United States Patent [19]

Tack

[11] **3,795,201**

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[54] **RAILWAY CAR ROLL DAMPENING FRICTION DEVICE**

[76] Inventor: **Carl E. Tack,** 157 Linden St., Elmhurst, Ill. 60126

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[21] Appl. No.: **321,236**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 6,473, Jan. 28, 1970, Pat. No. 3,731,638.

[52] **U.S. Cl.**..... **105/199 A,** 105/199 CB, 105/453, 267/9 A, 267/9 C, 308/138

[51] **Int. Cl.**..... **B61f 5/14,** B61f 5/24, F16c 17/04

[58] **Field of Search**.....105/197 D, 197 R, 199 A, 105/199 C; 199 CB, 199 F, 199 R, 105/453; 267/9 A, 9 C; 308/138

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Primary Examiner—Robert G. Sheridan
Assistant Examiner—Howard Beltran
Attorney, Agent, or Firm—Gary, Juettner, Pigott & Cullinan

[57] **ABSTRACT**

An energy-absorber for swaying motion between the body and side-frame portions of a railroad car has a housing and a fulcrum adapted for mounting on the same portion of the car and has a lever pivoted on the fulcrum and adapted for sliding engagement with the other portion of the car. The housing contains a friction shoe having inclined wedging surfaces at its opposite ends and inner and outer wedge members having inclined surfaces mating with those of the shoe. The drive rod of the energy-absorber is pivoted to the operating lever and has an abutment engaging the outer wedge and has a compression spring around its inner end engaging the inner wedge. A spring of greater capacity in the housing produces friction increasing with the insertion of the rod and the shoe into the housing. Structure for providing maintenance-free operation over long periods of use is described.

7 Claims, 14 Drawing Figures

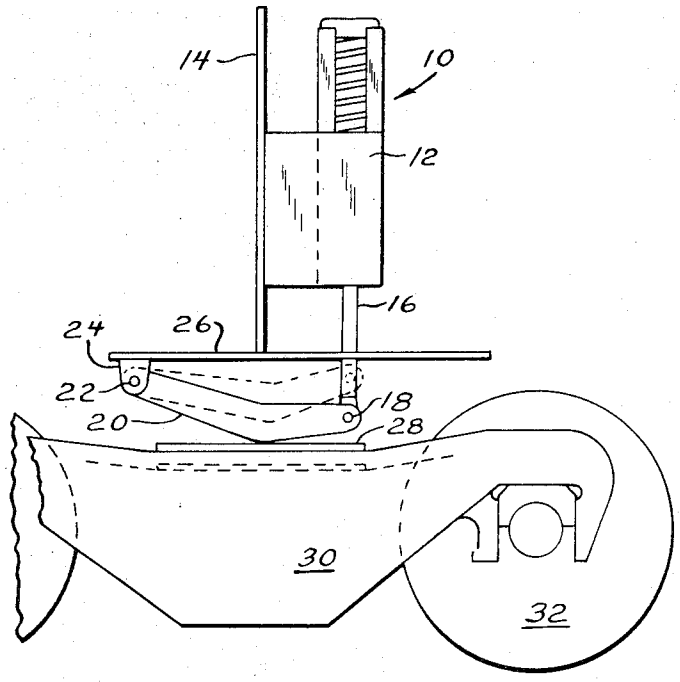


Fig. 1

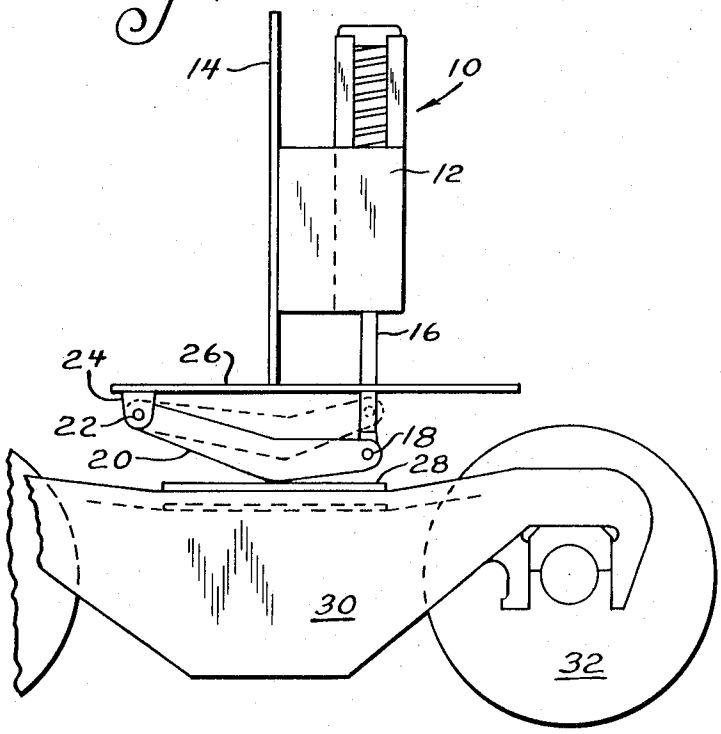


Fig. 2

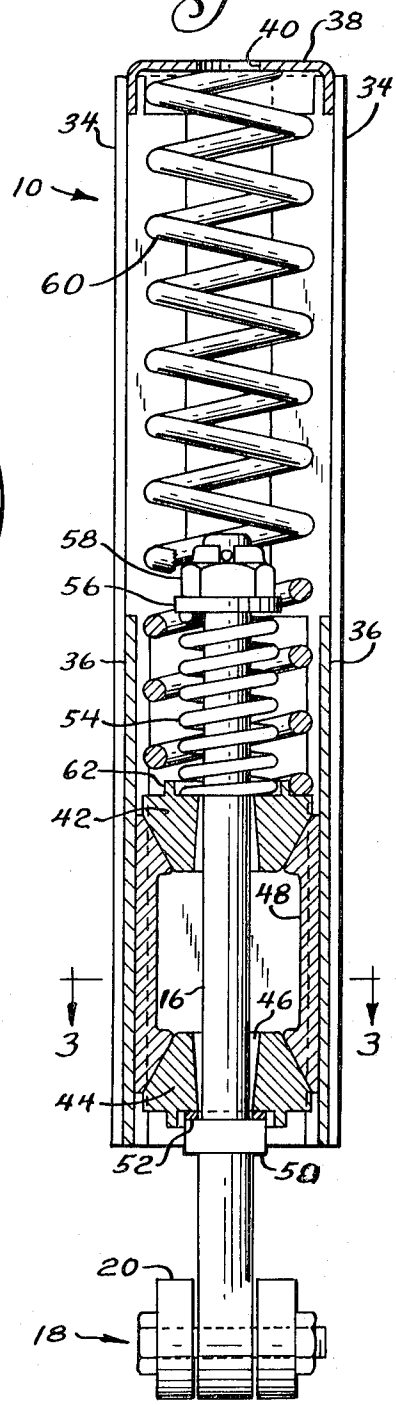


Fig. 3

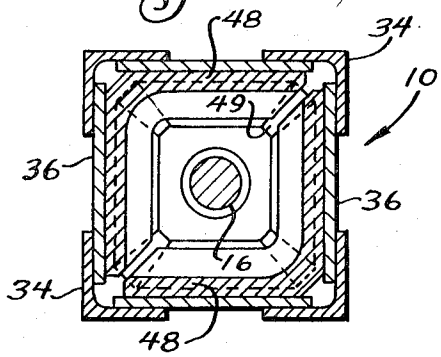


Fig. 4

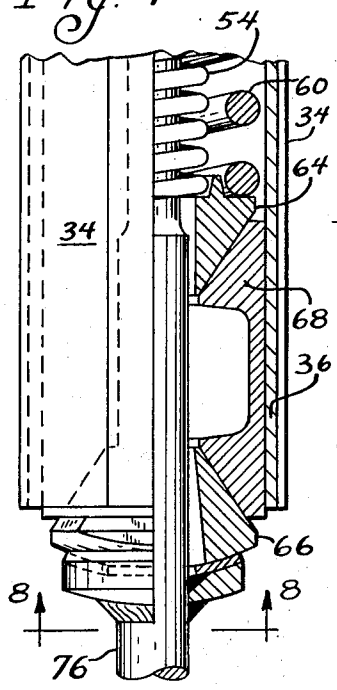


Fig. 5

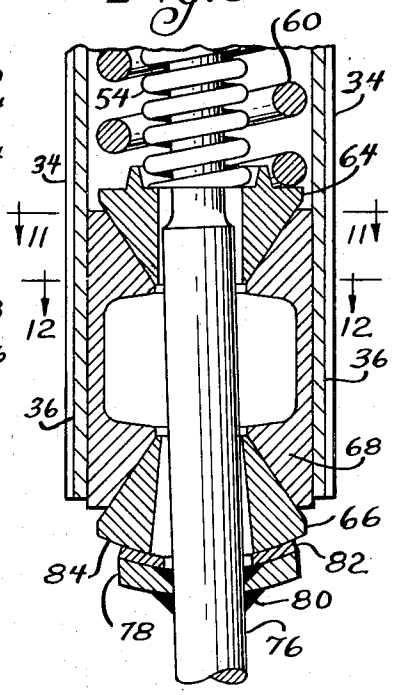


Fig. 8

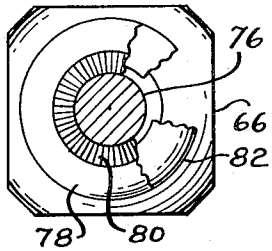


Fig. 9

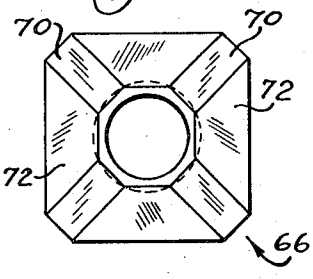


Fig. 6

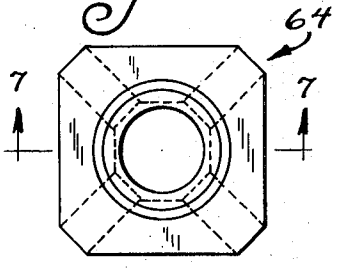


Fig. 11

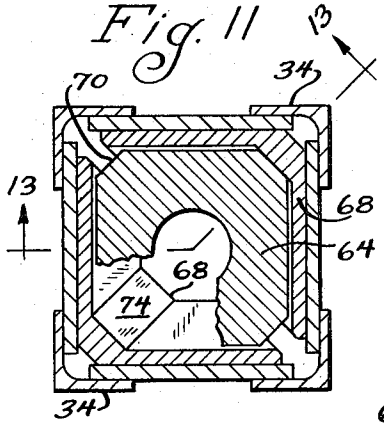


Fig. 7

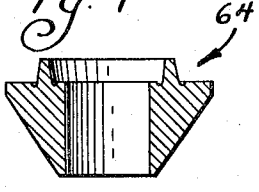


Fig. 10

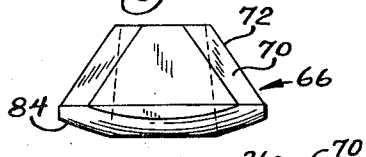


Fig. 12

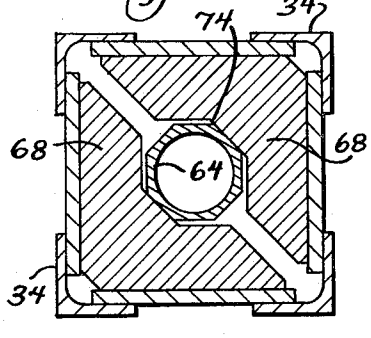
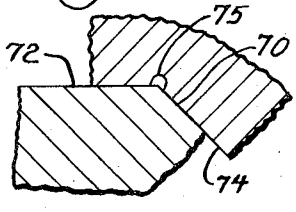


Fig. 14



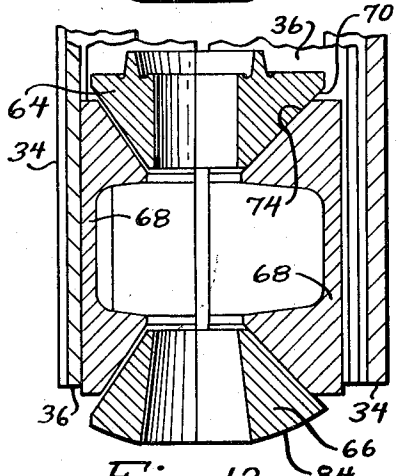


Fig. 13

RAILWAY CAR ROLL DAMPENING FRICTION DEVICE

This is a continuation-in-part of an application of the same inventor filed Jan. 28, 1970, Ser. No. 6,473, now U.S. Pat. No. 3,731,638 issued May 8, 1973.

This invention relates to energy-absorption devices for railroad cars, and more particularly to a "friction strut" or frictional energy absorber for application to a freight car to permit high speed operation thereof without the problems of derailment, particularly on curves, limiting the operating speed before the invention.

In the interest of brevity, there are omitted from this application certain aspects of the fuller discussion of the purposes and advantages of the invention already appearing in the above-mentioned co-pending application, which is accordingly incorporated herein by reference.

In brief, the invention herein described and claimed is a novel construction for an energy-absorbing device to be employed for opposing approach motion of each side of the body of a car relative to the corresponding side-frame. The device has substantially greater energy-absorption of approach motion in th region of high compression of the conventional car-spring which mounts the truck bolster on the side-frame than in the region of normal compression and, in addition, provides means to disable the energy absorber during return motion occurring immediately after separative motion substantially faster than the body-oscillation motion which occurs at critical car speed. As more fully discussed in the co-pending application, the latter feature of operation permits rapid downward and return motions of the wheels at crossings and the like without transfer of shock to the body which would result if all approach motions of the side-frame and the body were opposed without discrimination therebetween.

The invention will best be understood, both generally and in detail, from consideration of the embodiments thereof illustrated in the annexed drawing, in which:

FIG. **1** is a more or less schematic fragmentary elevation view of a frictional energy-absorbing device of the invention mounted on a car body and slidingly engaged with the side-frame of the truck;

FIG. **2** is a vertical sectional view of a frictional energy-absorbing device embodying certain aspects of the invention;

FIG. **3** is a horizontal sectional view taken along the line **3—3** of FIG. **2**;

FIG. **4** is a fragmentary view, partially in section and partially in elevation, of an improved embodiment of the invention;

FIG. **5** is a sectional view similar to the section of FIG. **4**, but showing an altered position of the parts;

FIG. **6** is a top plan view of the upper of two wedge members shown in FIGS. **4** and **5**;

FIG. **7** is a sectional view of the wedge member taken along the line **7—7** of FIG. **6**;

FIG. **8** is a view partially in elevation and partially in section taken along the line **8—8** of FIG. **4** in the direction indicated by arrows, with certain parts shown in elevation successively broken away in section for clarification of the relationship of the parts;

FIG. **9** is a top plan view of the lower of the wedges shown in FIGS. **4** and **5**;

FIG. **10** is a side elevational view of the wedge of FIG. **9**;

FIG. **11** is a sectional view along the line **11—11** of FIG. **5** in the direction indicated by arrows;

FIG. **12** is a sectional view along the line **12—12** of FIG. **5** in the direction indicated by arrows;

FIG. **13** is an angled or offset sectional view along the line **13—13** of FIG. **11**; and

FIG. **14** is an enlarged fragmentary sectional view corresponding generally to a portion of FIG. **11** or **12**, but showing the effect of wear-in of certain of the parts.

The illustration of FIG. **1** shows one manner of mounting an energy-absorbing device of the invention on a railroad car (four being normally employed but only one being shown) for the purposes set forth in the co-pending application earlier mentioned. The energy-absorbing device, generally designated **10**, is mounted by brackets **12** to a web **14** associated with the body bolster and extending across the lower portion of the end of the car body (not shown). A drive rod or actuator **16** of the energy-absorber **10** depends downwardly and its lower end is pivotally attached at **18** to the outer end of a lever or crank **20**, the opposite end of which is pivoted at **22** on suitable ears **24** depending from the shear panel portion **26** of the body bolster assembly. The ears **24** thus constitute a fulcrum for the lever or crank **20**. The crank **20** is in sliding engagement with a bearing plate **28** on the upper surface of the side-frame **30** of the car, upon which the wheels **32** are mounted in conventional fashion. The conventional spring-mounted truck bolster and pivotal mounting thereon of the body bolster are omitted from the drawing, the showing thereof being superfluous to understanding of the present invention.

The internal construction of the energy-absorbing device is shown in FIGS. **2** and **3**. The housing or casing is formed by four corner-angle members **34**. In the lower region, these are joined, preferably by welding, to four internal plates **36**, which thus enclose the lower portion of the housing and also serve as friction surfaces as later described. At the top, the angle members **34** are welded to an internally seated end cap **38** having a central aperture **40**.

Loosely surrounding the rod or shaft **16** are upper and lower wedges or wedge rings **42** and **44**. Each wedge has a central aperture **46** of tapered diameter, being largest at the adjacent or facing surfaces and smallest at the opposite surfaces, but passing the rod **16** freely and loosely at all points to accommodate the slightly arcuate motion of the lower end of rod **16** to be later described. The periphery of each wedge ring is generally square and each wedge has the general outer shape of a truncated pyramid having minimum dimensions in the inner or facing region and maximum dimensions in the opposite region.

Between the wedge surfaces of the rings **42** and **44** are disposed friction shoes **48**, each of an L-shaped horizontal cross-section having the outer surface of one arm in sliding engagement with one of the plates **36** and the outer surface of the other arm in sliding engagement with an adjacent plate **36**. The upper and lower end portions of the shoes **48** are internally inclined in correspondence with the inclination of the wedge rings, which are in contact therewith only at the orthogonal faces, the corners of the pyramidal wedges being bevelled at **49** to avoid contact with the internal corner

portions of the shoes **48**. A flange or collar **50** on the external lower portion of the rod **16** constitutes an abutment engaging the outer surface of the lower ring **44**, with a suitable washer **52** interposed. A coiled spring **54** surrounds the inner or upper end of the rod **16** and is compressed between the surface of the upper wedge ring **42** and a disk flange or washer **56**, which is adjustably positioned by a nut **58** on the threaded inner or upper end of the rod **16**.

A coiled spring **60**, of much larger restoring-force or capacity than the spring **54**, surrounds the entire upper portion of the movable assembly just described, being normally under relatively small compression between the end cap **38** and the radially outer portion of the upper wedge ring **42**. The latter is formed with a rib **62** separating the radially inner seating of the end of the spring **54** from the radially outer seating of the surrounding heavier spring **60**.

The energy-absorption characteristics of the construction shown in FIGS. **2** and **3**, which may be called a friction strut, may be understood from consideration of the above-described construction. The moving portion of the assembly (the rod **16**, the wedges **42** and **44** and the shoes **48**) slides in the housing against a frictional force determined by the lateral force spreading apart the shoes **48**, which is in turn determined by the magnitude of the spring forces urging the wedge rings **42** and **44** together. A minimum or biasing force is provided by the small spring **54**. This spring exerts no longitudinal force urging the rod **16** in either direction, and the lateral force exerted on the shoes **48** by this spring may be considered more or less uniform at all times.

The larger spring **60** serves a dual purpose, both biasing the entire movable assembly outward and exercising variable control of the frictional resistance to motion. The friction established by the light biasing spring **54** is relatively small and is normally effective primarily when the rod **16** is in a wholly extended position, i.e., with the spring **60** under substantially no compression and no inward force exerted at the outer-end pivot point **18**. The position assumed by the rod **16** in this condition may be determined by the adjustment of the nut **58**, which is usually adjusted to sufficient tightness so that lifting of the lever from engagement with the side-frame which normally supports it does not produce removal of the shoes **48** from the housing. A pin or similar stop-member (not shown) is normally inserted across the housing at the outer end to limit the outward motion and thus facilitate assembly as well as permit adjustment of the nut **58** to be made without restriction to such a minimum friction requirement if it is desired to make the first portion of an inward stroke of the rod **16** essentially entirely frictionless. If so desired, the adjustment of the nut **58** can be used as a trimming adjustment, to provide a pre-established frictional damping or opposing force to inward motion of the rod **16** at any predetermined inward position.

The motions and forces produced by the energy-absorbers **10** of the invention in the coupling between the body and the side frames will now be briefly described, omitting certain more detailed explanation of the purposes served and advantages obtained in operation of a railroad car which appears in the earlier-mentioned co-pending application. As already indicated, the lowermost portion of the crank **20** is in frictional sliding contact on the bearing plate **28** atop the side frame **30** leaving the truck free for pivotal motion at curves without the use of universal joints or any similar constructions introducing problems of complexity and mechanical failure. The energy-absorbers **10** are installed at a height such that with the car stationary on a level track, the rod **16** is driven by the weight of the car body part-way into the housing. The degree of penetration in this median or normal position will of course vary somewhat with the weight of the load in the car. It is of course possible to match a particular detailed description or adjustment to the car each time it is loaded (or emptied) but the mode of operation is to a large extent self-compensating for degree of loading because of inertia change. In this normal or median position, the compression of the large spring **60** is relatively small as compared with the degree of compression which occurs on alternate sides upon the occurrence of rocking relative motion between the body and the side frames.

When rocking motion occurs on a straight track, damping action occurs alternately on one side of the car and then the other. As the rod is driven into the housing, the pressure of the spring **60** on the wedge rings **42** and **44** increases, thus increasing the friction between the shoes **48** and the plates **36** to dissipate oscillation energy of the springs of the car (not shown). However, this frictional dissipation is essentially unidirectional. When the motion reverses, i.e., as the car body and the side frame commence to separate, the spring **60** forces the rod **16** outward. Obviously, the energy-absorber **10** presents no frictional resistance to this separative motion. On straight uninterrupted track in well-maintained condition, cranks **20** on both sides of the car are at all times in contact with their corresponding side-frame plates **28**. However, in the event of relatively large separative excursions, the rod **16** may reach the outer limit of its travel before the separative motion ends, in which event contact between the crank **20** and plate **28** may be broken, until the motion is arrested by the action of the absorber on the oppsite side, and then again reestablished to commence the compression of the spring **60**. Such a departure from contact also occurs for a short time in the event a downward wheel excursion, even though of small magnitude, is too fast to be followed by the lever as now to be discussed.

Despite its effectiveness in damping car body oscillations, the energy-absorber of the invention produces a minimum of interference with the action of the car springs in isolating the car body from impact-type rapid excursions of the wheels such as at crossings, sudden dips at very soft joints, etc., and in high-speed operation on rough track. Although the release of friction within the damping device and outward return of the actuator rod are sufficiently fast so that swaying of the car (except of very large magnitude) does not produce disengagement of the crank or lever **20** from the bearing plate **28**, small downward excursions and returns of the wheels, if sufficiently fast, are not followed due to the finite time required for release of friction within the damping device at the instant when the side frame suddenly drops down and also the minimum friction established by the bias spring **54**, which limit the speed of ejection of the rod and the shoe. The greater the compression of the spring **60** at the time of such an occurrence, the greater the time lag before the lever **20** is able to follow such a rapid downward motion. Accord-

ingly, the rapid upward return of the wheels produces minimal jarring of the load even when (as is uncommon) such a track discontinuity is encountered at an instant when the frictional force within the damping device is very high. The minimum friction is desirably adjusted (or may less advantageously be fixed by suitable precise selection of the larger springs, if bias springs are omitted) so that moderatly large body oscillations are wholly followed at the car's critical speed but separative motions occurring very much faster than this at either side quickly break the contact.

An improved embodiment of the energy-aborber or friction strut of the invention is shown in FIGS. **4** through **14**, in which portions or elements which are substantially identical with the embodiment already described bear the same reference characters. Portions of the assembly are altered in a manner found to greatly improve smooth and maintenance-free operation over long periods of use.

The external corners of the upper and lower wedges **64** and **66** and the corresponding portions of the shoes **68** are differently shaped and related than in the embodiment of FIGS. **2** and **3**. As already indicated, in that embodiment clearance is provided at the internal angles of the L-shaped shoes, all contact between the wedges and the shoes being along orthogonal interfaces excluding the corners. It will be noted that with this construction, i.e., with sufficient of the pyramidal corners of the wedges bevelled away to avoid all contact with the internal corner of a shoe, both the internal shaping of the corner of the shoe and the shape of the mentioned bevel are unimportant. In the embodiment of FIGS. **2** and **3**, the internal corner or angle of each L-shaped shoe is merely formed with a convenient arbitrary degree of roundness and the corner bevels **49** on the wedges are likewise more or less arbitrarily determined, subject only to the limitation of having sufficient corner-removal in all horizontal planes to avoid contact with the rounded internal corner of the shoe. Thus in the illustration of FIG. **3**, it will be seen that the bevelled corners **49** of the wedge form planes of an inclination producing greater bevel width with increasing horizontal dimension, the slope of the plane of the bevel being more or less arbitrarily selected.

The improved embodiment employs a substantially different relation between the external corners of the pyramidal wedges and the internal corners of the L-shaped shoes (i.e., the end portions of the shoes which receive the oppositely disposed wedges). The construction of FIGS. **2** and **3** is found to require great precision of matching of the abutting surfaces of the wedge and the shoe, respectively, to produce and maintain the desired smooth and trouble-free operation. Any roughness or deviation from smooth and exact correspondence between the internal half-pyramidal shape of the end of the shoe and the external pyramidal shape of the wedge fitting therein except at the corners is found to produce jamming and locking.

In theory, such effects may be avoided by sufficiently high precision in manufacture, but this is difficult as a practical matter. As a result, the construction of FIGS. **2** and **3** in practice requires a prolonged period of "break-in", either installed on a railroad car or with artificial simulation of the action thereof, before operation is fully reliable. In such break-in, it is normally found necessary to occasionally free the device from a jammed or locked condition, which occurs with decreasing frequency as use continues until reliably smooth operation is ultimately obtained when wear on the parts finally produces exact mating.

The difficulty in producing this smooth mated condition without prohibitive precision in manufacture, and without extended break-in during which jamming and locking may occur, it avoided by the improved construction.

In essence, the construction of FIGS. **4** to **14** provides what might be termined a temporary or short-term manner of cooperation of the parts which gives fully satisfactory maintenance-free operation during a breaking-in period which is not externally observable as a distinct performance phase but produces a transition to a final or long-term mode of operation which is not only equivalent to, but indeed somewhat superior to, the long-term operation obtainable only after a long break-in period involving freeing of occasional jamming with the construction previously described.

In the wedges **64** and **66** of the improved construction, the bevelled planar corner surfaces **70** which separate the inclined planar sides **72** are mated to corresponding inclined planar surfaces **74** in the angles of the L-shaped shoes **68**. Both the external corner surfaces **70** on the wedges and the internal corner surfaces **74** on the shoes are rectangular, i.e., of equal width along their length. As best seen in FIGS. **11** and **12**, in the as-manufactured condition, the internal corner surfaces **74** of the shoes are slightly wider than the external corner surfaces **70** on the wedges. The effect of this is that in the as-manufactured condition, contact between the shoes and the wedges is solely at the corners, the arms of the L-shaped shoes being substantially entirely out of contact with the sides **72** of the wedges in this condition. The force on the shoes producing friction with the plates **36** is thus exerted substantially solely at the corners, but is distributed between the orthogonal components into which this force is inherently resolved in producing the friction. The application of the wedging action at only the two diagonally opposite corners, rather than at the four sides of a square, eliminates the primary cause of problems with jamming during the period of break-in.

As use progresses, the difference in width of the wedging surfaces at the diagonally disposed interfaces is gradually reduced until there is ultimately reached the condition of abutment of all of the mating surfaces, both at the four sides and at the diagonally opposite corners, as shown in the enlarged view of FIG. **14**, showing an exemplary pair of adjacent wedging interfaces. To prevent any possible binding, grooves **75** (seen only in the enlarged FIG. **14**) are formed at opposite edges of the corner surfaces of shoes **74**. After the break-in period, all of the mating surfaces thus cooperate in the wedging action. In addition to the advantage regarding elimination of malfunction, and thus fully practicable usability during break-in, the already-long useful life of the device is further extended by the long-term utilization of the corner portions in the wedging action, as compared to the previously described construction wherein the corners are not utilized. It will be noted (best seen in FIG. **12**) that in the regions where the cross-section of the wedges is small, and the cross-section of the shoes correspondingly large, the added contribution of the corner portions to the wedging action is major.

The improved embodiment also differs from the one earlier described in the construction by which the drive rod **76**, otherwise similar to the drive rod **16**, is coupled to the wedge-and-shoe assembly to produce reciprocation thereof in the housing. The drive rod **76** has a flange **78** welded thereto at **80**, on which is seated a washer **82**. The flange **78** and washer **72**, rather than being planar, have a concave generally spherical curvature, and the lower end **84** of the lower wedge **66** is spherically convex to match. As seen by comparison of FIGS. **4** and **5**, the lower wedge **66** is thus efficiently isolated from all non-vertical components of motion of the rod **76**. Such components of motion arise from two sources. First, as earlier mentioned, although the motion of the pivot **18** at the outer end of the rod **16** (rod **76** in the improved embodiment) is generally linear, it has an arcuate component about the pivot **22** as a center. Also, pivoting of the car truck with respect to the car body inherently produces slight sidewise motion of the outer end of the rod with practical constructions. With the spherical-interface coupling between the rod **76** and the lower wedge **66**, a substantial angle of tilt of the rod in any direction with respect to the housing of the energy-absorber produces no adverse effect on its proper operation. The radius of curvature of the spherical interface constituting, in essence, a ball-and-socket coupling between the drive rod and the lower wedge, is substantially at the longitudinal center of the shoe, so that the aperture size in the wedges required to accommodate the tilting of the rod is minimized. This predetermination of the direction of tilt also permits the shaping of the apertures in the wedges in a manner wherein the apertures are largest in cross-section where the wedges are largest in cross-section.

Persons skilled in the art will readily devise many variants substantially departing from the illustrated embodiments, but nevertheless utilizing the teachings of the invention. The scope of the protection to be afforded the invention should accordingly not be limited to the specific embodiments illustrated.

What is claimed is:

1. A motion-damping device for a railroad car having body and side-frame portions comprising an elongated housing adapted to be attached to one of said portions and having a longitudinally extending internal friction surface, a friction shoe guided for sliding motion along said surface and having inclined wedging surfaces at opposite ends thereof, inner and outer wedge members having inclined surfaces mating with the respective inclined surfaces of the shoe, a drive actuator extending into the housing and having its inner end inward of the inner wedge members, an abutment on the actuator engaging the outer wedge member in the direction to drive it inwardly, a compression spring on the inner end of the actuator urging the inner wedge member outwardly to maintain a minimum friction, and a compression spring of greater capacity seated in the inner end of the housing and also urging the inner wedge member outwardly to produce friction increasing with insertion of the actuator and the shoe into the housing in response to external force and to return the actuator and the shoe outward when external force is withdrawn.

2. The motion-damping device of claim **1** having the wedge members of generally square cross-section and having two shoes of L-shape cross-section.

3. The motion-damping device of claim **2** having additional mating wedging surfaces on the internal corners of the shoes and the diagonally opposite external corners of the wedge members thereby engaged, the wedging surfaces at the corners being initially substantially the sole points of contact between the wedging members and the shoes.

4. The motion-damping device of claim **1** having the abutment and the portion of the wedge member engaged thereby of mating generally spherical shape.

5. The motion-damping device of claim **1** having a lever pivotally engaged with the outer end of the actuator and adapted to slidingly engage the other portion of the car and a fulcrum member adapted to be mounted on the same portion of the car as the housing and pivotally engaged with the lever.

6. A motion-damping device for a railroad car having body and side-frame portions comprising a housing adapted to be mounted on one of said portions, an actuating member extending from the housing, a lever pivotally engaged with the outer end of the actuator and adapted to slidingly engage the other said portion of the car, and a fulcrum member adapted to be mounted on the same portion of the car as the housing and pivotally engaged with the lever, the housing containing friction means opposing insertion of the actuating member and responsive to inward driven motion of the actuating member to increase the friction, spring means to return the actuating member outwardly to follow the separating relative motion of said portions of the car produced by car-spring oscillations, and means to maintain substantial friction opposing said spring means to prevent following by the actuating member of the fast separative and return relative motions of said portions of the car produced by track discontinuities at crossings and the like.

7. The motion-damping device of claim **6** having a sliding assembly within the housing having an apertured outer member, the actuator member extending through the outer member and having an abutment portion engaging the portion of the outer member surrounding the aperture, said abutment portion and said surrounding portion being of mating spherical shape.

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