

Sept. 23, 1969

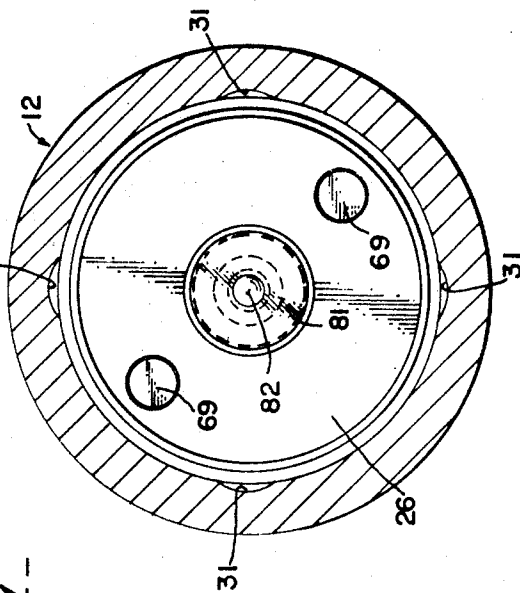
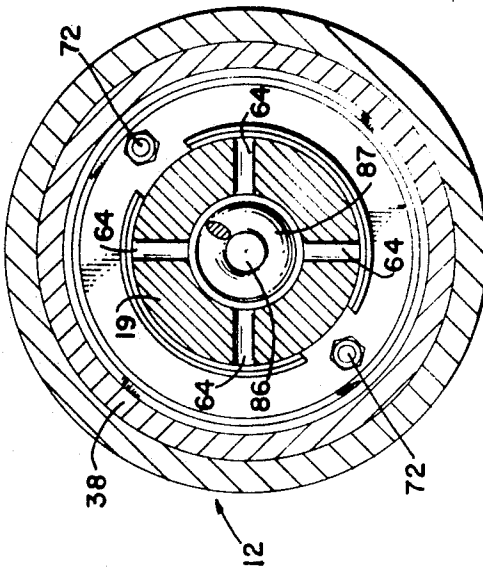
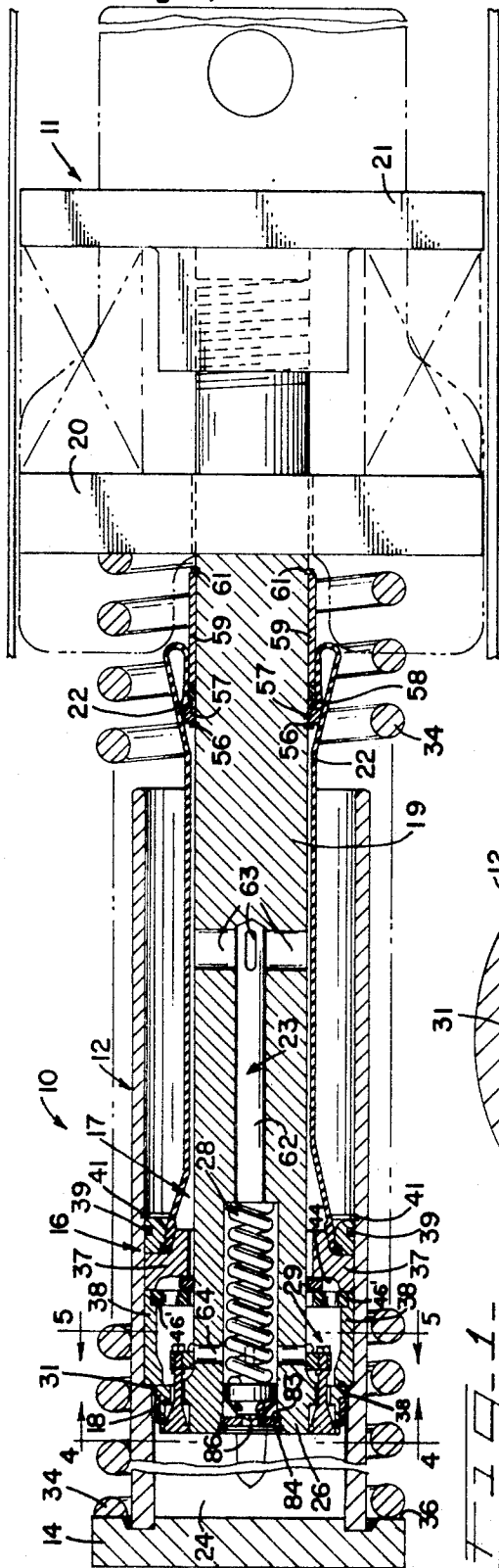
W. H. PETERSON

3,468,433

DOUBLE ACTING HYDRAULIC CUSHION

Filed Aug. 7, 1967

2 Sheets-Sheet 1



INVENTOR
WILLIAM H. PETERSON
BY *W. Morris Russell*
ATT. Y.

Sept. 23, 1969

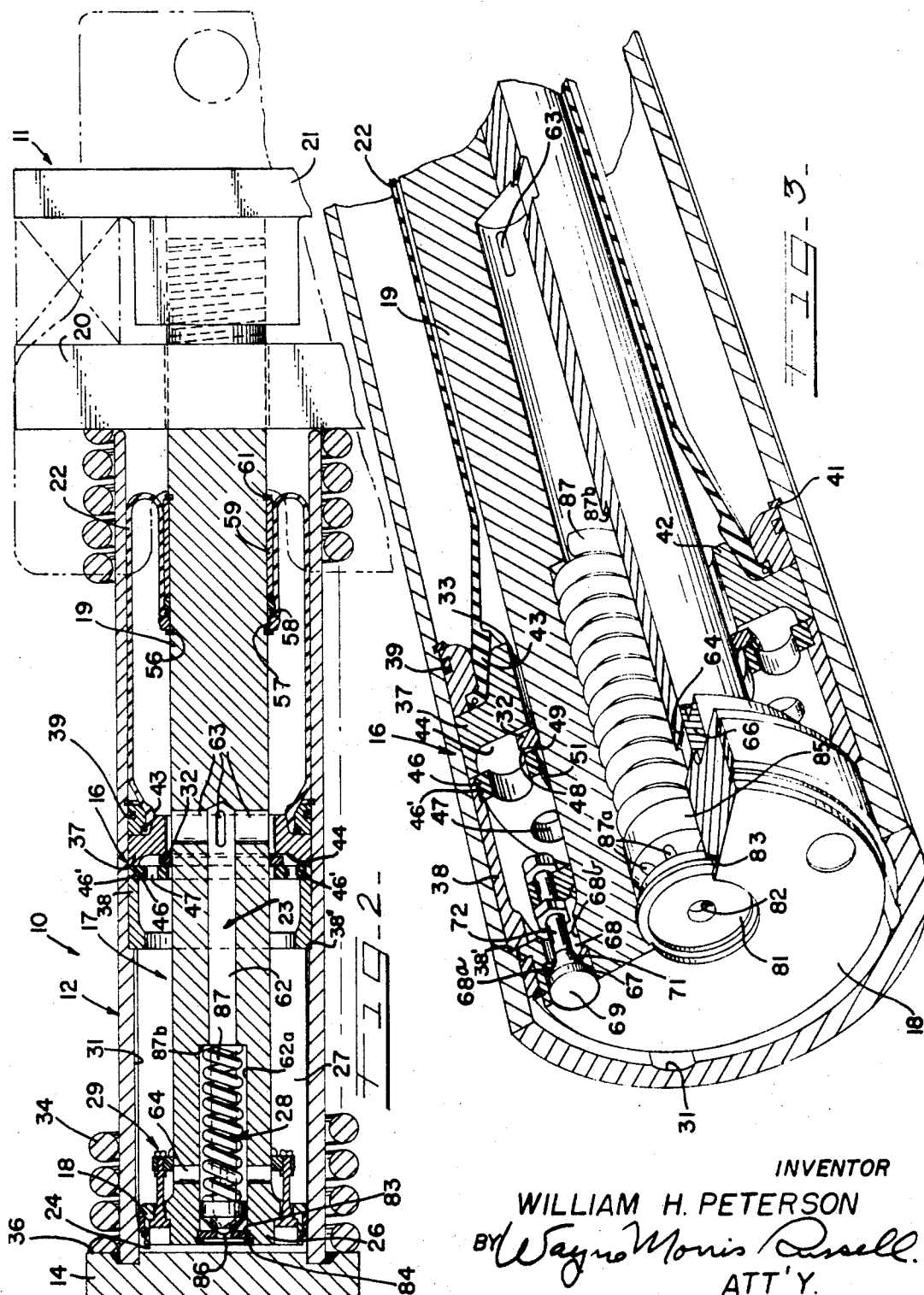
W. H. PETERSON

3,468,433

DOUBLE ACTING HYDRAULIC CUSHION

Filed Aug. 7, 1967

2 Sheets-Sheet 2



INVENTOR

WILLIAM H. PETERSON

BY *Wayne Morris Russell*
ATT'Y.

1

2

3,468,433

DOUBLE ACTING HYDRAULIC CUSHION

William H. Peterson, Homewood, Ill., assignor to Pullman Incorporated, Chicago, Ill., a corporation of Delaware

Filed Aug. 7, 1967, Ser. No. 658,782

Int. Cl. B61g 9/02, 9/12, 9/06

U.S. Cl. 213—43

12 Claims

ABSTRACT OF THE DISCLOSURE

A double acting hydraulic cushion device for relieving buff and draft impacts imposed on the couplers of a railway car. The cushion device comprises a cylinder having a closed end and an open end and a piston assembly reciprocal therein including a piston head and a piston rod extending from one face thereof through said open end of the cylinder, and an intermediate cylinder head assembly mounted in the cylinder inwardly of the open end thereof. Connected between the intermediate cylinder head and the piston rod is a flexible accumulator which closes off the open end of the cylinder so that the cylinder may be filled with hydraulic fluid. Bore means is formed in the piston head assembly and provides communication between the flexible accumulator and a first chamber in the cylinder defined by the intermediate cylinder head assembly and one face of the piston head. A second chamber is defined by the closed end of the cylinder and the opposite face of the piston head assembly. Communication to the second chamber and the accumulator is provided by the bore means and a pressure relief valve disposed in the bore means. A slide valve assembly responsive to fluid pressure forces is disposed on the piston head assembly so as to selectively provide communication between the first chamber and the accumulator during relative movement of the cylinder and piston head assembly. To achieve a predetermined force travel characteristic as the piston head assembly and the cylinder move relative to each other, there are provided metering opening means which are arranged to meter the flow of hydraulic fluid past the piston head between the first and the second chambers in a manner achieving the desired force travel characteristic. A flap valve means is disposed adjacent the intermediate cylinder head assembly so as to selectively close and open communication between the accumulator and the second chamber.

Background of the invention

The invention relates to double acting hydraulic cushion units employed in railway cars for relieving the buff and draft impacts imposed on the couplers and thereby to reduce both car and lading damage. Double acting hydraulic cushions of the above general type are usually mounted in the draft sill ends of the car and associated with the couplers so as to be operative upon impact to the latter. The hydraulic cushions are normally constructed so as to be operative in both buff and draft so as to be capable of relieving both the buff and draft impacts.

Heretofore the double acting hydraulic cushions have been constructed in a manner requiring diametric seals and thereby to increase the manufacturing and operating costs of the units. Moreover, the units, in order to achieve the desired cushioning characteristics, have been generally complex structures requiring frequent maintenance to eliminate operating difficulties.

Summary of the invention

It is a principal object of the present invention to pro-

vide a new and improved double acting hydraulic cushioning unit which is constructed so as to incorporate only static seals and thereby to eliminate the operating and cost of the diametric seals used heretofore.

It is a further object of the invention to provide double acting hydraulic cushioning units which are constructed and arranged so as to incorporate a static seal member which serves as an accumulator chamber for receiving fluid displaced during relative reciprocation of the cylinder and piston assembly.

It is still another object taken in conjunction with the immediately foregoing object to provide a new and improved arrangement for providing communication between the accumulator boot and the hydraulic cylinder chambers.

The fluid pressure responsive slide valve assembly provided on the piston head is movable from a position overlying ports communicating with a passageway system in the piston assembly to a position clear of the ports when the piston head moves toward the closed end of the cylinder. The slide valve assembly includes a slide ring disposed on the piston rod to open and close such ports and is actuated by one or more pistons slidably disposed in one or more openings through the piston head and which are responsive to fluid pressures developed in the cylinder between the piston head and the closed end of the cylinder.

Further objects and features will hereinafter appear.

Brief description of the drawings

FIG. 1 is a cross sectional view of the double acting hydraulic cushion unit embodying the principles of the present invention and showing the cushion unit in operative connection with a draft gear associated with the coupler;

FIG. 2 is a cross sectional view similar to FIG. 1 but showing the component parts of the cushion unit in the position when a buff impact has been applied thereto;

FIG. 3 is a fragmentary perspective view partially in section showing details of structure of the cylinder, piston head assembly and intermediate cylinder head assembly;

FIG. 4 is a cross sectional view through the cushion unit taken generally along the lines 4—4 of FIG. 1; and FIG. 5 is a cross sectional view through the cushion unit taken generally along the lines 5—5 of FIG. 1.

Description of the preferred embodiment

Referring now to the drawings, in particular, FIGS. 1 and 2, there is shown the double acting hydraulic cushion unit 10 associated with a draft gear 11 to which there is connected a coupler (not shown). The cushion unit 10 comprises generally a cylinder 12 having fixed to one end thereof a base plate 14. Disposed intermediate the ends of the cylinder is an intermediate cylinder head assembly 16 which defines with the base plate 14 the limit of travel of a piston assembly 17. The piston assembly 17 includes a piston head 18 and a piston rod 19 extending from one face thereof. The piston rod 19 extends through a stationary stop plate 20 and is connected at its outer end to lengthwise movable plate 21 of the draft gear 11 so as to be responsive to movement of the coupler upon impact thereto in either buff or draft. As shown in FIG. 1, the piston head assembly 17 is shown in its normal neutral position so that upon the imposition of a buff impact the piston assembly moves relatively to the cylinder 16 to the left to the position as shown in FIG. 2. Connected between the intermediate cylinder head assembly 16 and the piston rod 19 is an accumulator chamber which, as shown, is formed by a flexible boot 22.

The flexible boot or chamber 22 serves to close off the

open end of the cylinder 12 so that the latter may be charged with a hydraulic fluid. Formed in the piston head assembly is a fluid passage system 23 which provides communication between a chamber 24 (defined between the outboard face of the piston head and the cylinder end base plate 14), a chamber 27 (defined between the inboard face of the piston head 18 and the intermediate cylinder head assembly), and the accumulator chamber 22.

Disposed in the piston head end of the passageway system is a relief valve assembly 28 which is operative during buff impact and upon a predetermined pressure force to permit direct fluid communication between the chamber 24, the chamber 27 and the boot 22.

Mounted on the piston head 18 is a slide valve assembly 29 which is operative to open communication to the fluid passage system during movement of the piston head assembly 26 to the buff position and to close off communication when the piston head assembly 26 moves in the opposite direction. When communication is open to the fluid passageway system 23, the hydraulic fluid displaced by the piston rod 19 in the chamber 27 is free to flow into the accumulator boot 22.

Formed on the inner wall of the cylinder 12 are a plurality of angularly spaced metering grooves 31 which are tapered in a manner such that upon movement of the piston head assembly 26 the cylinder hydraulic fluid is displaced at a metered rate between the chambers 24 and 27 so as to impart a predetermined force travel characteristic to the cushion unit 10 and thereby achieve optimum car body and lading protection.

To obtain a predetermined cushion characteristic upon draft impact as the piston head 18 moves relative to the cylinder to the neutral position after buff impact, there is disposed in the intermediate cylinder head assembly 16 a flap valve 32 which closes off an annular passage 33 providing communication between the chamber 27 and the boot 22, as more fully to be explained hereinafter. When the cushion unit 10 returns to its neutral position the flap valve 32 moves away from the annular opening to permit a free flow of hydraulic fluid from the boot 22 to the chamber 27 so that the unit is again in condition to receive a buff impact. Disposed between the base plate and the stationary plate is a return spring 34 which serves to return the piston head assembly to its neutral position in the event a draft force is not applied on the coupler.

More specifically, the cylinder may be formed of a tube or the like which is preferably formed with a pre-formed bore so as to eliminate machining costs. The base plate 14 which may be of any suitable contour is provided with a peripheral groove into which one end of the cylinder is inserted and welded therein. It is to be observed that the base plate 14 extends upon the outer periphery cylinder so as to provide a ledge 36 against which one end of the return spring 34 engages.

The intermediate cylinder head assembly 16 includes an annular disk 37 having an axial opening 33 of somewhat larger diameter than the diameter of the piston rod 19 so as to define therein the annular passage 33. The annular disk 37 is held in fixed position against longitudinal movement by a collar 38 which abuts along one edge against a ledge 38' formed in the bore of the cylinder 12. On the other side of the disk 37 there is a clamp ring 39 which is held fixed by means of a snap ring 41.

The clamp ring 39 is formed on its inner face with a surface which is spaced from a boss 42 so as to clampingly accommodate therebetween one beaded end 43 of the accumulator boot 22. On the opposite face the disk 37 is formed with an axial recess 44 which accommodates the flap valve 32. The movement of the flap valve is limited by an annular plate 46 having openings 47 and which is seated in a groove 46' formed in the end of the clamping ring 38 and the adjacent face of the disk 37 as shown in FIG. 3. It is to be noted that the flap valve 32

has an outer circumference which is disposed in line with the radially inner edges of the perforations in the annular plate 46. Also, the flap valve is formed with an upper chamfered surface 48 which merges with a face 49 which is disposed in line with an annular passage 51 defined between the outer circumference of the piston rod 19 and the inner circumference of the opening in the annular plate 46.

The piston assembly 17 may be formed of a forging or the like including the piston head 18 and the piston rod 19. The piston head 18 is of somewhat lesser diameter than the internal diameter of the cylinder so as to preclude metal to metal contact. Seated within a groove formed in the periphery of the piston head 18 is a piston ring which is preferably formed from a resin or the like.

The piston rod passes through the intermediate cylinder head assembly 16 and the stationary draft gear plate 20 and is threaded to the movable draft gear plate 21. In this connection it is to be observed that resilient means are disposed between the stationary and movable plates 20 and 21 so as to yieldably resist impact on the coupler.

As heretofore described, one end of the accumulator boot 22 is clamped to the intermediate cylinder head assembly 16. The other end of the boot is reversely turned inwardly and a beaded edge thereof is clamped to the piston rod 19. The clamping arrangement includes a snap ring 56 seated in a groove formed in the piston rod 19 and retaining a clamping ring 57 in clamping relationship with a slidable clamping ring 58 which is held in position by a slidable sleeve 59 fixed against longitudinal movement by means of a second snap ring 61 seated in the piston rod. The flexible boot or accumulator is preferably formed of a laminated rubber so as to be expandable and to exert a pressure on the hydraulic fluid when the latter is introduced therein.

The fluid passageway 23 includes a bore 62 extending longitudinally from the outboard face of the piston head 18 inwardly into the piston rod 19 to a point which when the cushion unit is in the extended position as shown in FIG. 1 is disposed within the accumulator boot 22. Communication from the longitudinally extending bore 62 to the boot chamber 22 is achieved by radially extending passages 63. Inwardly of the inner face of the piston head 18 there are formed a plurality of radially extending ports 64 which provide communication between the chamber 27 and the boot 22 via the longitudinal bore 62 and radial passages 63.

For selectively providing communication through the radial ports 64 and the boot 22 there is provided the slide valve assembly 29 which is operative to selectively open and close the ports 64. The slide valve assembly, as shown in particular in FIG. 3, comprises a slide ring 66 slidably disposed on the piston rod. Fixed to the slide ring 66 are actuating pistons 67 which are slidably disposed in diametrically opposed openings 68 formed in the piston head 18. The actuating pistons 67 as shown are each formed with a head 69 from the underside of which there extends a tapered section 71 merging with a shank 72. The openings 68 are each formed with a large bore 68a in which the head 69 is slidably disposed and a bore 68b which is of larger diameter than the shank 72.

Disposed in the enlarged bore 62a extending from the outboard face of the piston head 18 inwardly into the bore 62 is the pressure relief valve assembly 28. The pressure relief valve assembly 28 comprises a disk 81 having an axial opening 82. The disk 81 is seated within a groove 83 and held fast therein by a snap ring 84. Inwardly of the disk 81 is a poppet valve 85 having a ball end 86 which is seatable within the axial opening 82 of the disk 81. Formed through the body of the poppet valve 85 are a plurality of fluid passages 87a through which the hydraulic fluid may pass. Yieldably holding the ball end 86 in engagement within the axial opening is a compression spring 87 which is seated within the enlarged bore 62a and abuts at one end against a shoulder

5

6

87. The compression spring 87b is selected so as to yield at a predetermined fluid pressure force applied on the ball end of the valve 86 through the axial opening 82. The pressure force at which the spring yields is selected so as to minimize or eliminate excess pressure which would tend to rupture the cylinder 12.

In operation, the cushion device 10 is disposed in a pocket adjacent the draft gear 11, with the base plate 14 engaging suitable stops, not shown. The other end of the cylinder may abut the fixed stop plate 20 as shown. Upon an application of an impact force in buff to a coupler, not shown, the plate 11 to which one end of the piston rod is fixed, moves inwardly so that the piston assembly 17 moves from the neutral position shown in FIG. 1 to the position shown in FIG. 2.

This movement of the piston head 18 causes fluid to flow from the chamber 24 through the metering grooves 31 into the chamber 27. At the same time the pressure forces being exerted on the actuating pistons 69 of the slide valve assembly 29 move the assembly inwardly so that the slide ring 66 is displaced away from the ports 64 permitting fluid to flow from the chamber 27 through the ports 64 into the bore 62 and thence into the accumulator boot 22. Thus, the fluid displaced by the piston rod 19 entering the chamber 27 is displaced into the accumulator boot 22. It is to be observed that during the movement of the piston rod inwardly the tapered section 71 of each of the actuating pistons 69 is moved against the hydraulic fluid within the bores 68 and 68a so as to preclude a rapid sharp movement of the actuating pistons 69 to the open position as shown in FIG. 2.

During the period in which the piston head 18 moves to the buff position of FIG. 2, the flap valve 32 remains seated over the annular opening 33 providing communication between the chamber 27 and the accumulator boot 22 so that fluid flow only occurs through the passageway system 23 as above described. Such seating of the flap valve 32 occurs due to the pressure forces being exerted on the vertical face 49.

When the buff impact has been dissipated and in the absence of a draft impact the return spring 34 disposed between the ledge 36 of the base plate 14 and the stationary plate 20 is operative to return the unit to its neutral position shown in FIG. 1. In the event a draft impact is applied, the return spring 34 will assist in returning the piston assembly 17 to the neutral position. During return movement the fluid pressure forces acting on the slide ring 66 of the slide valve assembly 29 are operative to return the actuating pistons 69 to a position precluding fluid flow through the openings. At the same time the hydraulic fluid flow is reversed from the chamber 27 to the chamber 24 via the metering grooves 31.

The metered flow of the fluid from the chamber 27 to chamber 24 via the grooves 31 yields a predetermined force travel characteristic to achieve the requisite protection. In view of the fact that pressure forces in the chambers 24 and 27 are reversed from those occurring during buff impact, the flap valve 32 will remain in closed relationship over the annular opening 33 so that fluid does not enter the accumulator boot 22. When the piston assembly 17 returns to its neutral position and is stationary, a pressure differential occurs between the accumulator boot 22 and the chamber 27 so that the fluid pressure forces in the boot 22 are operative to displace the flap valve 32 away from the opening permitting a return of the displaced hydraulic fluid to the chamber 27. In this connection it is to be noted that the chamfered surface 48 of the flap valve minimizes a reaction due to Bernoulli effect of the hydraulic fluid so that the flap valve 32 is freely movable when the unit 10 is stationary.

Thus it can be seen that the flap valve 32 closes both on the closing stroke of the piston and on the piston's return stroke and moves to its open position after the piston has traveled a complete cycle including a closing stroke

and its return stroke. At that time all of the fluid has not returned to the cylinder. This in effect results in a relative sub-pressure or vacuum condition which taken with the pressure exerted by the distended flexible accumulator 22 causes the fluid to flow into chamber 27 opening the flap valve 32 as it flows through passage 33 in the intermediate cylinder head assembly.

I claim:

1. A double acting hydraulic cushion unit for relieving the buff and draft impacts imposed on the couplers of a railway car, said cushion unit comprising a cylinder having a closed end and an open end, a piston assembly including a piston head and a piston rod disposed in said cylinder having lengthwise travel relative to said closed end, an intermediate cylinder head mounted in said cylinder limiting said travel of said piston head relative to said cylinder in one direction, hydraulic fluid filling said cylinder and means metering the flow of said fluid relative to said piston during said travel between said closed end and said intermediate cylinder head, a flexible accumulator connected between said cylinder and said piston rod for closing the open end of said cylinder, a passageway system formed in said piston assembly providing communication between said flexible accumulator and a chamber defined by said piston head and said intermediate cylinder head, and slide valve means on said piston rod actuated by a piston in said piston head responsive to fluid pressure between said piston head and said closed end and movable from a position overlying ports in said rod communicating with said passageway system to a position clear of said ports when said piston head moves toward said closed end of said cylinder.

2. A double acting hydraulic cushion unit for relieving the buff and draft impacts imposed on the couplers of a railway car, said cushion unit comprising a cylinder having a closed end and an open end, a piston assembly including a piston head and a piston rod disposed in said cylinder having lengthwise travel relative to said closed end, an intermediate cylinder head mounted in said cylinder limiting said travel of said piston head relative to said cylinder in one direction, a flexible accumulator connected between said intermediate cylinder head and said piston rod for closing the open end of said cylinder, passageway means formed in said intermediate cylinder head providing communication between said flexible accumulator and a first chamber defined by said piston head and said intermediate cylinder head, valve means disposed in said passageway means and operable upon a predetermined pressure force in said first chamber and in a second chamber defined by said piston head and said closed end to provide communication through said passageway means with said flexible accumulator, hydraulic fluid filling said chambers and means metering the flow of said fluid between the first and second chambers during travel of said piston head, a passageway system formed in said piston rod providing communication between said first chamber and said accumulator, and slide valve means on said piston head and rod actuated by a piston in said piston head so as to be responsive to fluid pressure in said second chamber and movable from a position overlying ports in said rod communicating with said passageway system to a position clear of said ports when said piston head moves toward said closed end of said cylinder.

3. The invention as defined in claim 1 wherein said slide valve means includes an assembly comprised of a slide ring disposed on said piston rod to open and close said ports, and an actuating piston slidably disposed in an opening through said piston head responsive to fluid pressures developed in said cylinder between the piston head and said closed end.

4. The invention as claimed in claim 1 wherein said intermediate cylinder head comprises an assembly including an annular collar having one edge seated against a ledge formed in said cylinder, a perforated annular plate

7

seated in said collar adjacent its opposite edge, an annular disk having an annular recess on one face and clamping said plate in said collar, a clamp ring at the opposite face of said disk clamping said disk, plate and collar in assembled relation, and a snap ring fixing said clamp ring in operative position, said clamp ring being formed on its inner face with an annular shoulder clamping the adjacent beaded end of said accumulator against said opposite face of said disk, said disk having an annular boss underlying said beaded end of the accumulator.

5. The invention as defined in claim 1 wherein a pressure responsive relief valve disposed in said passageway system provides fluid communication through said passageway system to said flexible accumulator from said cylinder between said closed end and said piston head.

6. The invention as defined in claim 2 wherein a pressure responsive relief valve in said passageway system provides fluid communication through said passageway system between said second chamber and said flexible accumulator.

7. The invention as defined in claim 1 wherein said passageway system comprises an axial bore extending longitudinally of said piston assembly.

8. The invention as defined in claim 7 wherein said piston rod is provided with longitudinally spaced radially disposed ports in communication with said axial bore adjacent to said piston head and opening into said accumulator, respectively.

9. The invention as defined in claim 8 wherein said radially disposed ports adjacent to said piston head are covered and uncovered by said slide valve means.

8

10. The invention as defined in claim 1 wherein said intermediate cylinder head includes an annular passage and a flap valve releasably closing off said passage.

11. The invention as defined in claim 10 wherein the intermediate cylinder head includes an annular disk having an axial opening of greater diameter than said piston rod defining said annular passage, said disk having an axial recess receiving said flap valve, and an annular plate seated in said intermediate cylinder head is provided with a plurality of spaced openings therethrough and limiting movement of said flap valve.

12. The invention as defined in claim 10 wherein an annular plate seated in said intermediate cylinder head and provided with a plurality of spaced openings therethrough and limiting movement of said flap valve and wherein said flap valve has an outer circumference disposed in line with the inner edge of said openings through said annular plate and said valve is formed with an inclined surface adjacent said plate.

References Cited

UNITED STATES PATENTS

3,128,885	4/1964	Thompson et al.	213—43
3,216,592	11/1965	Peterson et al.	213—43
3,275,164	9/1966	Peterson	213—43

DRAYTON E. HOFFMAN, Primary Examiner

U.S. Cl. X.R.

188—88; 213—8; 267—1