United States Patent

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[54] **HYDRAULIC CUSHIONING DEVICE FOR RAILWAY CARS**
10 Claims, 6 Drawing Figs.

[52] **U.S. Cl.** **213/43,** 213/8, 267/115
[51] **Int. Cl.** **B61g 9/08,** B61g 9/16
[50] **Field of Search** ..... 213/8, 43, 223; 188/88, 509, 100, 100 (R); 267/64, 65, 115

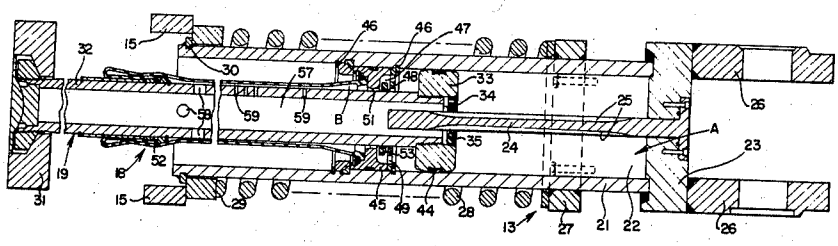
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ABSTRACT: A double-acting hydraulic cushioning device for railway cars is formed with a hydraulic fluid filled cylinder having a closed end and an open end through which a piston rod is movable for reciprocating a piston within the cylinder. A flexible accumulator boot is connected to the piston rod and to an intermediate cylinder head for closing the end of the cylinder. A metering pin cooperates with the piston for providing a relatively constant metered flow from the cylinder to the accumulator during the buff stroke on the unit. The piston is provided with a sliding valve and orifice plate which cooperates with the metering pin to meter the flow during the buff stroke and to move to another position during the return stroke thereby permitting an increased flow of fluid from the accumulator boot through the cylinder. The intermediate cylinder head is provided with a cavity which contains a fluid pressure responsive valve slidable to open passages leading from the accumulator boot to the cylinder and in a return and draft stroke of the piston the valve being movable over the passages to restrict the flow therethrough. The valve plate and the piston has a configuration which permits misalignment of the piston relative to the axis of the cylinder without affecting the metering operation. Further, the piston is provided with a piston ring engaging the cylinder wall with the piston ring groove on the piston being designed to permit misalignment without affecting the sealing relation of the piston ring. The slidable valve plate within the recess or cavity of the intermediate cylinder is also of a flexible construction which in the event of misalignment does not impair its functional operation.



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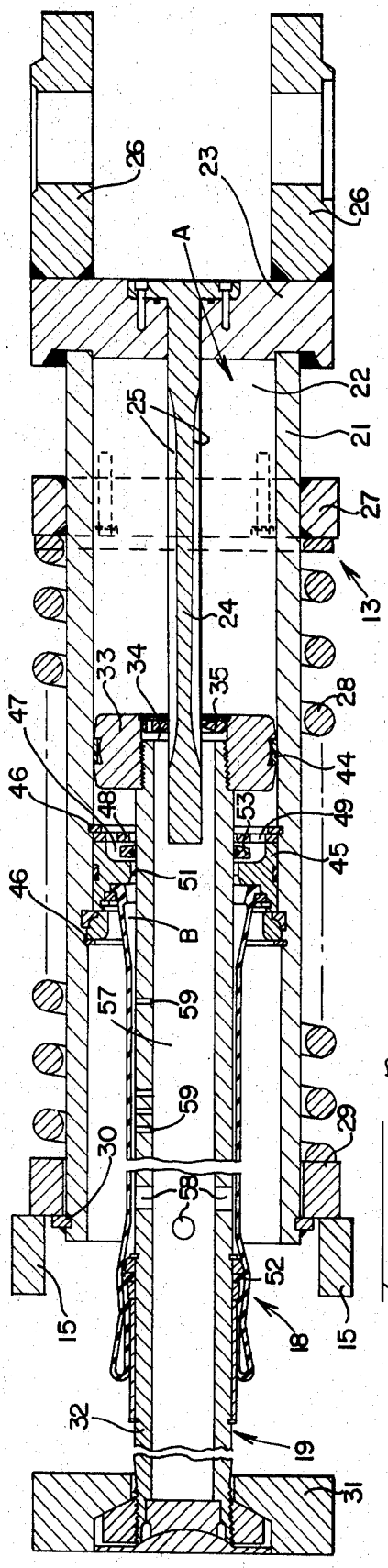


FIG-2-

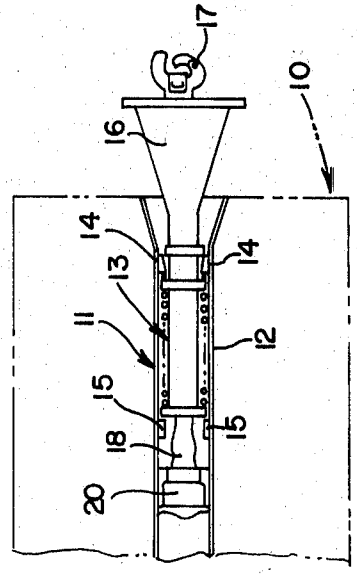


FIG-1-

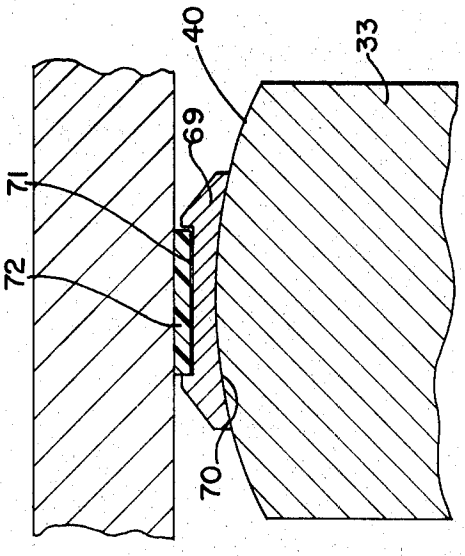


FIG-6-

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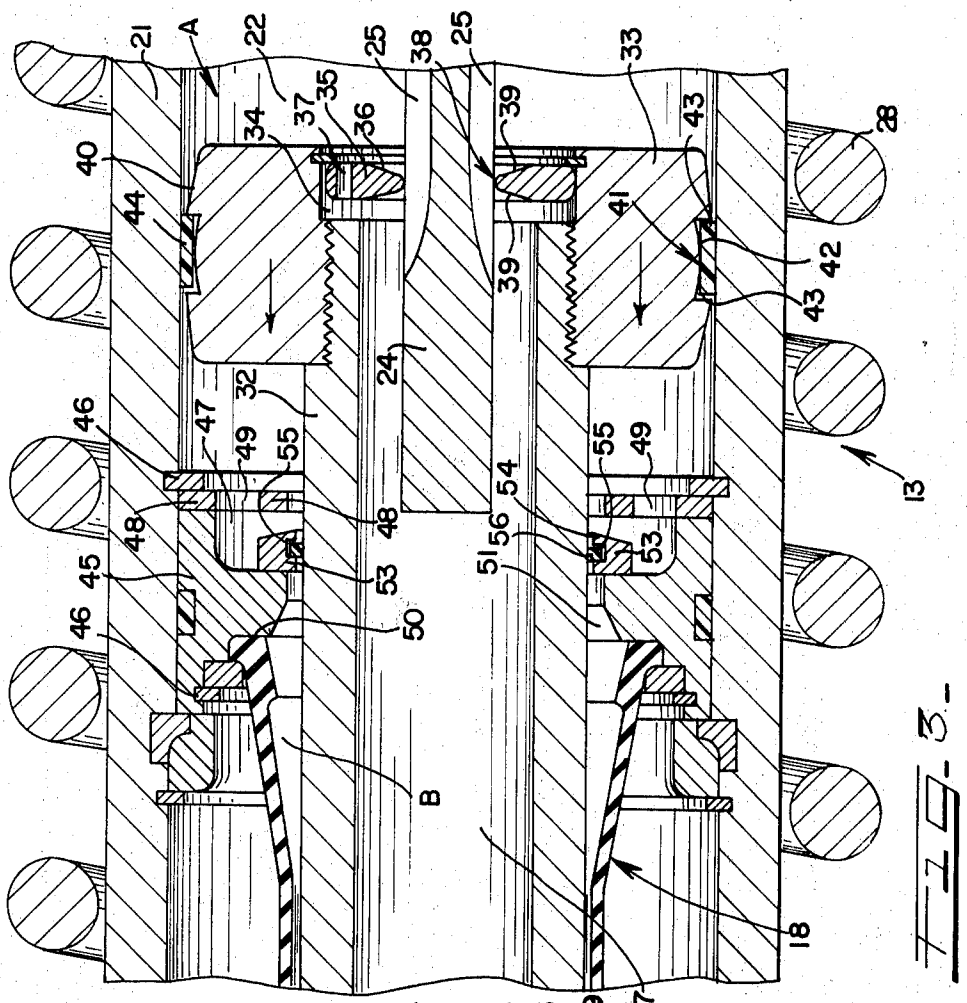


FIG. 3.

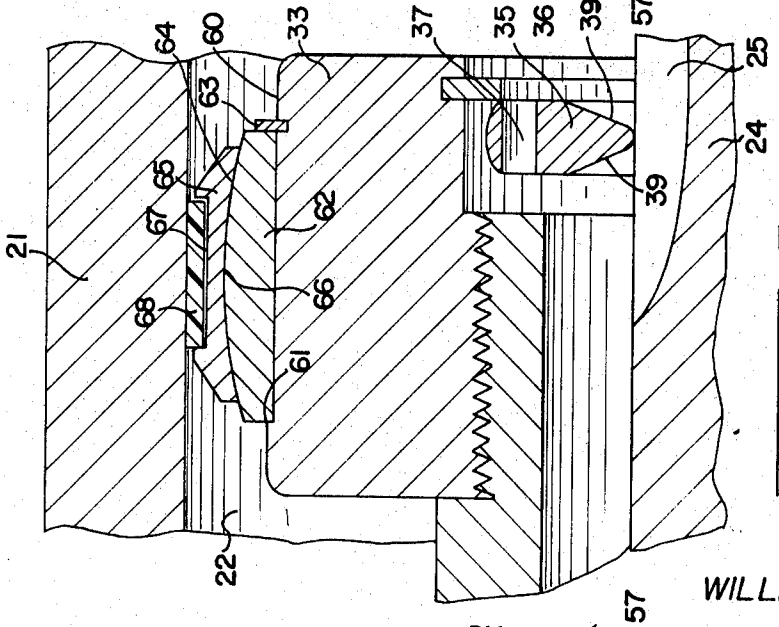


FIG. 5.

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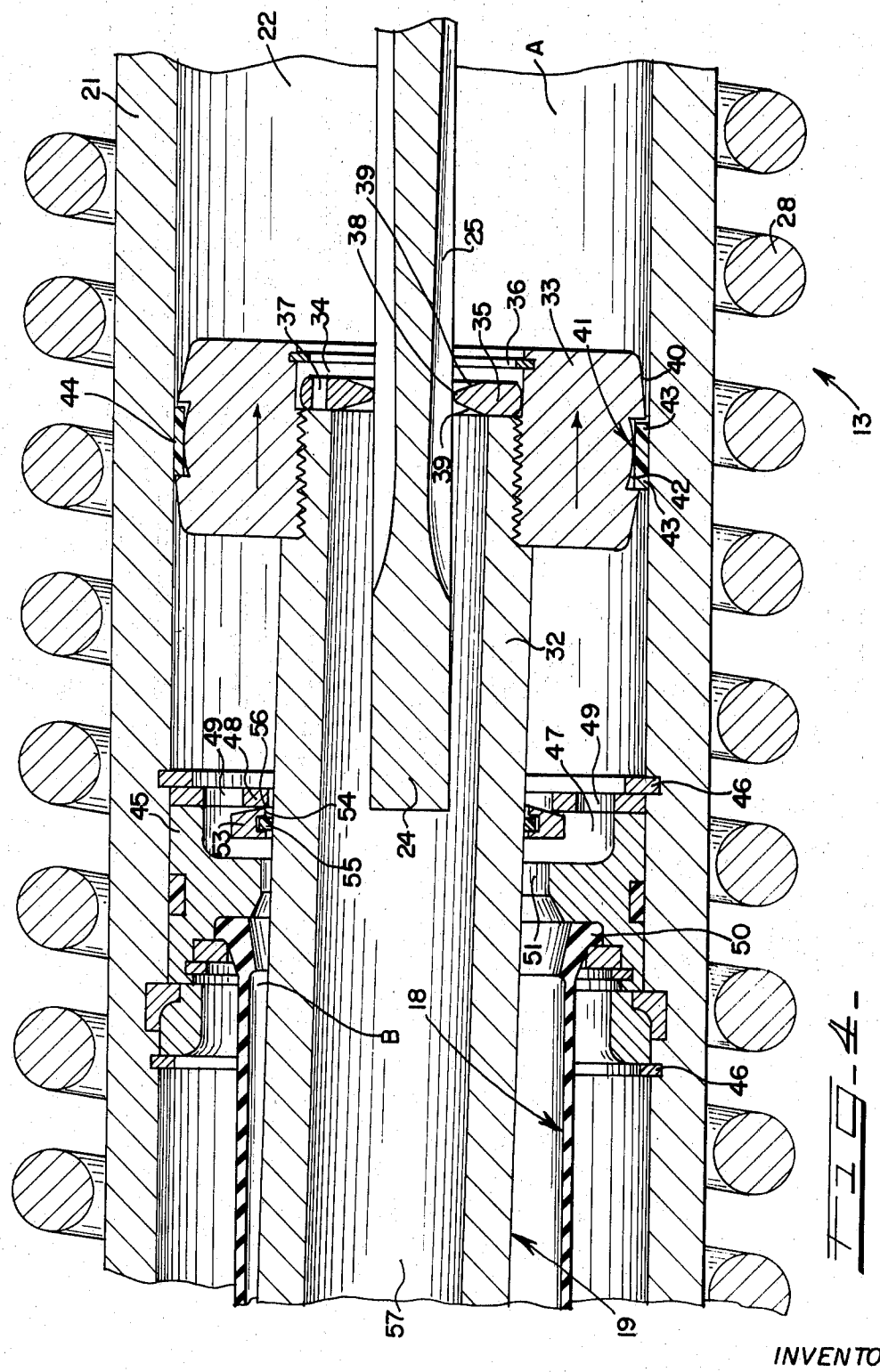


FIG. 4

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HYDRAULIC CUSHIONING DEVICE FOR RAILWAY CARS

SUMMARY

The invention relates to a hydraulic cushioning unit particularly adapted for railroad cars which during operation provides cushioning for both buff and draft impacts to which a railroad car is subjected. The cushioning unit of the present invention may be readily incorporated in the underframe at opposite ends of the car to provide end-of-car cushioning for impacts which are applied to the coupler of a car. A related application of applicant's assignee is Ser. No. 799,175 filed Feb. 14, 1969. A cushioning unit of this type is subjected to extremely rigorous operating conditions which tend to cause misalignment of the piston rod and piston axis relative to the axis of the hydraulic cylinder. It is a prime object of the invention to provide a cushioning unit having components which include a metering valve and orifice assembly, a slidable valve regulating fluid from a flexible accumulator boot to the cylinder, and a piston ring, said components being designed to accommodate conditions of misalignment which do not interfere with the proper functioning of the unit.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic view of one end of a railroad car underframe having supported therein an improved end-of-car cushioning unit incorporating the features of the invention;

FIG. 2 is a cross-sectional view of a cushioning unit shown in a neutral position;

FIG. 3 is an enlarged sectional view of a portion of a cushioning unit with a cylinder head in a neutral position;

FIG. 4 is a cross-sectional view through a cushioning device showing a piston with its axis in misalignment with the axis of the cylinder with which it cooperates;

FIG. 5 is an enlarged cross-sectional view through a piston showing a modified piston ring installation; and

FIG. 6 is another modification of a piston head and piston ring installation.

DETAILED DESCRIPTION

FIG. 1 discloses one end of a railway car designated by the reference character 10. The car 10 comprises a conventional underframe 11 including a center sill 12 which is broken away to show a hydraulic cushion unit generally designated at 13. The cushion unit 13 engages at one end front stops 14 provided on the center sill 12 and at its other end rear stops 15 also on the center sill 12. A bellmouth coupler housing and yoke assembly is generally designated at 16 which is suitably connected to the cushion unit 13. The assembly 16 includes a coupler 17 of conventional construction. The hydraulic cushion unit 13 also includes a flexible boot or reservoir assembly 18 which will be described below in more detail. A piston rod assembly designated at 19 has one end suitably secured against longitudinal movement on the sill 12 by means of a stop structure generally designated at 20.

Referring now particularly to FIGS. 2, 3 and 4 the hydraulic cushion unit 13 comprises a cylinder 21 having an inner cylindrical wall 22. One end of the cylinder 21 is closed by means of an end plate or cylinder head 23 from which a metering pin 24 projects inwardly into the cylinder 21. The metering pin 24 includes metering flutes 25. The head 23 also has connected thereto a pair of yoke attaching elements 26 to which the bellmouth coupler and yoke assembly 16 is suitably connected. A spring retainer ring 27 is connected around the outer periphery of the cylinder 21 for anchoring one end of the coil spring 28. The coil spring 28 is held captive at its other end by means of a slide ring 29, as best shown in FIG. 2, which is retained on the cylinder 21 by means of a retainer ring 30. The slide ring 29 is in abutment with rear stops 15 provided on the center sill 12.

The piston rod assembly 19 is provided at its end with an end or base plate 31 which is suitably connected to a piston rod 32 to which in turn is connected a piston head 33. The piston head 33 is provided with an annular cavity or recess 34 in which a slide valve 35 is longitudinally movable. The slide valve 35 is maintained within the cavity 34 by means of a retainer or stop ring 36. The slide valve 35 includes one or more bores 37 which provide for communication of the cavity 34 with a high-pressure chamber designated by A. The slide valve 35 is provided with a metering orifice 38 which is formed by means of a pair of tapering cylindrical walls 39 providing in cross section a V-shaped configuration which effectively, with the metering pin 24, provides for a small area or circumferential line contact.

As best shown in FIGS. 2, 3, 4, and 6, the piston 33 is provided with an outer circumferential surface 40 arcuate or sloping to provide a semispherical configuration. The surface 40 includes a circumferentially extending piston ring groove 41 which is provided with a semispherical or arcuate wall 42 which at its opposite or deepest extent into the piston 33 joins spaced vertical sidewalls 43. A piston ring 44 is disposed in the groove 41 and includes outer and inner peripheral walls of flat and relative parallel configuration. As best shown in FIGS. 2, 3, and 4, an intermediate cylinder head assembly is designated at 45 and is positioned within the cylinder 21 by means of retainer rings 46 suitably carried within the cylinder wall 22. The head assembly 45 includes an annular recess or cavity 47 provided at one end thereof with a plate 48 having openings 49 communicating with chamber A. As indicated at 50 the boot assembly 18 is connected at one end to the head assembly 45 and includes a low pressure chamber designated at B. The other end of the boot assembly 18 is suitably connected to the piston rod 32 as designated at 52. The boot or accumulator assembly 18 is described in more detail in the aforereferenced patent application. The intermediate head assembly 45 also includes a passage 51 which communicates with the cavity 47. A slidable valve plate 53 is longitudinally movable within the cavity 47 and is provided with an inner peripheral wall 54 spaced from the piston rod 32. The wall 54 is provided with an annular recess or undercut 55 in which a plastic ring 56 is disposed. The ring 56 is of a tough plastic construction having a certain amount of resiliency and permitting ready sliding movement of the valve plate 53 on the piston rod 32.

The piston rod 32 is also provided with an axially extending passage 57 and by means of openings 58 communicates with the chamber B of the accumulator boot assembly 18. A plurality of metering openings 59 also are disposed along the piston rod 32 to communicate with the chamber B to provide metering during the draft stroke of the unit.

Referring now to FIG. 5 which shows a modified piston construction 33, the outer circumferential wall is flat and is designated at 60. The wall 60 is provided with a shoulder 61 against which a ring 62 is positioned and retained by means of a retainer ring 63. The ring 62 is provided with an outer circumferential surface 64 of semispherical shape and another concentric ring 65 is supported on the ring 62. The ring 65 also includes a semispherical surface 66 conforming to the surface 64 and permitting the ring 65 to axially tilt and slide relative to the ring 62. The ring 65 is also provided with a piston ring groove or recess 67 having retained therein an outer flat slide ring 68 which may also be of a plastic material and which engages the surface 22 of the cylinder 21 in sealing and sliding relation.

FIG. 6 discloses another modification of the piston 33 in which the surface is also of a semispherical shape. In this modification, an outer ring 69 is provided with an inner peripheral semispherical surface 70 conforming to the surface 40 and thus permitting relative axial tilting movement of the ring 69 relative to the piston 33. The ring 69 is also provided with a piston ring groove or recess 71 in which an outer flat slide ring 72 is positioned, the said ring 72 also preferably being of a plastic construction which will easily slide on the wall 22 and yet have an effective sealing relationship therewith.

THE OPERATION

Upon a buff impact on one end of the car, the coupler and assembly 16 cause movement of the cylinder 21, shown in FIG. 2, to the left. During this movement the spring 28 is contracted since the rear stops 15 retain the slide ring 29 in position and the retainer ring 30 moves with the open end of the cylinder 21 to the left. In the position shown in FIG. 2, the piston 33 is in a neutral position and as the cylinder 21 moves to the left the piston finally reaches a buff position substantially close to the end plate 23. The fluid in the high pressure chamber A during the buff movement is metered through the metering flutes 25 and through the orifice 38, through the passage 57, and through the openings 58 into the chamber B of the accumulator boot. The valve plate 35, as shown in FIG. 4, during this buff movement is up against the end of the piston rod 32 and the openings 37 are in nonfunctioning relation. The metering provides for a constant force throughout the buff stroke of the hydraulic cushion unit. During said buff stroke fluid in the chamber B flows through the bore 51 into the cavity 47 around the valve plate 53 through the openings 49 into the space of the cylinder 21 provided at the back end of the piston 33.

In the event of a draft impact which is a sudden pull on the coupler 17 the cylinder 21 is moved to the right from the position indicated in FIG. 2 whereupon the piston 33 assumes a draft position substantially up against the plate 48. During the draft impact fluid in back of the piston 33 moves through the passage 51 into the boot B. While the valve plate 53 is disposed over the passage 51 the plastic ring 56 has sufficient clearance to permit a restricted flow through the passage 51. The openings 59 also during this short draft stroke provide a metered flow of fluid through the passage 57 and into the chamber A to provide a constant force during draft impacts. On the return stroke which is provided by means of the spring 28, that is, when the cylinder 21 and piston are relatively moved apart by means of the spring 28, the valve plate 35 moves to the position shown in FIG. 2 thus permitting an increased flow of fluid from the chamber B to the chamber A through the openings 37. Also during the buff stroke the valve plate 53 is moved away from the passage 51 to permit the excess flow of fluid in the accumulator B to move into the space in back of the piston 33.

In FIG. 4 a misalignment of the piston assembly 19 relative with respect to its axis and with respect to the axis of the cylinder 21 is indicated. Such misalignment can occur for a number of reasons and can be attributed to the manner in which the impact occurs at the coupler. Since it is recognized that this misalignment is not infrequent, provisions have been made in the present invention to accommodate the same. It is desirable for cylinders of this type to function properly with a minimum of maintenance over long periods of time. The piston 33 assists in obtaining this objective. In the piston 33 the semispherical outer surface, as shown in FIG. 4, permits the cocking or tilting of the piston 33 and yet the sealing or piston ring 44 remains in contact over its complete outer surface with the inner cylindrical wall 22 and thus proper function as a result of misalignment is not endangered. The semispherical surface 42 permits such misalignment to take place.

Further, it can be seen in FIG. 4 that the line contact on the metering pin 24 afforded by the shape of the valve plate 35 and the orifice 38 permits the valve plate 35 to tilt and still maintain proper metering function during the buff impact despite the misalignment of the piston rod axis relative to the cylinder axis.

FIG. 4 also discloses the effect of misalignment with respect to the valve plate 53. The function of the valve 53 is not endangered since the flexible ring 56 is maintained in proper sliding relation with respect to the outer peripheral wall of the piston rod 32 and the valve plate 53 retains its proper position and thus performs its proper function.

The modifications shown in FIGS. 5 and 6 with respect to the piston 33 also clearly permit the piston rings 68 and 72 to be maintained in proper full contact with the inner walls 22 of the cylinder 21 since the spherical surfaces 64—66 and 40—70 permits proper sliding movement of the related parts so that misalignment of the piston rod assembly and the cylinder 21 does not endanger the proper functioning of the hydraulic cushion unit.

Thus it is clear that by virtue of these features an efficient and improved hydraulic arrangement has been described.

I claim:

1. A hydraulic cushioning device for railway cars including:
a hydraulic cylinder including a first cylinder head adjacent one end thereof, a metering pin supported on said first cylinder head and extending longitudinally within said cylinder, said cylinder being open on an opposite end thereof;
said cylinder including a second intermediate cylinder head fixed in said cylinder and being positioned between said open end and said first head to provide a high-pressure chamber, said intermediate head having a longitudinal opening therethrough, a piston positioned for reciprocation within said chamber;
metering means on said piston including an annular portion providing a metering opening encircling said metering pin to control the fluid flow through said passageway system;
said piston being movable from a neutral position between said cylinder heads to a buff position in proximity to said first head, and to a draft position in proximity to said second head;
a piston rod connected to said piston and extending through said longitudinal head opening and said open end;
a flexible tubular reservoir having one end connected around said piston rod and its other end connected to said intermediate head to provide a second low-pressure chamber;
said piston rod and piston including a passageway system communicating said second chamber with said first chamber;
said intermediate cylinder head including a recessed portion surrounding said piston rod and including passageway means providing for communication with said second chamber and said first chamber, the improvement comprising:
a longitudinally slidable valve element in said recessed portion;
said valve element having an inner annular portion radially spaced from and encircling said piston rod;
said valve element including a ring of flexible material on said inner portion and engaging said piston rod in sliding relation, said valve element on said movement of said piston to a buff position opening said passageway means for the passage of fluid from said second to said first chambers, and on movement of said piston to a draft position, said second valve element restricting fluid flow through said passageway means; and
said flexible ring accommodating relative misalignment of said cylinder and piston rod axes.

2. The invention in accordance with claim 1, said inner peripheral portion of said valve element having an annular undercut, and said flexible ring having an outer diameter portion disposed in said undercut.

3. The invention in accordance with claim 1,
said piston having an annular cavity communicating with said passageway system and said first chamber;
a second slidable valve element in said cavity;
said second element having an inner annular portion encircling said metering pin;
said second element metering the fluid flow to said passageway system during movement to a buff position, and being slidable to another position during movement to a draft position to provide an unrestricted flow of fluid from said passageway system to said second chamber; and

said inner annular portion in transverse cross section defining a generally V-shaped configuration providing a reduced annular contact portion with said metering pin to accommodate relative misalignment of said piston rod and cylinder axes.

4. The invention in accordance with claim 2,

piston having an annular cavity communicating with said passageway system and said first chamber;

a second slidable valve element in said cavity;

said second element having an inner annular portion encircling said metering pin;

said second element metering the fluid flow to said passageway system during movement to a buff position, and being slidable to another position during movement to a draft position to provide an unrestricted flow of fluid from said passageway system to said second chamber; and

said inner annular portion in transverse cross section defining a generally V-shaped configuration providing a reduced annular contact portion with said metering pin to accommodate relative misalignment of said piston rod and cylinder axes.

5. The invention in accordance with claim 2,

said piston including an outer circumferential surface having a piston ring groove coextensive therewith;

said groove including a bottom wall, and laterally spaced upright walls, and a piston ring disposed in said groove; and

said bottom wall being of arcuate configuration with opposite side portions of said bottom wall sloping from a central portion downwardly toward said sidewalls.

6. The invention in accordance with claim 5, said outer circumferential surface being of generally arcuate configuration with opposite side portions thereof sloping inwardly away from an inner cylindrical wall of said cylinder.

7. The invention in accordance with claim 6, said piston ring having an inner circumferential surface parallel to said inner cylindrical wall engaging said central portion of said arcuate bottom wall.

8. A hydraulic cushioning device for railway cars including:

a hydraulic cylinder including a first cylinder head adjacent one end thereof, said cylinder being open on an opposite end thereof;

said cylinder including a second intermediate cylinder head fixed in said cylinder and being positioned between said open end and said first head to provide a high-pressure

chamber, said intermediate head having a longitudinal opening therethrough, a piston positioned for reciprocation within said cylinder and defining one end of said chamber;

said piston being movable from a neutral position between said cylinder heads to a buff position in proximity to said first head, and to a draft position in proximity to said second head;

a piston rod connected to said piston and extending through said longitudinal head opening and said open end;

a flexible tubular reservoir having one end connected around said piston rod and its other end connected to said intermediate head to provide a second low-pressure chamber;

said piston rod and piston including a passageway system communicating said second chamber with said first chamber;

said intermediate cylinder head including a recessed portion surrounding said piston rod and including passageway means providing for communication with said second chamber and said first chamber, the improvement comprising:

a longitudinally slidable valve element in said recessed portion;

said valve element having an inner annular portion radially spaced from and encircling said piston rod, said annular portion having an undercut groove coextensive therewith, and a ring of flexible material carried in said groove and in sliding engagement with said piston rod.

9. The invention in accordance with claim 8, said piston having an outer circumferential surface of semispherical shape, a piston ring groove in said surface, said groove having a bottom wall of semispherical configuration, and a piston ring disposed in said piston ring groove and projecting outwardly therefrom for engaging the inner cylindrical wall of said cylinder.

10. The invention in accordance with claim 8,

said piston having an outer semispherical portion;

a ring-shaped element having an inner circumferential surface conforming to said semispherical portion and axially tiltably disposed thereon; and

said ring-shaped element having an outer circumferential surface including a piston ring engaging the inner wall of said cylinder.