Dec. 27, 1955

L. M. APPLEGATE

RAILWAY TRUCKS

2,728,304

Filed July 18, 1950

2 Sheets-Sheet 1

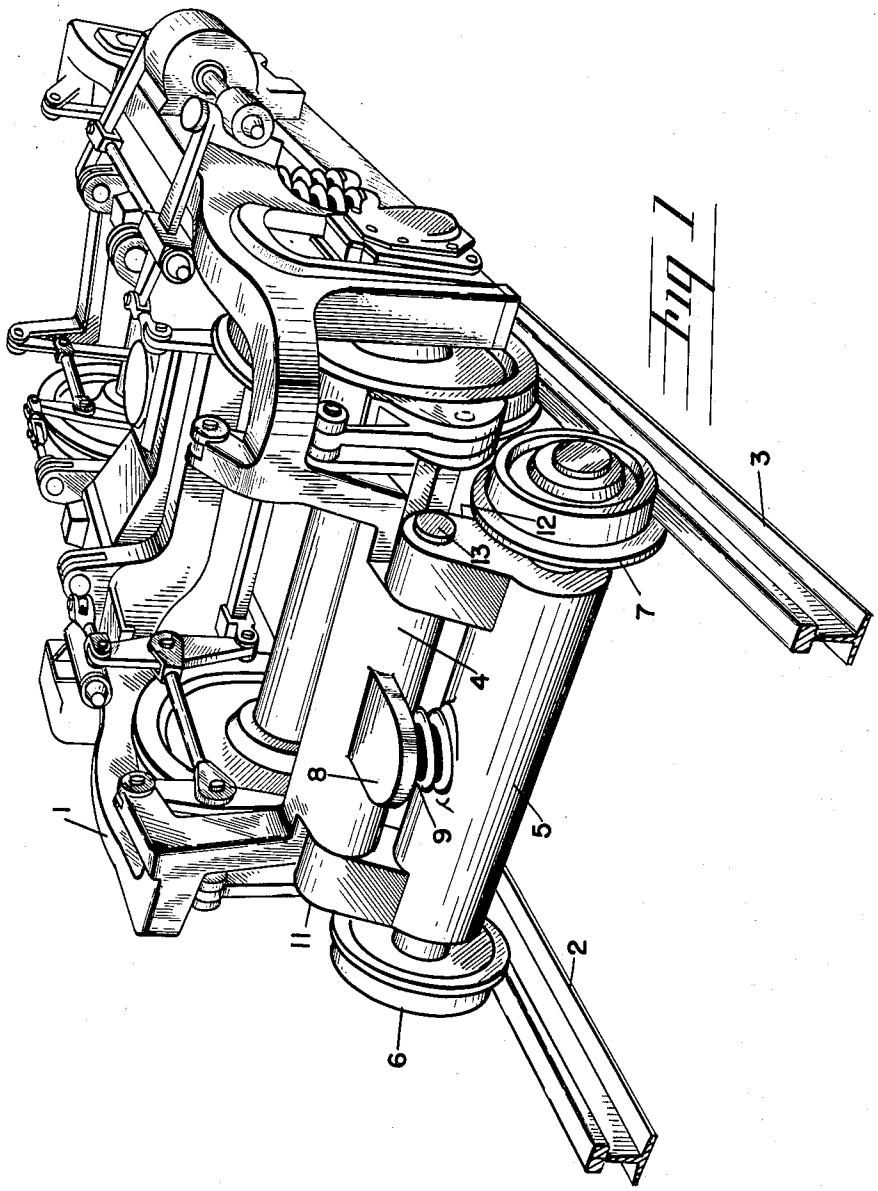


Fig. 1

INVENTOR.

Lindsay M. Applegate

Dec. 27, 1955 L. M. APPLEGATE 2,728,304

RAILWAY TRUCKS

Filed July 18, 1950 2 Sheets-Sheet 2

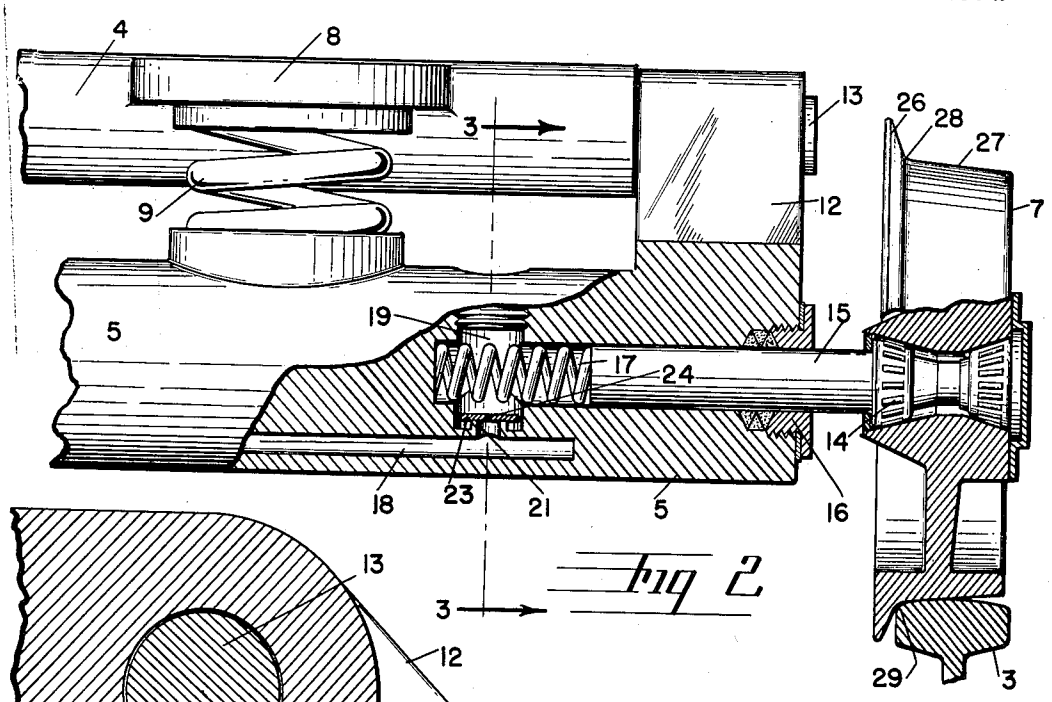


Fig 2

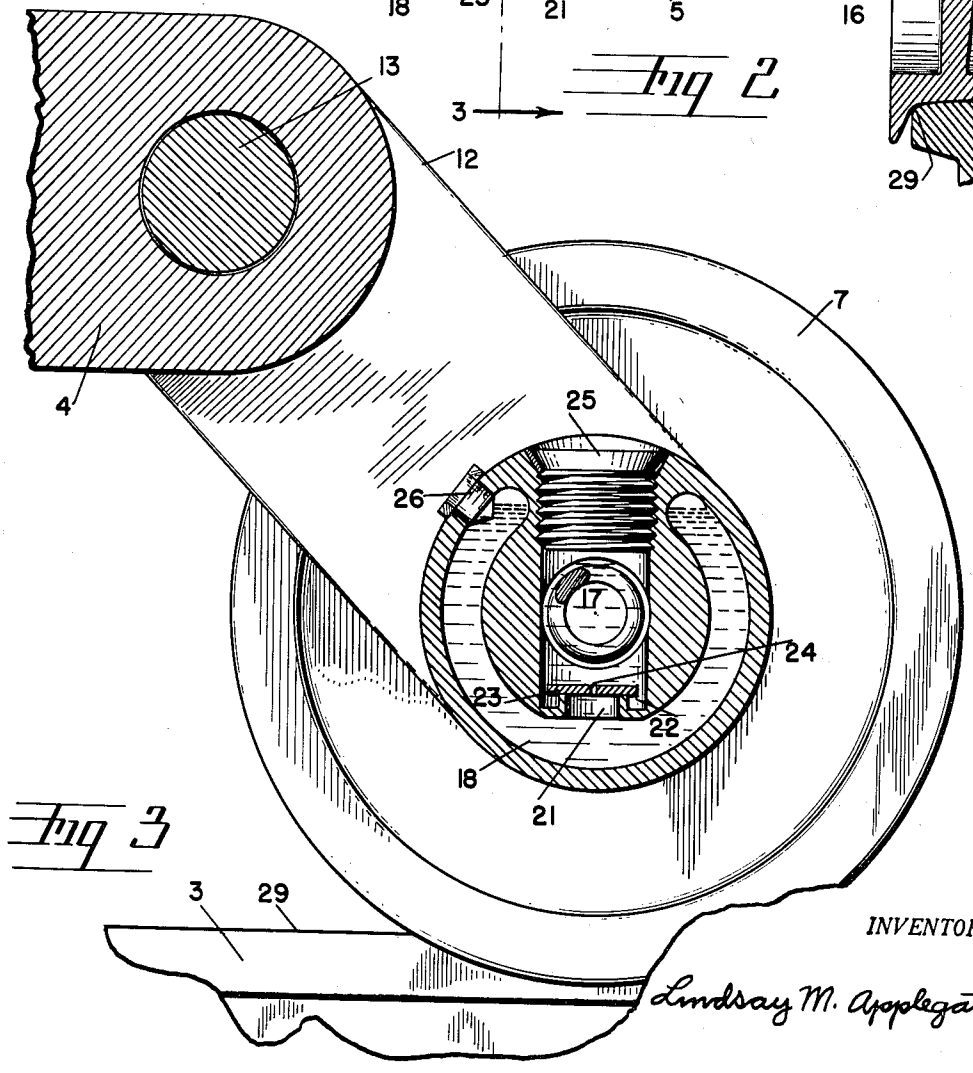


Fig 3

INVENTOR.

Lindsay M. Applegate

United States Patent Office 2,728,304 Patented Dec. 27, 1955

2,728,304

RAILWAY TRUCKS

Lindsay M. Applegate, Fort Belvoir, Va.

Application July 18, 1950, Serial No. 174,541

28 Claims. (Cl. 105—183)

(Granted under Title 35, U. S. Code (1952), sec. 266)

The invention described herein may be manufactured and used by or for the Government of the United States for governmental purposes without the payment to me of any royalty thereon in accordance with the provisions of the act of March 3, 1883 (22 Stat. 625), as amended by the act of April 30, 1928 (45 Stat. 467, 35 U. S. C., 1946 ed., sec. 45).

This invention relates to railroad rolling stock. In particular it relates to the trucks of cars intended to operate at high speeds. Railway cars operated at high speeds frequently wander from side to side on the rails. This lateral wandering can become very severe causing the flanges of the car wheels to hit the rails with considerable impact. These impacts are communicated to the bearings and to the car in general resulting in destructive forces and in a rough ride in the car.

Lateral wandering of railway trucks at high speed has some of the characteristics of resonance. The lateral movement builds up into a periodic oscillation from side to side on the rails until the forces and frictional losses involved in the oscillation are sufficient to prevent further increases in amplitude. These swings are not confined entirely to the relative movement of wheels on the rails. The oscillation extends throughout the flexible system of the car suspension. The car rocks laterally on the springs and linkages supporting the car. The bearings, when they have lattitude for movement, slide sidewise over the bearing surfaces. The springs are deflected in the rocking, being compressed on one side and extended on the other in alternation. Any shock absorbers present are deflected and they absorb energy of the oscillation. There is, possibly, in the most severe oscillation even some distortion of supporting members with the consequent energy absorption of mechanical hysteresis. All these actions together absorb energy in the lateral oscillation and tend to prevent the oscillation becoming so violent as to damage the car and impair the safety of its operation. There appear, however, to be limits to the speed at which some cars can safely be operated. At or beyond some critical speeds, some cars are likely to incur such violent lateral oscillation that they would be damaged beyond the point of safe operation.

There have been many attempts to design car trucks to avoid oscillation. Small and superficially insignificant differences in mechanical dimensions and configurations are said to make the difference between a truck that will wander and one that is laterally stable. In long trains at high speed the difference in oscillating characteristics of apparently identical cars is easily observed. In the same train one car may be wandering badly and the next car to it not wandering at all. This suggests that the lateral movements are started by comparatively small initial forces and that if these small forces are immediately neutralized, the oscillation will not build up into any appreciable amplitude.

This invention is concerned with displacements of the car on the track which involve lateral components of displacement between the car wheels and the rails. A

lateral displacement is produced when the car wheels roll or slip sideways between the rails without any perceptible angular deflection of the wheels in reference to the car. A lateral component of displacement between the wheels and the rail is produced also when the car wheels roll at a small angle on the rails when given an angular displacement in reference to the car.

Angular and lateral displacements of the car wheels and trucks in reference to the car body have been the subject of invention by earlier inventors. Some of these inventors have attempted in various ways to stabilize the lateral motion of the car on the rails by introducing controls between the truck and the car body. These attempts probably have been partially successful in suppressing lateral oscillation of the car by damping the movement of the car relative to the wheels. It is probable that by suppressing swings of the car body of large amplitude with respect to the truck the violence of impact encountered in the lateral displacement of the wheels on the rails is decreased. These efforts at control have not however been sufficient to prevent objectionable lateral oscillation of the car as a whole, including the wheels, on the rails. My invention is, therefore, concerned with the components of lateral displacement of the car wheels themselves with reference to the rails which occur when the car wheels and trucks oscillate transversely to the direction of the rails by wandering from side to side as the wheels roll at high speed along the rails.

This discussion of lateral wandering of cars applies to conventional railways in which there is clearance between the flanges of the wheels and the inside edges of the tracks. There are, in the prior art, railways of other kinds such as those in which the flanges of the wheels are restrained from lateral movement by grooves in the rails. Wandering of trucks as observed in ordinary railways would not exist in these types where the flanges of the wheels are specially restrained. In these types, flexibility in the distance between the wheels may be necessary to permit adjustment to variation in distance between the rails, and in at least one instance in the prior art an adjustable axle was patented including an air chamber in which relative movement of the two wheels on the axle produced a partial vacuum for resisting forces tending to lengthen the distance between the wheels. Such devices as this, while they in their specialized application might be associated with cars which would not wander on the rails, are not directly related to the problem with which this invention is concerned.

The principal object of this invention is to provide means for permitting railway cars to operate at high speeds without wandering laterally on the rails. Another object is to prevent lateral wandering in car trucks by the use of substantial and simple means that can be attached to ordinary trucks without any basic change in the truck itself. Another object is to provide means that are effective immediately, even with very small amplitudes of lateral movement in suppressing wandering of the trucks.

What constitutes my present invention is set forth in the specification following with reference to the accompanying drawings and is succinctly defined in the appended claims.

In the drawings,

Figure 1 is a general view of a conventional railway car truck designed to operate at high speed to which has been attached one practical form of embodiment of my invention.

Figure 2 is a longitudinal section of part of the embodiment shown in Figure 1, from which the principles of operation can be understood.

Figure 3 is a transverse section of part of the embodi-

ment shown in Figure 1, intended to show some details of construction.

In Figure 1 a conventional railway car truck **1** is shown in ordinary operation on two rails **2** and **3**. An extension or bracket **4** on truck **1** supports a hinged axle housing **5**. Housing **5** supports two flanged auxiliary wheels **6** tand **7** together with the necessary shafts and bearings. Bracket **4** has an extension **8** between which and housing **5** a spring applies some downward pressure to housing **5**. Housing **5** has two extensions **11** and **12** which together with a pin **13** provide a hinge about which housing **5** is free to rotate subject to the loading of spring **9**.

Figures 2 and 3 show, in addition to parts also shown in Figure 1, the principal internal parts. Wheel **7** is carried on a bearing **14** and a shaft **15**. Bearing **14** is preferably of the so-called frictionless type, not because of the importance of the friction, but to provide construction that has a minimum of end play in the bearing. Some end play is permissible but it is not desirable. Shaft **15** is supported in housing **5** in a way that permits endwise movement, but preferably no rotation. Shaft **15** enters housing **5** through a packing **16**. A spring **17** applies pressure to the end of shaft **15** tending to force shaft **15** out of housing **5**.

Inside housing **5** a chamber **18** is provided to contain fluid for hydraulic damping. Spring **17** is contained in a chamber **19** connected with chamber **18** by a port **21**. Port **21** terminates in a valve seat **22** on which a valve plate **23** is provided to act as a throttled valve. The throttling is provided by an orifice **24** in plate **23**. Chamber **19** is closed by a screw plug **25**. A filler plug **26** is provided for chamber **18**. Chambers **18** and **19** are filled completely, preferably with all air removed, with a hydraulic shock absorber fluid.

Wheel **7** being held by axial pressure of spring **17** against the inside of rail **3** has a configuration between the flange **26** and the tread **27** in which the transition curve **28** between flange **26** and tread **27** is made to a radius of curvature preferably appreciably greater than the radius of curvature of the inner top edge **29** of rail **3**. This difference in radius of curvature permits wheel **7** to ride against the curved inside edge of rail **3** with considerable axial pressure without appreciable slipping. Continuous contact of wheel **7** and rail **3** with axial pressure prevents wheel **7** from wandering laterally on rail **3**.

In operation, truck **1** is subject continually to small lateral impacts due to irregularities of the rail roadbed and rails and other influences that tend to cause the wheels to shift laterally on the rails. Assuming a lateral shift or directional displacement of truck **1** of any appreciable magnitude, housing **5** will be moved toward one of the wheels **6** or **7**. Assuming a movement toward wheel **7**, shaft **15** will be forced against the pressure of spring **17** thus momentarily decreasing the volume of chamber **19**, and forcing some of the contained hydraulic fluid from chamber **19** to chamber **18** through valve orifice **24**. This will absorb some energy and will tend to damp the lateral movement of truck **1**. Each half cycle of any lateral oscillation of truck **1** on the rails will dissipate some energy in the hydraulic damping system.

If the amount of energy stored in the oscillating system comprising car and truck each half cycle is increased by less than the amount of energy dissipated each half cycle, there will be no augmentation of amplitude of oscillation, but instead any oscillation that starts will be damped out. This will hold oscillation to an amplitude where the energy absorbed by the damping system is equal to the added increments from outside impacts. The relative rate of absorption of energy for small amplitudes of oscillation is made sufficiently large by making the hydraulic system comprising shaft **15**, chamber **19** and valve **22** tight and leak-proof. Also, in order to assure that shaft **15** moves definitely in reference to housing **5** for any lateral displacement of truck **1** with respect to rail **3** bearing **14** is made practically free from end play.

The configuration of wheels **6** and **7** is such the tread **27** and flange **26** both slope more than on ordinary car wheels. This is to give more complete assurance of relatively frictionless rolling of wheels **6** and **7** on the rails. This permits more ready adjustment of wheel **7** to rail **3** so as to ride with the curve **28** of wheel **7** in contact with the curved edge **29** of the rail.

In the design of the hydraulic energy absorbing system valve plate **23** permits ready replacement of hydraulic fluid in chamber **19** when shaft **15** is moving outward and thus increasing the volume of chamber **19**. Valve plate **23** lifts up readily when the pressure in chamber **18** exceeds the pressure in chamber **19**, but seats firmly when the pressure in chamber **19** is greater. This requires that the flow of fluid from chamber **19** to chamber **18** be through orifice **24**. The damping operation of the system would be substantially the same as described if plate **23** were not movable but this could result in slowness of movement of shaft **15** out of housing **5**, when truck **1** is moving toward the opposite rail, and also by maintaining decreased pressure momentarily in chamber **19** might tend to induce leakage of air along shaft **15** into chamber **19**. Although the system could still operate effectively under such circumstances, it is desirable to provide for relative freedom of movement of shaft **15** out of housing **5** and to avoid the admission of air.

The construction shown in the drawings is illustrative of what is required to fulfill the basic requirements of the system. The mass and loading of housing **5** and the associated parts should be sufficient only to hold wheels **6** and **7** stable on rails **2** and **3** under practical conditions of operation. Any equivalent construction such as supporting wheels **6** and **7** on brackets laterally hinged with ordinary shock absorbers might be arranged to produce the same effect as the construction described.

In analyzing the operation of this invention, it will be apparent that, although the movement of truck **1** relative to the rails is conveniently referred to as "lateral," most wandering will be associated with a small angular displacement of the truck with respect to the center line of the rails. The angular displacement ordinarily will reverse in direction each half-cycle of the lateral oscillation. It will be seen therefore that there can be displacement of wheels **6** and **7** with respect to truck **1** even though there be no resultant displacement of truck **1** as a whole with respect to the rails. This contributes effectively to the suppression of lateral oscillation by resisting angular displacement of truck **1** on the rails which is likely to occur before there has been any overall resultant lateral displacement. Accordingly, it may properly be said that the energy extraction system of shock absorption in the structure is effective upon angular displacement of truck **1** as well as lateral displacement.

It will be obvious that the magnitudes of the angular displacements will be small and that to be effective the energy absorption system must be responsive to small displacements. This accounts for the relatively rigid construction shown in Figures 2 and 3. Bearings **14** are made preferably as close-fitting ball or roller bearings without appreciable end-play. Shaft **15** is close fitting in its housing and stuffing box **16** is made as nearly leakproof as possible. Throttling orifice **24** is made small so as to provide effective damping with a small movement of shaft **15** against spring **17**, and the oil channels and reservoir **18** are made so as to assure space **19** remaining full of oil. Under some circumstances, if the forces tending to produce lateral oscillation are small, the energy absorbed by the friction of shaft **15** moving in stuffing box **16** against the resistance of spring **17** probably will be sufficient. Although hydraulic energy absorbers

are conventionally desirable for use where energy is to be absorbed in small displacements, other systems which are functionally equivalent can be used. The important functional requirement is that when truck **1** is displaced laterally or angularly with respect to the rails energy will be absorbed even when the displacement is small. Obviously any other system capable of absorbing energy from a small displacement can be substituted for the system shown.

In principle, for additional emphasis and understanding the significance of the illustrative mechanism described above, it will be observed that essential requirements of operation are: mechanical tightness of the system which will assure detection and following of small lateral displacements of truck **1** relative to rails **2** and **3**; freedom from looseness in bearings, supporting structures and damping members which would permit truck **1** to move laterally on rails **2** and **3** without such lateral movement being detected, opposed and damped by the springs and frictional parts which are intended to resist lateral movement; and tightness in the energy absorbing system to assure damping even when the lateral displacements are very small. It will be obvious that, inasmuch as the lateral movement of truck **1** on rails **2** and **3** is limited inherently by the flange clearance between the rails, it can never be more than a fraction of an inch. An energy absorbing system intended for such small displacements needs, therefore, to be responsive to displacements much less than are usually encountered in vehicular spring systems. Accordingly the tightness of the damping system shown in Figures 2 and 3 is important rather than the volume thereof.

In those situations where mechanical friction such as in packing **16** is used for damping instead of using hydraulic damping, the friction should not be so great as to require excessive strength in spring **17** to assure close following of the flange of wheel **7** against the inner edge of rail **3**. It is important that small lateral displacements of truck **1** on rails **2** and **3** produce, in spring **17** and the associated energy absorbing mechanism, a second displacement which is the counterpart of the displacement of truck **1** on the rails. This necessarily requires close fit of all parts of the energy absorbing system and close following of wheel **7** on rail **3**. This applies also to extension **12** and pin **13** which should fit snugly to assure housing **5** rigidly following lateral movements of truck **1**. Looseness is undesirable inasmuch as the displacement of shaft **15** in housing **5** should be the direct resultant of displacement of truck **1** on rail **3** rather than a product of inertia effects derived from such displacements.

In the construction of wheel **7**, shaft **15**, and associated parts it is not required that wheel **7** occupy only the position illustrated in the drawing. It is required only that when truck **1** moves laterally relative to track **3** that shaft **15** be given appropriate displacement.

In describing this invention it should be understood that auxiliary flanged wheel **7**, in essence is a moving point of contact on the rail. The flanged wheel is a convenient mechanical arrangement, but it may be referred to along with other possible mechanical arrangements as a moving or rolling contact. The movement of truck **1** transversely relative to rails **2** and **3** the control of which is the object of this invention, may be referred to as lateral, transverse, or side-to-side movement or displacement. It is sometimes convenient to use the words lateral movement in reference to the truck as a whole on the rails, and the word displacement to designate mechanical movements of parts on the truck to avoid confusion.

Springs **9** and **17** are elastic members with the inherent characteristics of such elements. Rubber blocks and other elastic materials are conventionally classified also as elastic members. The forces set up in wheel **7**, shaft **15**, spring **17**, and the damping devices associated

therewith, and the force resulting from friction which may resist relative movement of these parts appears by reaction in accordance with the recognized laws of physics. In describing the action and reaction of the movements of wheel **7** and connected parts relative to the truck, it will be understood that if, for example, spring **17** is compressed by a given displacement of shaft **17** the force exerted on the flange of wheel **7** when being moved by spring **17** will be less by the amount of frictional force than when wheel **7** was being moved by the rail while storing energy in spring **17**, It should be understood that the force the elastic member is capable of delivering when recovering from an impressed distortion will be less by the frictional forces or forces absorbed in energy dissipating devices connected therewith than the forces initially present to produce the distortion or elastic displacement. This effect contributes to damping of oscillation.

The mechanical connections including the auxiliary wheel **7**, bearing **14**, shaft **15**, spring **17** and other mechanical moving parts associated therewith or alternative thereto are conveniently referred to as linkage. It will be understood, of course, that mechanical linkage in the broad sense employed in the terminology of mechanism is denoted by the shorter expression linkage. Housing **5** shown in Figure 1, as a rigid structure supporting both wheels **6** and **7** is obviously schematic and does not illustrate the ordinary flexibility required to permit wheels **6** and **7** to ride the rails smoothly when truck **1** rocks on its supporting springs. It will be obvious to those skilled in this art that the usual flexibility between truck **1** and all wheels, both load bearing and auxiliary, must be provided to assure normal tracking. In effect, housing **5** should be cut in two to permit truck **1** to rock freely without lifting either auxiliary wheel **6** or **7** off the rails.

I claim:

1. In a flanged-wheel railway truck with clearance between the wheel flanges and the rails, means for preventing excessive lateral wandering which comprise an auxiliary flanged wheel in contact with one edge of the rail, means for holding said auxiliary wheel in contact with the rail responsive to displacement of said auxiliary wheel with respect to the truck produced by lateral movement of the truck on the rail, and means for resisting said displacement and for absorbing energy therefrom, whereby lateral movement of the truck on the rails is damped through displacement of said auxiliary wheel relative to said truck by forces applied by said auxiliary wheel and to said rail.

2. In a flanged-wheel railway truck with clearance between the wheel flanges and the rails, means for preventing excessive lateral wandering which comprise an auxiliary flanged wheel in contact with the inside edge of the rail, means for holding said auxiliary wheel in contact with the rails responsive to displacement of said auxiliary wheel with respect to the truck produced by lateral movement of the truck on the rails, and means for resisting said displacement and for absorbing energy therefrom, whereby lateral movement of the truck on the rails is damped by forces in said holding means developed by relative displacement of said auxiliary wheel and truck.

3. In a flanged-wheel railway truck with clearance between the wheel flanges and the rails, means for suppressing lateral wandering which comprise an auxiliary flanged wheel in contact with one edge of the rail, means for holding said auxiliary wheel in contact with the rail providing for movement of said wheel with respect to the truck, and means for resisting said movement and for absorbing energy therefrom, whereby lateral movement of said truck on said rail causes movement of said auxiliary wheel relative to said truck developing a force between said auxiliary wheel and said rail resisting and damping lateral wandering of the truck with respect to the rails.

4. In a flanged-wheel railway truck with clearance between the wheel flanges and the rails, means for suppressing lateral wandering which comprise an auxiliary flanged wheel, means for applying force both radially and axially to hold said auxiliary wheel in contact with the inside edge of the rail, said force-applying means responsive to movement of said auxiliary wheel with respect to said truck, and energy absorbing means to resist said movement, whereby wandering of the truck with respect to the rails causes said force applied axially to vary in accordance with and to resist, said wandering.

5. In a flanged-wheel railway truck with clearance between the wheel flanges and the rails, means for suppressing lateral wandering which comprise an auxiliary flanged wheel, supported by a closely fitted bearing in flexible means responsive to axial movement of said auxiliary wheel with respect to the truck, elastic members for applying radial and axial forces holding said auxiliary wheel in contact with the rail, and energy absorbing means responsive to displacement in said flexible means produced by movement of said auxiliary wheel with respect to the truck, whereby lateral wandering of the truck with respect to the rails produces axial movement of said auxiliary wheel with respect to the truck, energy being communicated through said flexible means and absorbed from said axial movement, and forces which are developed thereby being applied between said auxiliary wheel and rail in opposition to said lateral wandering.

6. In a flanged-wheel railway truck with clearance between the wheel flanges and the rails, means for suppressing lateral wandering comprising a pair of auxiliary flanged wheels, each auxiliary wheel being held in contact with the rail by a mechanical assemblage in which springs apply radial and axial forces between said auxiliary wheel and the truck, and hydraulic energy absorbing means responsive to axial displacement of said auxiliary wheel with respect to the truck, whereby lateral movement of the truck with respect to the rails produces displacement of the auxiliary wheels with respect to the truck, and consequent variation of axial force applied by said springs, together with absorption of energy from said displacement, said variation of axial force being opposed to the movement of the truck on the rails, and thereby suppressing said lateral wandering.

7. In a flanged-wheel railway truck with clearance between the wheel flanges and the rails, means for suppressing lateral wandering of the truck on the rails, said means comprising an auxiliary flanged wheel in contact with the inside edge of the rail, a bearing with little or no end play connecting said auxiliary wheel to a mechanism for applying radial and axial forces to said auxiliary wheel, said axial force being provided by a stressed spring and a hydraulic damping device connected with said mechanism to absorb energy from axial displacement of said auxiliary wheel with respect to the truck, whereby lateral movement of the truck on the rails produces axial displacement of said auxiliary wheel with respect to the truck with consequent variation in axial force, said variation in force being in opposition to the lateral movement of the truck on the rails thereby suppressing lateral wandering of the truck on the rails.

8. In a flanged-wheel railway truck with clearance between the wheel flanges and the rails, means for suppressing lateral wandering of the truck on the rails comprising an auxiliary flanged wheel in contact with the inside edge of the rail, means for applying to said auxiliary wheel axial and radial pressure to maintain close contact with the rail, including bearings with little or no end play connecting said auxiliary wheel through a shaft to a spring under stress and a damping device, whereby movement of the truck on the rail causes displacement of said auxiliary wheel with respect to said truck increasing the stress in said spring, and encountering forceful resistance in said damping device, said spring having sufficient force to hold said auxiliary wheel in effective contact with the rail, and the combination of spring and damping forces together opposing the movement of the truck on the rails.

9. In combination with a truck for running on rails, a pair of flanged auxiliary wheels mounted on said truck with means for holding said wheels firmly against the rails with loading on both treads and flanges of said wheels, said means being responsive to movement of said wheels in respect to said truck as a resultant of lateral displacement of said truck on said rails, said means including elements for producing a force opposing said lateral movement, and elements for hydraulically damping movement in said means, said movement producing, through said means, force between said rails and said wheels for stabilizing the travel of said truck on said rails.

10. In combination with a truck for running on rails, a pair of flanged wheels mounted to ride on said rails in contact therewith and with forces continuously applied laterally to said wheels, a housing hinged on a horizontal axis so said housing can move vertically, but not laterally with respect to said truck, a shaft at each end of said housing carrying bearings for said wheels and protruding from said housing, tight chambers in said housing communicating with the ends of said shafts, a reservoir in said housing communicating with said chambers through orifices, springs in said chambers for providing said lateral forces on said wheels, and hydraulic fluid in said chambers and reservoir, the arrangement being that when said truck moves laterally on said rails said shafts move in and out of said chambers transversely to said rails, producing hydraulic forces resisting said lateral movement and thereby laterally stabilizing the travel of said truck on said rails.

11. In combination with a truck for running on rails, a flanged auxiliary wheel mounted on said truck in contact with one of said rails with latitude of movement transversely to the truck, said wheel equipped with close fitting bearings which communicate with a force-producing and energy-absorbing system in which changes in direction of said truck on said rail cause displacement of said wheel with respect to said truck, and in which said displacement produces a force between said truck and wheel which resists said changes in direction of said truck.

12. In combination with a truck for running on rails, means for producing from lateral movement of said truck on said rails a displacement in an elastic member on said truck, said member being connected to a moving contact on said rail, said elastic member producing from said displacement a force, and applying said force through said means between said truck and said rail for resisting said lateral movement.

13. In combination with a truck for running on rails, means for producing from lateral movement of said truck on said rails a displacement and a force in an elastic member on said truck, said member being connected to a rolling contact on said rail, said means applying said force between said truck and said rail for resisting said lateral movement.

14. In combination with a truck for running on rails, an elastic member and a frictional member on the truck connected responsively through mechanical linkage to an auxiliary flanged wheel in contact with the upper inside edge of the rail whereby lateral and angular movements of said truck on said rail produces displacement and force in said frictional member and communicates said force to said rail through said auxiliary flanged wheel for resisting said lateral and angular movements with said force.

15. In combination with a truck for running on rails, an elastic member and a frictional member on the truck connected to an auxiliary flanged wheel on the rail, said elastic member holding said auxiliary wheel in contact with the upper inside edge of the rail, lateral movement of said truck on said rail producing displacement and force in said frictional member, said force being applied

between said truck and said rail through said auxiliary wheel for resisting said lateral movement with said force.

16. In combination with a truck for running on rails, an elastic member and a frictional member on the truck connected to an auxiliary flanged wheel on the rail whereby angular movement of said truck on said rail produces displacement and force in said frictional member, said force being communicated from said truck to said rail for resisting said angular movement.

17. In combination with a truck for running on rails, means including auxiliary wheels running on the same rails as the main wheels of the truck for deriving from lateral movement of the truck on the rails a displacement of energy-absorbing means on said truck, means for producing from said displacement a force opposed thereto and means for applying said force between said truck and said rail in opposition to said lateral movement.

18. In combination with a truck for running on rails, an elastic member and a frictional member on the truck connected to an auxiliary flanged wheel held in contact by said elastic member with the same rail as used by the main wheels of the truck whereby lateral and angular movements of said truck on said rail produce displacement and force in said frictional member, said force resisting through said auxiliary wheel said lateral and angular movements of said truck on said rail.

19. In combination with a truck for running on rails, an elastic member, an energy-dissipating member on the truck connected to an auxiliary flanged wheel in contact with the edge of the rail whereby lateral and angular movements of said truck on said rail produce displacement and force in said energy-dissipating member, said force resisting, through said auxiliary wheel, said lateral and angular movements of said truck on said rail, and said energy dissipating member damping said movement.

20. In combination with a truck for running on rails, a rolling contact on the rail, a linkage between said contact and an elastic member on the truck, said linkage translating lateral movement of said truck on said rail into displacement of said elastic member with the production of force therein, said linkage also communicating by reaction said force through said rolling contact to said rail for resisting said lateral movement.

21. In combination with a truck for running on rails, an auxiliary flanged wheel held in contact with the inside edge of the rail, a linkage between said wheel and a frictional member on the truck, said linkage translating lateral and angular movements of said truck on said rail into displacement in said frictional member with the production of force therein, said linkage also communicating by reaction said force through said auxiliary wheel to said rail for resisting said lateral and angular movements.

22. In combination with a truck for running on rails, an auxiliary flanged wheel rolling on the rail, a linkage between said flanged wheel and an elastic member on the truck, said linkage translating lateral movement of said truck on said rail into displacement of said elastic member with the production of force therein, said linkage also communicating by reaction said force through said auxiliary flanged wheel to said rail for resisting said lateral movement.

23. In combination with a truck for running on rails, an auxiliary flanged wheel rolling on the rail, a linkage between said wheel and said truck, said linkage including a spring to hold the flange of said wheel in close contact with said rail and energy dissipating means responsive to said linkage, said linkage translating lateral movement of said truck on the rails with consequent displacement of said wheel with respect to said truck into deflection and force in said spring and said energy dissipating means, said linkage also communicating, by reaction, said force through said wheel to said rail for resisting said lateral movement.

24. In combination with a truck for running on rails, an auxiliary flanged wheel, with springs and linkage between the truck and said wheel for holding said wheel in close contact with the upper inside edge of the rail, said linkage translating lateral movement of the truck on the rail with consequent movement of said wheel with respect to said truck into displacement in said springs with consequent production of forces therein, said linkage also communicating by reaction said forces through the flange of said wheel to the rail in opposition to said lateral movement.

25. In combination with a truck for running on rails, an auxiliary flanged wheel rolling on the rail, a linkage including an elastic member holding said wheel in close contact with the inside upper edge of the rail, and energy dissipating means responsive to displacement of said linkage whereby lateral movement of said truck on said rails produces a lateral displacement of, with consequent lateral force on, said wheel relative to said truck, said displacement being communicated to said elastic member and to said energy dissipating means, said force acting against said rail to oppose and damp said lateral movement.

26. In combination with a truck for running on rails, an auxiliary flanged wheel held in contact with the inside edge of the rail, a linkage between said wheel and an elastic member on the truck, said linkage translating lateral and angular movements of said truck on said rail into displacement of said elastic member with the production of force therein subject to friction in said linkage and elastic member, said linkage also communicating by reaction said force through said auxiliary wheel to said rail for resisting said lateral and angular movements.

27. In a flanged-wheel railway truck with clearance between the wheel flanges and the rails, means for preventing excessive lateral movement of the truck on the rails consisting of an auxiliary flanged wheel supported on the truck by a flexible linkage containing an elastic member for holding said auxiliary wheel in contact with the inside edge of the rail and containing frictional elements which absorb energy from displacements produced therein by movement within said linkage, whereby lateral and angular movements of said truck on said rail cause displacement of said auxiliary wheel with respect to said truck with consequent displacements in said linkage which are resisted by said elastic member and said frictional elements diminishing the energy in said displacements by the absorption of energy therefrom, and resisting said lateral and angular movements.

28. In a flanged-wheel railway truck with clearance between the wheel flanges and the rails, means for preventing excessive lateral movement of the truck on the rails consisting of an auxiliary wheel held in contact with the inside edge of the rail by a flexible linkage containing elastic and frictional elements maintaining a force between said truck and said auxiliary wheel, whereby lateral and angular movements of said truck on said rail cause said auxiliary wheel to move with respect to the truck producing displacements and additional forces in said linkage, the energy of said displacements being diminished by said frictional elements, with the said additional forces acting between said truck and said auxiliary wheel to resist the lateral and angular movements of the truck on the rail.

References Cited in the file of this patent

UNITED STATES PATENTS

496,145	Williams	Apr. 25, 1893
765,211	Thompson	July 19, 1904
1,391,223	Votaw	Sept. 20, 1921
1,871,778	Clasen	Aug. 16, 1932
1,954,705	Kruckenberg et al.	Apr. 10, 1934
2,040,262	Kruckenberg et al.	May 12, 1936
2,088,520	Huquenin	July 27, 1937
2,568,401	Lynn et al.	Sept. 18, 1951

FOREIGN PATENTS

60,730	Germany	Jan. 23, 1892