pad 19, without affecting the above described action of the compensating valve. The degree of movement will, of course, diminish as the pivot stud is approached.

The invention has been described in connection with a conventional wheel and axle unit. It is conceivable that the axle could be omitted and single independent wheels used, as illustrated in the alternate form of Fig. 6. In the latter form, wheel lever beams 59 are employed corresponding in operation to the wheel lever beams 17 previously described. The rear extremity of each of the wheel lever beams 59, however, are bifurcated, as shown at 60, and suitably journalled to receive independent track-engaging wheels 61, thus eliminating the unitary axle 15 of the previous form, if so desired. The other elements of the suspension remain as previously described.

While the improved wheel suspension has been described as applied to one extremity of a car of an articulated train, it could, of course, be applied to both extremities of a conventional car, or to a wheeled, car-supporting truck, or other wheeled vehicle, all of which are herein included by the term "car."

While a specific form of the improvement has been described and illustrated herein, it is to be understood that the same may be varied, within the scope of the appended claims, without departing from the spirit of the invention.

Having thus described the invention, what is claimed and desired secured by Letters Patent is:

1. A wheel suspension for a railway car comprising: a longitudinally-extending wheel lever beam at each side of said car; a track-engaging wheel rotatably mounted at the first extremity of each lever beam and supporting the latter from a track rail; pneumatic means supporting the second extremity of each lever beam from said car; means for applying weight from said car to said lever beams between said wheels and said pneumatic means; and means for supplying compressed air to said pneumatic means.

2. A wheel suspension for a railway car as described in claim 1 having means for increasing the pressure of air in said pneumatic means in proportion to an increase in weight applied by said weight-applying means.

3. A wheel suspension for a railway car as described in claim 2 having a brake shoe affixed to said car over said rail and means for discharging air from said pneumatic means to allow said car to descend to bring said shoe into frictional engagement with said rail.

4. A wheel suspension for a railway car comprising: a longitudinally-extending wheel lever beam at each side of said car; a track-engaging wheel rotatably mounted at the first extremity of each lever beam and supporting the latter from a track rail; pneumatic means supporting the second extremity of each lever beam from said car; means for applying weight from said car to said lever beams between said wheels and said pneumatic means; a compressed air line communicating between the two pneumatic means; supply means for supplying compressed air to said air line; an independent valve controlling the flow of air from said air line to each pneumatic means; means operable from vertical movements of the second extremity of each lever beam for actuating said valve to supply compressed air to the pneumatic means at that extremity; and means for discharging air from each pneumatic means.

5. A wheel suspension for a railway car as described in claim 4 in which the means for actuating said valve comprises: a valve stem arranged to move said valve against the pressure of said air and to a closed position; a valve spring acting against said stem to urge said valve to the closed position; and means supporting said spring from the second extremity of said wheel lever beam so that upward and downward movements of said second extremity will increase and decrease, respectively, the reaction of said spring on said valve.

6. A wheel suspension for a railway car as described in claim 5 having a bleed orifice continually discharging air from each pneumatic means.

7. A wheel suspension for a railway car as described in claim 6 having a by-pass conduit communicating between said compressed air line and said supply means, and a check valve in said by-pass conduit positioned to prevent air from flowing from said supply means to said pneumatic means yet allowing air to flow from said pneumatic means to said supply means when the pressure in the latter drops below the pressure in the former so as to allow said car to descend toward said rail; and a brake shoe fixedly mounted on said car so as to frictionally engage said rail in consequence of the descent of said car for braking purposes.

8. A wheel suspension for a railway car as described in claim 7 having means for increasing the reaction of said valve spring when the air pressure in the supply means falls below a predetermined pressure so as to maintain said valve closed during a longer arc of travel of said second extremity.

9. A wheel suspension for a railway car as described in claim 8 having means for manually adjusting and presetting the reaction of said valve spring.

10. In a wheel suspension for a railway car of the type having an expansible pneumatic resiliently supporting said car on a wheeled, rail-engaging, car body supporting structure so that expansion and contraction of said pneumatic will respectively raise and lower said car, means for controlling a supply of compressed air to said pneumatic comprising: an air supply pipe communicating with said pneumatic; a compensating valve positioned in and controlling the flow through said supply pipe; means for actuating said compensating valve in consequence of the expansion and contraction of said pneumatic; and means for delaying the opening of said valve when the pressure in said supply pipe drops below a predetermined pressure.

11. Means for controlling a supply of compressed air to a pneumatic as described in claim 10 having a check valve arranged to open when the pressure in the pneumatic exceeds the pressure in said supply to return air from the former to the latter.

12. Means for controlling a supply of compressed air to a pneumatic as described in claim 11 having a bleed orifice continuously discharging air from said pneumatic to the atmosphere.

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