Nov. 7, 1967 W. T. BLAKE 3,351,336

RAILROAD CAR SHOCK ABSORBER

Filed Aug. 19, 1964 4 Sheets-Sheet 1

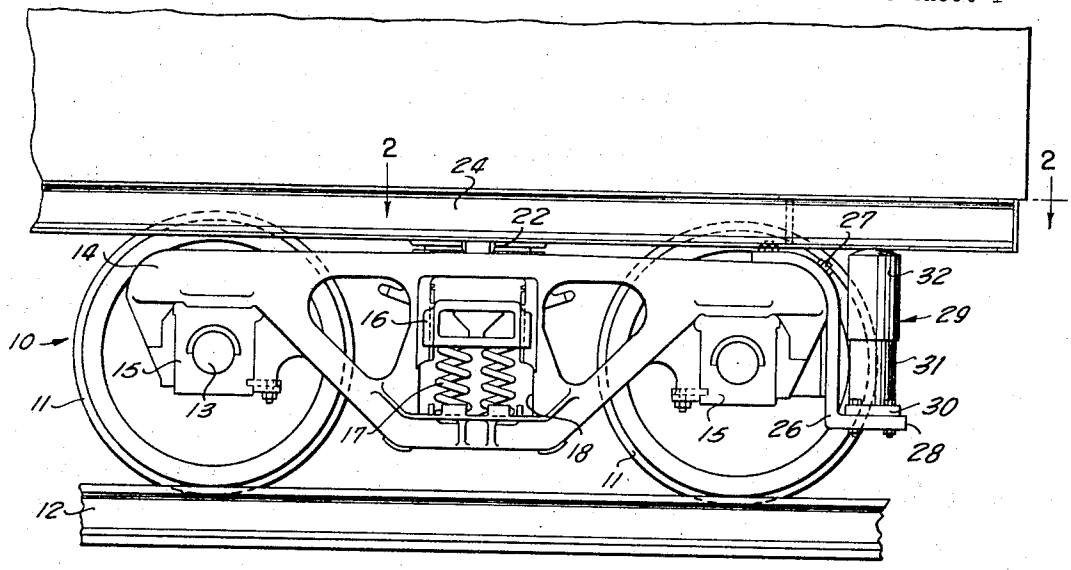


Fig. 1

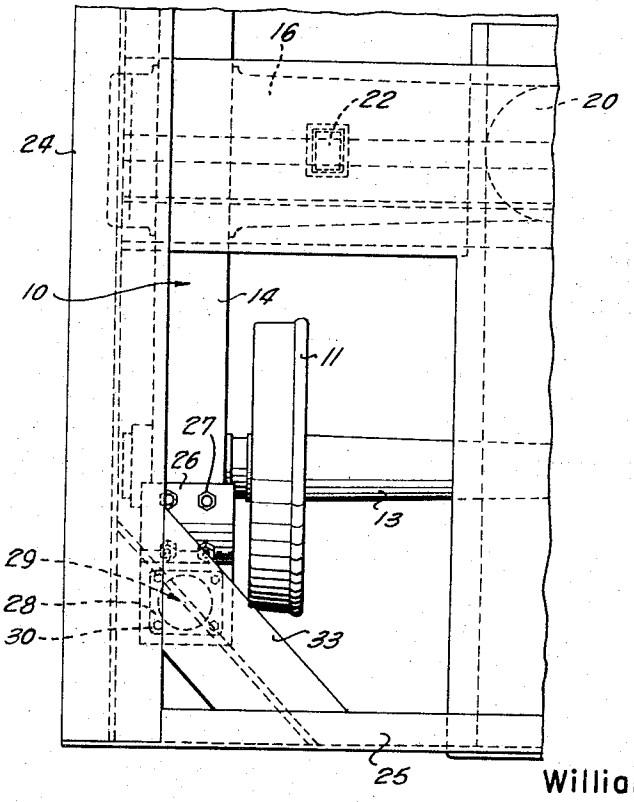


Fig. 2

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RAILROAD CAR SHOCK ABSORBER

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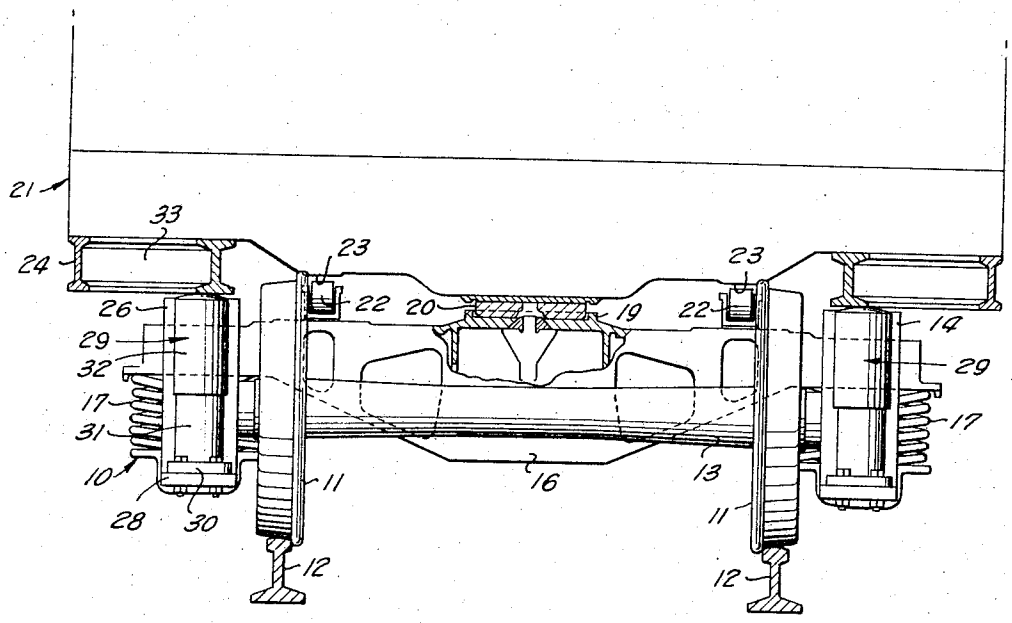


Fig. 3

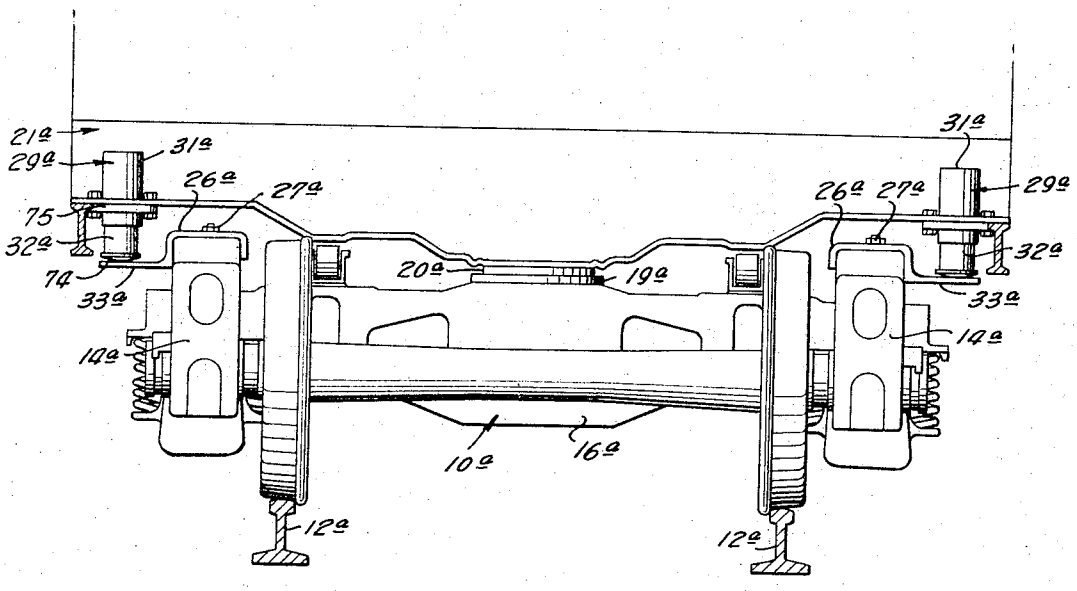


Fig. 4

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RAILROAD CAR SHOCK ABSORBER

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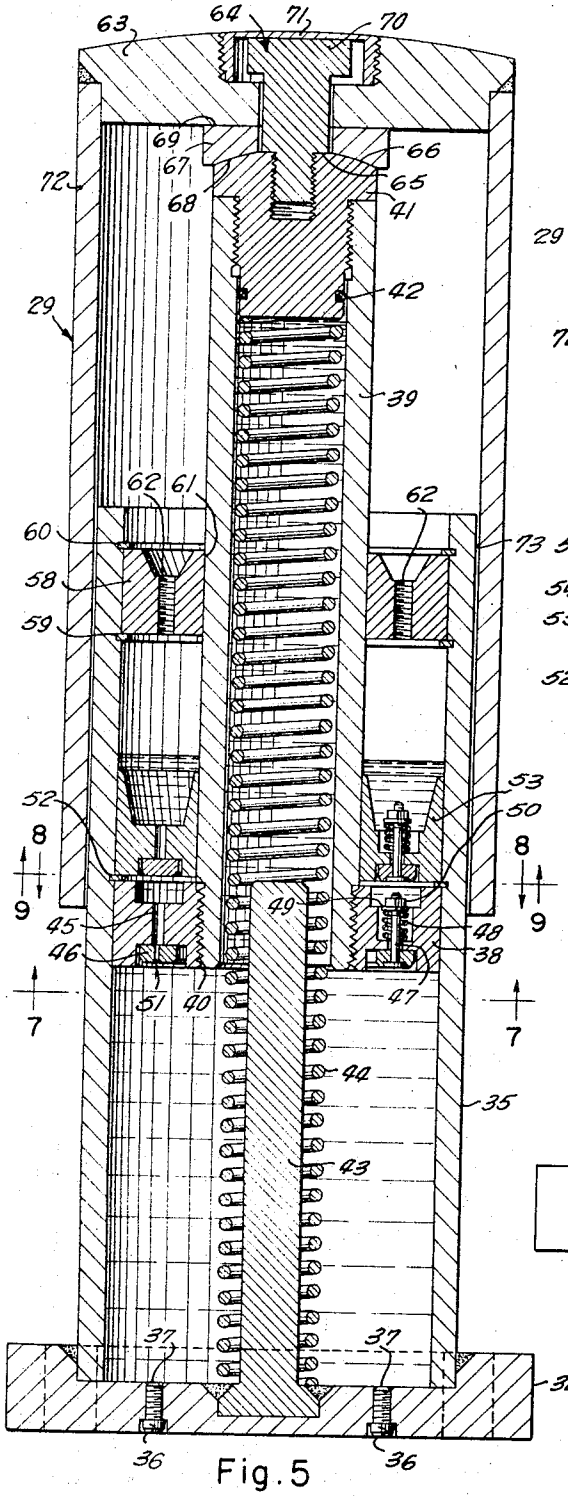


Fig. 5

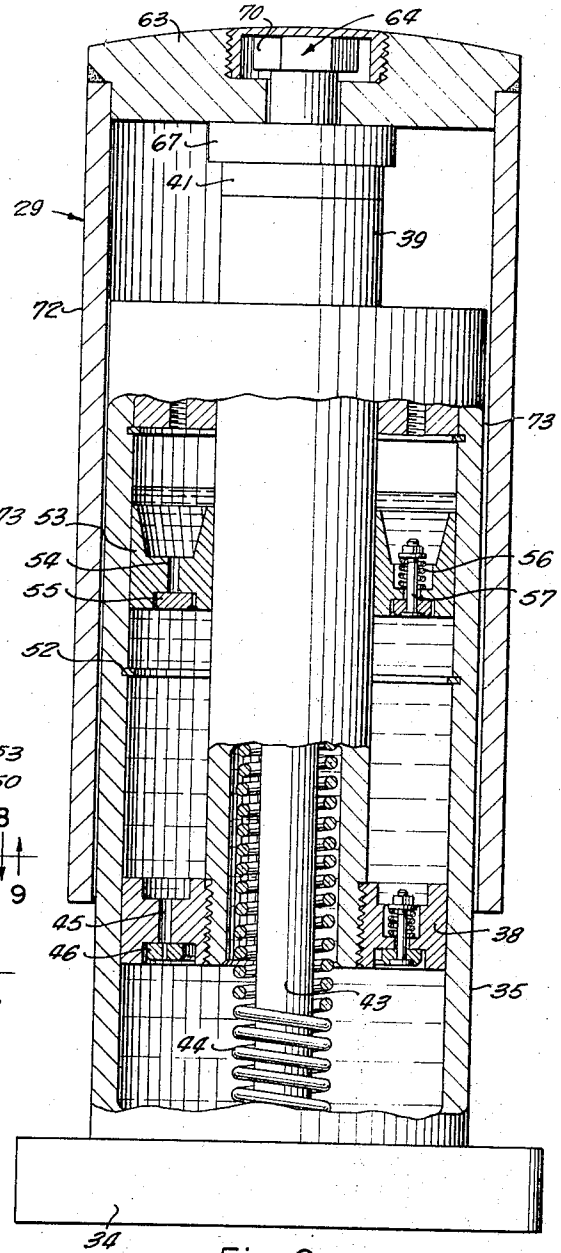


Fig. 6

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RAILROAD CAR SHOCK ABSORBER

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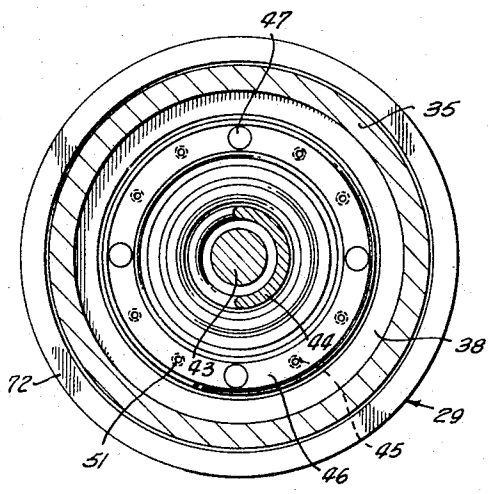


Fig. 7

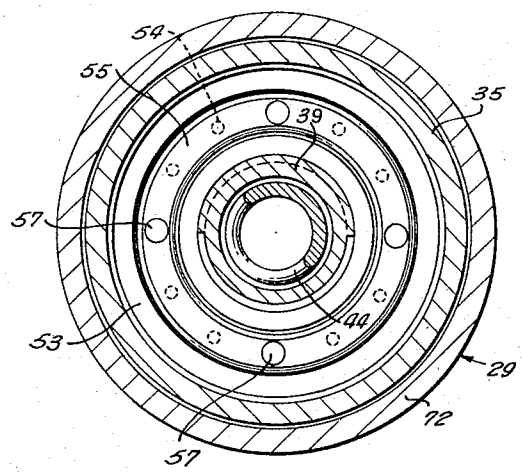


Fig. 9

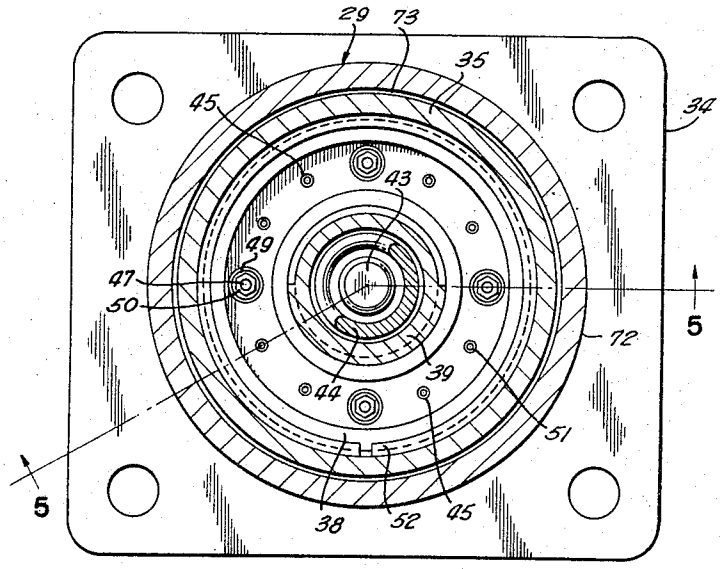


Fig. 8

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3,351,336

RAILROAD CAR SHOCK ABSORBER

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Filed Aug. 19, 1964, Ser. No. 390,562
5 Claims. (Cl. 267—3)

This invention relates to shock absorbers especially for railroad cars, and to railroad cars equipped with shock absorbers for controlling motions of the car body with respect to the trucks.

Railroad cars, such as freight cars, when running on a track are often damaged, but the car lading is damaged more frequently. Important causes of such damage are the rolling, bouncing, or pitching motions of the car bodies, or combinations of any two or all three of these motions. Roughness of the track, even though slight, may impart large swings to the car body. Thus, when a car hits waves in a track with a frequency corresponding to the natural frequency of motion of the car body on the trucks, the car body lurches violently. Sometimes this lurching extensively damages the lading and the car, and it can, if severe, derail the car.

The main object of the invention is to provide a railroad car, particularly a freight car, in which movements of the car body on the trucks are kept within acceptable limits.

Another object is to provide a railroad car that rides smoothly over the rails, whereby the chances of damaging the car lading and the car itself are low.

Another object of the invention is to provide a railroad car that is cushioned against side sway and other body motions without interference with the turning of the trucks.

Another object is to enable existing railroad cars to be readily altered to provide a car in accordance with the invention.

Yet another object is to provide a side sway cushioning arrangement that is easily installed in the building of a railroad car.

Still another object of the invention is to provide a railroad car having a side sway cushioning system that is reliable and simple to maintain, and that has a long service life.

Another object of the invention is to provide a hydraulic shock absorber that is especially adapted for use in controlling railroad car body movements.

Another object is to provide a hydraulic shock absorber in which the hydraulic liquid is prevented from foaming.

Still another object is to provide a hydraulic shock absorber that operates without forming an internal vacuum.

Certain of the foregoing and such other objects of the invention as appear hereinafter are attained in a railroad car having a car body structure; and a truck having wheels, an unsprung frame structure, and means supporting the car body structure for pivotal movement on the truck about a substantially vertical axis, the supporting means including resilient means permitting rolling, pitching and bouncing of the car body structure on the unsprung frame structure. A pair of shock absorbers or car stabilizers is provided, each stabilizer having a pair of relatively movable members, a body of liquid, and means metering the liquid to absorb energy as the members are moved. The car stabilizers are mounted at opposite sides of the pivotal axis of the car body structure to absorb energy of movement of the car body structure towards the unsprung frame structure. The mounting means for the stabilizers includes means fixing one of the movable members of each car stabilizer to one of the foregoing structures, and means permitting sliding movements of the other movable members of the car stabilizers on the other of the structures as the car body structure pivots on the truck.

Other objects of the invention are realized in a hydraulic, shock absorbing mechanism including a cylinder; a cylinder head closing one end of the cylinder; a piston slidable in the cylinder; means providing for the flow of fluid from side to side of the piston as the piston is reciprocated in the cylinder; a piston shaft carried by the piston and extending away from the cylinder head; and an annular piston slidingly mounted on the shaft and slidable in the cylinder.

In the drawings:

FIG. 1 is a fragmentary side view of one end of a railroad boxcar embodying the invention;

FIG. 2 is a partial sectional view taken along the line 2—2 of FIG. 1;

FIG. 3 is a right end view of the car shown in FIG. 1, with parts broken away;

FIG. 4 is a view similar to FIG. 3 of a railroad car embodying another form of the invention;

FIG. 5 is an axial sectional view taken along the line 5—5 of FIG. 8 of a shock absorber or stabilizer embodying the invention, the view showing positions of the parts when the piston shaft is fully extended;

FIG. 6 is an axial sectional view also taken along the line 5—5 of FIG. 8 showing the position of the parts when the piston shaft is moved partly into the cylinder;

FIG. 7 is a sectional view taken on the line 7—7 of FIG. 5;

FIG. 8 is a sectional view taken on the line 8—8 of FIG. 5; and

FIG. 9 is a sectional view taken on the line 9—9 of FIG. 5.

Referring to FIGS. 1 to 3, the railroad boxcar shown is conventional, except for certain added components that are combined with the car, which added components will be identified hereinafter. As is typical of railroad freight cars, the illustrated car has a truck **10**, including wheels **11, 11, 11, 11** that ride on track rails **12, 12**. The wheels are sweated to parallel axles **13, 13** upon the outer ends of which the side frames **14, 14** are carried by journal boxes **15, 15, 15, 15**. The wheels, axles, side frames, and journal boxes are unsprung components of the truck; that is, there are no resilient or cushioning devices between these parts and the track rails.

The truck further includes a transverse bolster **16**. Springs **17, 17** are mounted on the side frames in openings **18, 18**, and resiliently support the bolster at its ends. At the top center of the bolster is a pivot bearing having a low element **19** on the bolster and a complementary upper element **20** on the car body **21**. The bolster also has a pair of rollers **22, 22** mounted on it outwardly from the pivot bearing. These rollers are adapted to engage flat surfaces **23, 23** on the car body to limit tilting of the car body on the bolster.

The body has the usual longitudinal frame members **24** and end frame members **25**.

In accordance with the invention, the car heretofore described is modified by the addition of hydraulic shock absorbers. As thus modified, each side frame has a bracket **26** attached to its by bolts **27, 27**. A platform **28** at the bottom of the bracket carries a single-acting, quick-return, hydraulic shock absorber **29**. The shock absorber has a base **30** bolted to the platform, a fixed member **31**, and a relatively movable member **32** that is vertically reciprocable on the fixed member. The top of the movable member bears against a horizontal flat surface on the bottom of the car body. This flat surface is provided in part by a wear beam **33**, welded between a longitudinal frame member **24** and an end frame member **25** of the car body, and

in part by the flat bottom surfaces of the longitudinal and the end frame members themselves. This flat surface slides on the top of the shock absorber as the car body pivots on the truck.

Although the details of construction and of operation of the shock absorber will be fully described hereinafter, a brief statement here will help the reader understand how the car works. The movable member of the shock absorber is urged upwardly against the wear beams by an internal spring. When the movable member is pushed down, high resistance to movement is encountered and energy is absorbed in the shock absorber. And when the movable member is released, the internal spring quickly moves it up against low resistances.

While only one end of a boxcar is shown in the drawings, it will be understood that the other end of the boxcar is similar. It has a truck like the truck **10**, but this truck faces in the opposite direction so that the shock absorbers are located as close as possible to the near end of the car body.

Normal pivoting of the car body on the trucks is not affected by the absorbers. Moreover, the shock absorbers acts in their intended way whether the car is running on a straight or curved section of track, or whether it is going into or coming out of a curve. These desirable characteristics are present because the wear beams of the car slide with little effort over the tops of the shock absorbers, allowing the shock absorbers to adjust themselves to the various angular positions taken by the trucks

Referring to FIG. 4, showing a railroad car embodying another form of the invention, the car, apart from the shock absorber installation, is the same as the car in FIGS. 1 to 3. It has a truck **10***a* at either end, the trucks riding on rails **12***a*. The truck has side frames **14***a*, **14***a* and a pivot bearing **19***a*, **20***a* supporting a car body **21***a*.

Shock absorbers **29***a*, **29***a* are carried by the car body. Each shock absorber has an upper fixed member **31***a* having a base **30***a* which is bolted onto the car body. Each shock absorber also has a lower movable member **32***a* which slides in an arcuate path on the flat top surface of a wear plate **33***a* as the car body pivots on the trucks. This wear plate has an integral bracket **26***a* which is attached to the side frame **14***a* by bolts **27***a*, **27***a*. The shock absorbers **29***a*, **29***a* are in line with the bolster **16***a* when the truck is squared with the car, so that they bear down along a line extending across the truck at its center.

Shock absorbers **29***a*, **29***a* function similarly to their counterparts **29**, **29**. The movable members **32***a*, **32***a* are biased into contact with the wear plates by internal springs (not shown). When these movable members are forced upwardly into the fixed members **31***a*, they move against the resistance of hydraulic fluid flowing through metering orifices, whereby energy is absorbed and dissipated. And when the movable members are moved down by the internal springs, they move quickly and against low resistance to maintain their contact with the wear plates.

The shock absorbers **29***a* control the motions of the car **21***a* in about the same way as the shock absorbers **29** control the motions of the car **21**, all as described hereinbefore. It is thought unnecessary to repeat that description here, as the operation of the car of FIG. 4 will be obvious from the earlier description.

An embodiment of the invention as it relates to shock absorbers will now be described with reference to FIGS. 5 to 9. The illustrated shock absorber **29** has a rectangular base **34** to which is welded a cylinder **35**, the base forming a head for the bottom of the cylinder. Removable plugs **36**, **36** are screwed into tapped openings **37**, **37**, through which hydraulic fluid may be put into the cylinder.

A piston **38** is slidably fitted in the cylinder. The piston has a shaft **39** screwed into a threaded central opening **40** in the piston. The shaft is tubular, it being open at the bottom and closed at the top by a plug **41** threaded into the shaft. An O-ring **42** seals the plug into the shaft against leakage of fluid from within the shaft.

A guide pin **43** is welded to the center of the inside of the cylinder head and projects into the bore of the piston shaft with sufficient clearance to accommodate the piston return spring **44**. This spring is compressed between the piston shaft plug **41** and the cylinder head and urges the piston shaft and piston subassembly up.

The piston **38** has a number of ports **45** passing through it. These are normally closed by a ring check valve **46** having four valve stems **47** that pass through the piston. The ring valve is biased to closed position by valve springs **48** that press up on washers **49** secured to the valve stems by nuts **50**. Opposite each port **45**, the ring check valve has a small metering orifice **51**. However, fewer metering orifices may be used, and even one orifice may be enough, depending upon the resistance desired.

Upward movement of the piston is limited by a snap ring **52** in the cylinder wall.

Above the snap ring and slidable on the piston shaft and in the cylinder is an annular compensating piston **53**. Although this may be a piston without openings through it, as shown it has vertical openings **54** that are normally closed by a ring check valve **55**. This check valve a similar to the check valve **46** of the piston **38**, except that it has no metering orifices. The check valve **55** is resiliently urged to close the openings **54** by valve springs **56** that bias the valve stems **57** up.

The top of the cylinder has an annular closure member **58** held in position by snap rings **59** and **60**. The piston rod slides in a central opening **61** in the closure member which acts as a guide for the piston rod. Vents **62**, **62** extend through the closure member. These vents are tapped to receive temporary closure plugs, not shown, that are inserted prior to filling the shock absorber with hydraulic fluid. The plugs are left in place for shipment of the shock absorber and are removed when it is installed on a railroad car.

A bearing shoe **63** is fastened to the piston shaft closure plug **41** by a bolt **64**. The bolt has a shoulder **65** that is set against the spherical surface **66** of the top of the closure plug. A washer **67** is loosely fitted on the shank of the bolt. This washer has a spherical hollow **68** that mates with the spherical surface **66**, and a flat top surface **69** engaged by the flat bottom surface of the bearing shoe. Clearance is provided between the bolt head **70** and the shoe. A bolt head cover **71** is removably threaded into the bearing shoe to protect the bolt and to form a smooth bearing surface on the top of the shoe.

A cylindrical case **72** is welded to the bearing shoe and extends down around the outside of the cylinder **35**. The case is spaced from the cylinder to provide a working clearance **73** between these parts.

Operation of the shock absorber will now be explained with reference to FIGS. 5 and 6. FIG. 5 shows the shock absorber with the piston in the fully elevated position. In FIG. 6, the piston is shown in an intermediate position about half way between its top and bottom positions. With the parts disposed as shown in FIG. 5, the shock absorber is filled with hydraulic fluid such as oil to a level just above the top of the compensating piston **53**. The space between the compensating piston and the piston **38**, the openings in the pistons, and the spaces in the cylinder below the piston **38** and in the bore of the piston shaft are also filled with hydraulic fluid. The space in the cylinder above the surface of the hydraulic fluid is occupied by air.

When a downward force is applied to the shoe **63**, the piston shaft and piston **38** are forced into the cylinder. Hydraulic fluid flows from below the piston, through the metering orifices **51** in the check valve, and through the ports **45** to the zone above the piston. At the same time, the piston return spring is compressed. The metering of fluid through the orifices **51** causes substantial resistance to descent of the piston, and, smoothly dissipates most of the kinetic energy of the piston.

As the piston shaft moves down through the central opening in the compensating piston **53**, the shaft displaces

hydraulic fluid trapped between the piston and the compensating piston. The compensating piston rises in the cylinder by a distance directly related to the volume of hydraulic fluid so displaced. On the down stroke of the piston, the check valves in both the piston and the compensating piston are held closed by their respective valve springs and by the pressure of the fluid below the valves.

With the parts in the positions shown in FIG. 6, if downward pressure is released from the shoe **63**, the return spring forces the piston shaft and piston up. The check valve **46** in the piston opens against the force of the valve springs **48**, allowing liquid above the piston to flow freely down through the openings **45** as the piston rises. Concurrently, the compensating piston **53** falls in the cylinder, to fill the void created by withdrawal of the piston shaft through the central opening in the compensating piston.

There is no need for the check valve **55** in the compensating piston to open if the compensating piston descends freely in the cylinder. However, if the compensating piston should momentarily hang in the cylinder, or should work sluggishly, the check valve **55** would open to let hydraulic fluid from above the compensating piston flow down through the openings **54** and thereby prevent cavitation, or the drawing of a vacuum, in the fluid below the compensating piston.

There is another condition in which the check valve **55** in the compensating piston functions to prevent such cavitation. If the shock absorber remains for a long time with the piston in an intermediate position as in FIG. 6, the compensating piston may settle down in the cylinder until it comes to rest on the snap ring **52**. Now, if the piston and piston shaft are suddenly depressed the compensating piston can not descend. But, the check valve **55** will open to allow fluid to flow from above the compensating piston into the space between the two pistons, thus preventing cavitation in this space. And, after a few strokes of the piston and shaft, the compensating piston will find its normal operating position.

It will be seen from the foregoing description of operation that the compensating piston prevents cavitation in the hydraulic fluid below it. It also acts as a floating or movable barrier between the main body of hydraulic fluid below the compensating piston and the air above, keeping air out of the main body of fluid and eliminating frothing. Of course, frothing in the main body of fluid would introduce compressible gas into the working fluid, and thus seriously interfere with the desired cushioning action of the shock absorber.

When four shock absorbers **29** are installed in a railroad car, as in FIGS. 1 to 3, they are subject not only to downward forces applied by the car body, but also to transverse thrust forces that are applied to the shoes **63** by the wear beams **33** as they slide over the shoes when the car body pivots on the trucks. These transverse thrust forces are adequately resisted by the shock-absorbers because of certain features of their construction. The main cylinder **35** is rigidly welded to the base **34** which, in turn is securely bolted to a truck side frame **14**. The case **72** of the shock absorber overlaps the cylinder for a substantial distance and is free to move laterally with respect to the cylinder within the limits of the clearance **73** between these parts. This freedom of lateral movement is allowed by the loose fit of the shoe **63** on the shank of the bolt **64**. Thus, lateral thrust forces are transmitted from the shoe through the case to the rigidly mounted cylinder, without being applied by the shoe to the bolt **64** and to the piston shaft. Any slight misalignment of the shoe with the piston shaft that may result is compensated for by the washer **67** with its loose fit on the shank of the bolt **64** and its contact with the piston shaft plug **41** through the spherical surfaces **66** and **67**.

Moreover, the piston shaft and piston assembly is highly resistant to any minor transverse thrust forces that may be applied to the top of the shaft. The shaft is supported by three longitudinally spaced members namely: the piston **38**, the compensating piston **53**, and the annular cylinder closure member **58**. These members prevent binding of the shaft and piston in the cylinder when thrust forces normally encountered in operation are applied to the piston shaft.

With reference to FIG. 4, the shock absorbers **29*a*** may have the same internal construction as the shock absorbers **29** shown in FIGS. 5 to 9, and they may stand in the same direction, that is with the piston shaft extending up from the piston. In this arrangement, the fixed member **29*a*** is the case, and the movable number **32*a*** is the cylinder. A shoe **74** is supplied at the bottom of the cylinder and a mounting base **75** is fixed to the case.

Various modifications may be made in the specific embodiments of the invention shown and described herein without departing from the spirit of the invention as defined in the claims.

I claim:

1. A single-acting, hydraulic, shock absorbing mechanism comprising: a cylinder, a cylinder head closing one end of said cylinder, a piston slidable in said cylinder, port means extending longitudinally through said piston, check valve means for said port means, said check valve means opening toward said cylinder head, metering port means for allowing fluid to pass through said piston when said check valve means is closed, a hollow piston shaft carried by said piston and extending away from said cylinder head, an annular piston slidably mounted on said piston shaft and slidable in said cylinder, second port means extending longitudinally through the latter said annular piston, second check valve means for said second port means, said second check valve means opening toward said first-mentioned piston, and resilient means biasing said first-mentioned piston away form said cylinder head, said resilient means comprising a coil compression spring mounted within the hollow piston shaft, the spring having one end engaging an element on the piston shaft, the other end engaging said cylinder head.

2. The combination set forth in claim **1** together with piston shaft guide means supported in said cylinder and positioned remotely from said cylinder head.

3. The combination set forth in claim **1** including a spring guide pin carried by said cylinder head, said pin extending inside of said coil compression spring.

4. A single acting, hydraulic, shock absorber, comprising: a cylinder closed at its lower end and having a stop intermediate its ends, a vented guide at its upper end, a compensator piston freely movable in said cylinder between said guide and said stop, a shock absorbing piston movable in said cylinder between its lower end and said stop, a tubular stem protruding from the upper end of said cylinder and closed at its extended end, said stem being secured to said shock absorbing piston and slidable in said compensator piston and said guide, a spring within said stem and bearing against the closed end of said cylinder to extend said stem, a hydraulic liquid filling said cylinder to a level above said compensator piston, an orifice valve in said shock absorbing piston permitting restricted flow of hydraulic liquid during descent of said shock absorbing piston in said cylinder, a check valve in said shock absorbing piston permitting relatively unrestricted flow of hydraulic liquid during upward movement of said shock absorbing piston in said cylinder, a check valve in said compensator piston for relatively unrestricted downward flow of hydraulic liquid therethrough thereby to maintain the region below said compensator piston completely full of hydraulic fluid.

5. A shock absorber, as defined in claim **4**, which further comprises: an inverted cylinder closed at its upper end and secured to the protruding end of said stem, said inverted cylinder slidably receiving the first mentioned cylinder, means for securing one of said cylinders in a fixed position, a slide bearing formed by the end surface of

the other cylinder, and a slide plate engageable with said slide bearing.

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