Nov. 26, 1968 D. W. ROLLINS 3,412,870

END-OF-CAR HYDRAULIC BUFF AND DRAFT CUSHIONING

Filed Jan. 24, 1967 4 Sheets-Sheet 1

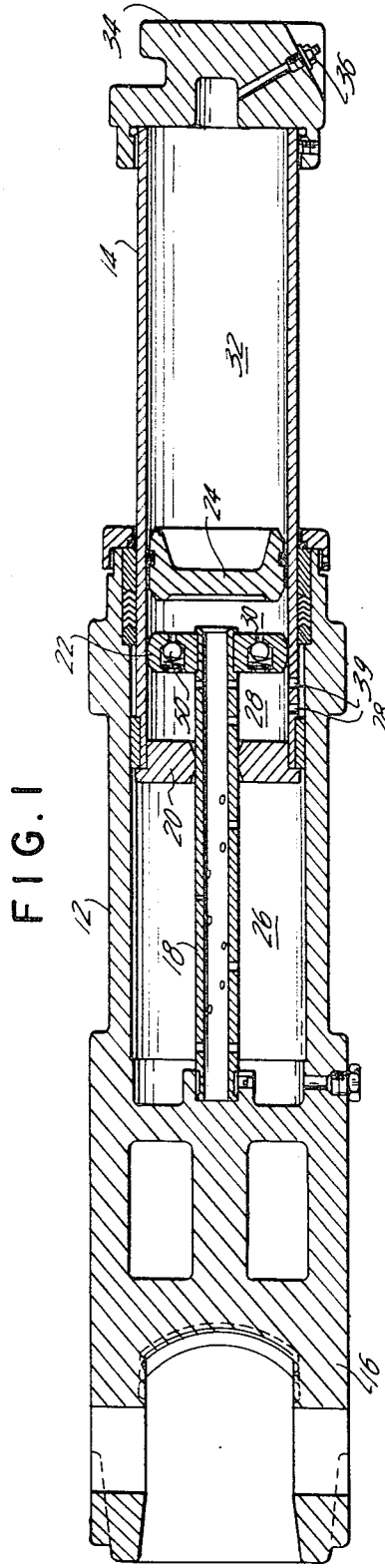


FIG. 1

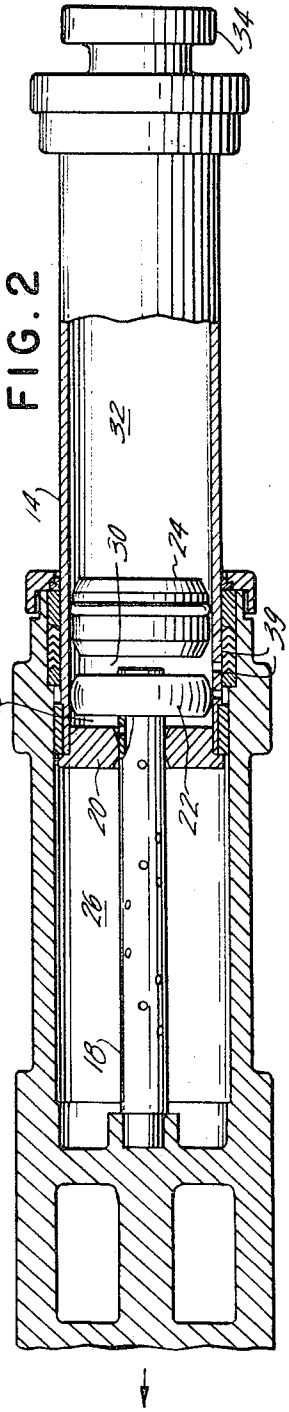


FIG. 2

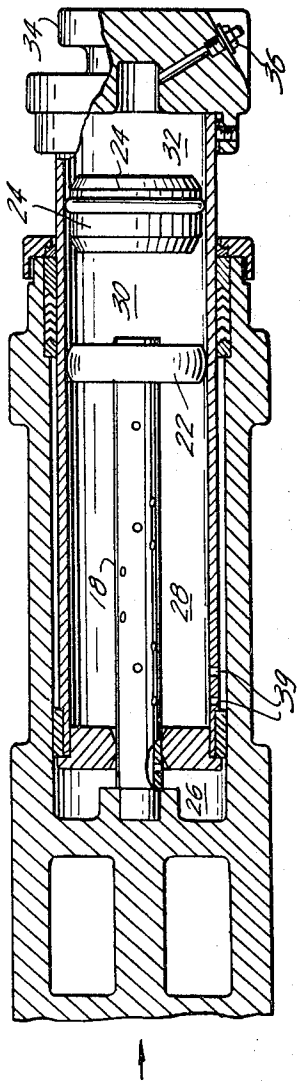


FIG. 3

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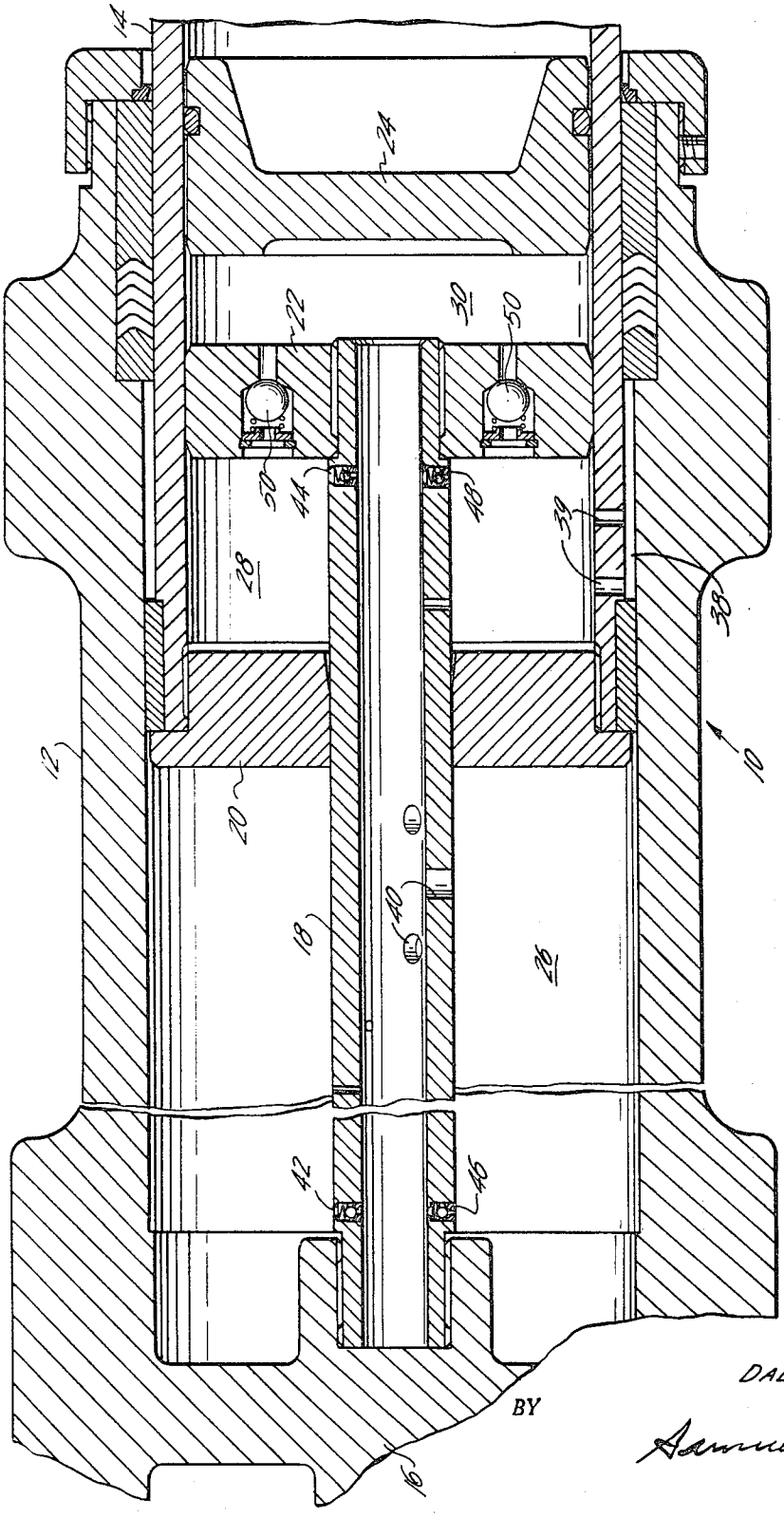


FIG. 4

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END-OF-CAR HYDRAULIC BUFF AND DRAFT CUSHIONING

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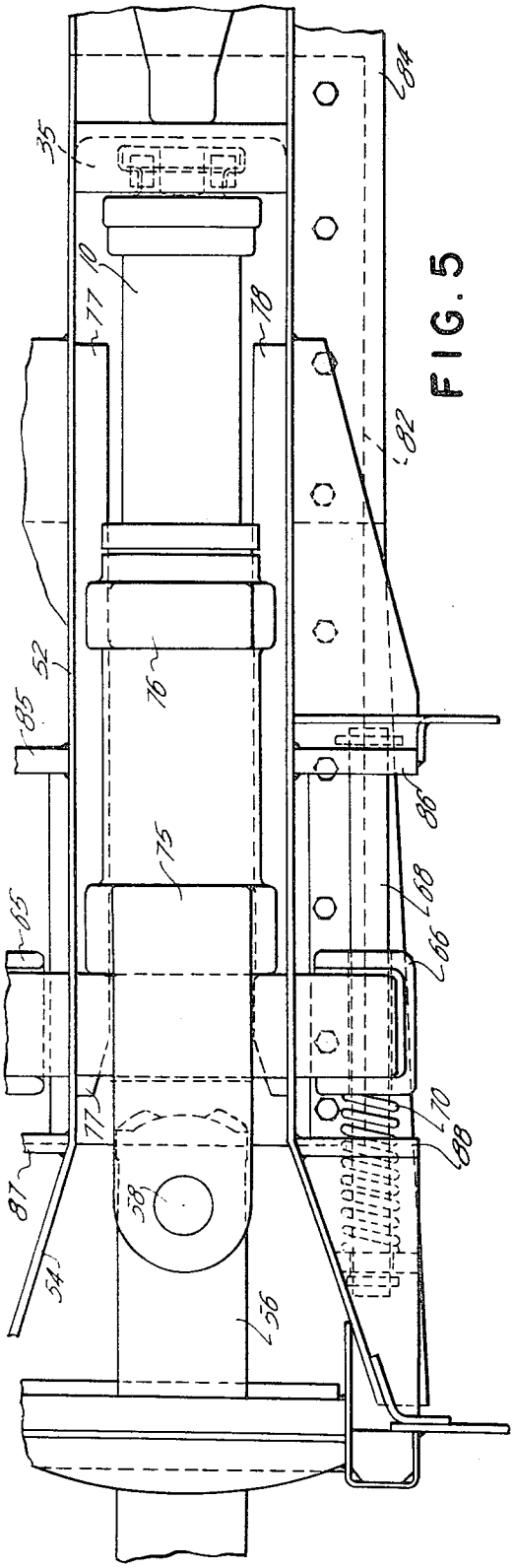


FIG. 5

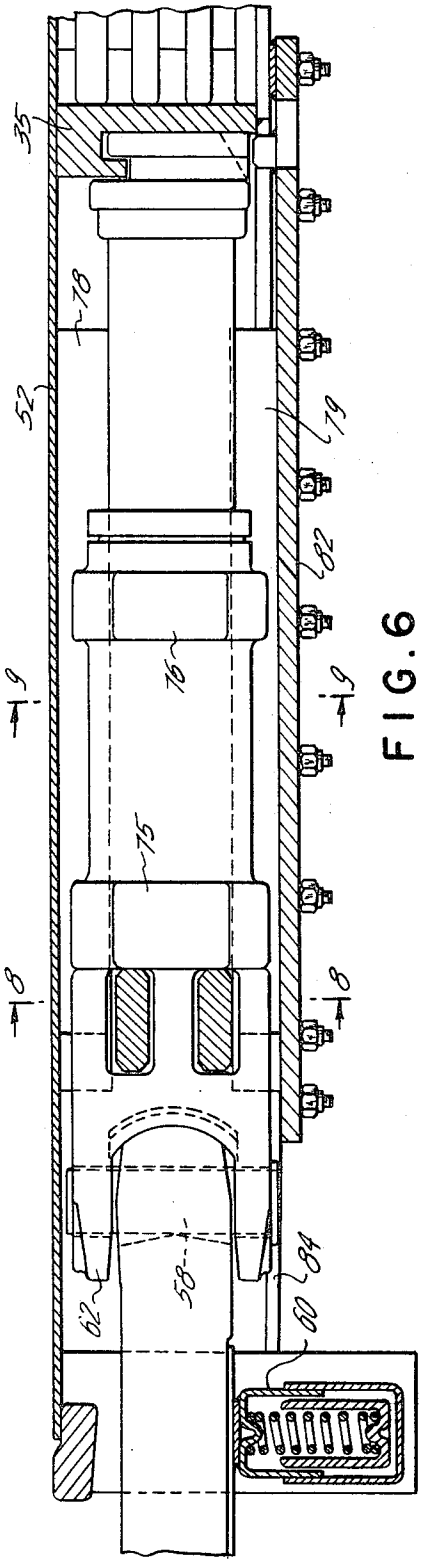


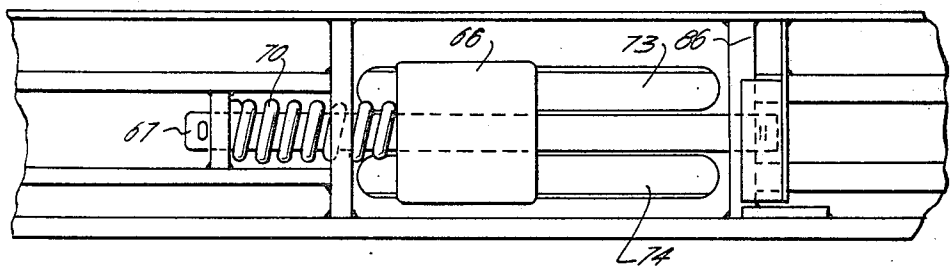
FIG. 6

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FIG. 7



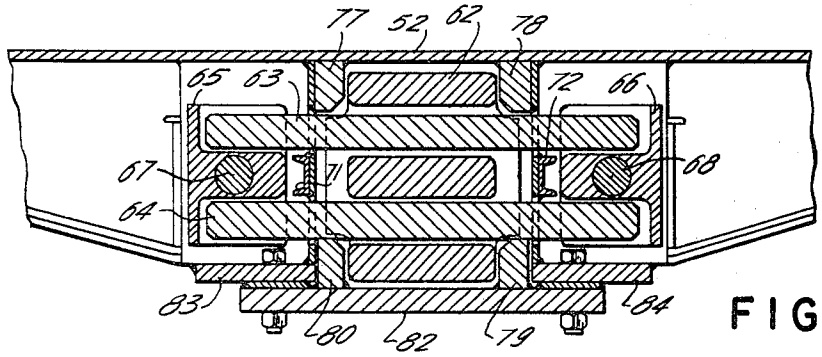


FIG. 8

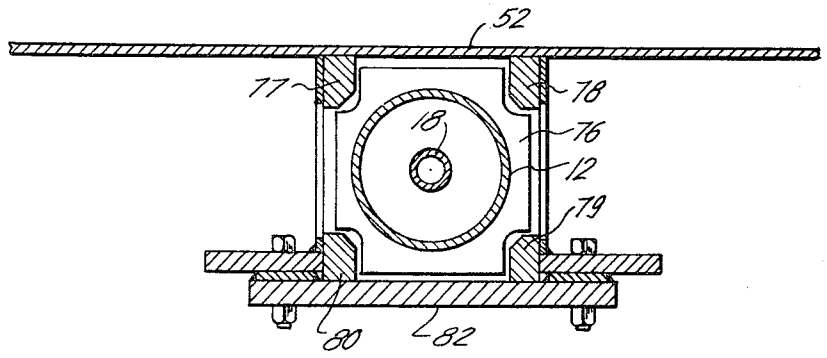


FIG. 9

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END-OF-CAR HYDRAULIC BUFF AND DRAFT CUSHIONING

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Filed Jan. 24, 1967, Ser. No. 611,456
10 Claims. (Cl. 213—8)

ABSTRACT OF THE DISCLOSURE

A hydropneumatic shock absorber connected to each coupler of a railroad car has a piston positioned by a spring to an intermediate point of its travel to provide buff and draft cushioning. The shock absorber has an axial hollow perforated metering tube and check valves in a partition between two liquid chambers providing a very low speed of return after a compression or extension of the shock absorber. The metering tube includes pressure relief and check valves at both its ends which permit additional cushion travel and prevent overloading which might result from impacts occurring before the cushion has returned sufficiently.

Background of the invention

The invention relates to hydraulic cushioning assemblies for railroad cars and particularly end-of-car hydropneumatic cushioning devices for absorbing both buff and draft impacts.

It is the usual practice to provide a draft gear between each coupler and an end-of-car hydraulic cushion to cushion draft forces, although hydraulic cushions acting upon draft and buff forces have also been proposed. In the latter type of cushions the piston must normally be held in an intermediate position, from which it is capable of moving in either direction with a high absorption of energy under high impact forces. After a cushioning stroke the piston should return to its normal position without a violent recoil, but quickly enough to be in a position to cushion a succeeding shock.

A problem found in the use of end of car cushioning units is the creation of free slack in the train by the inability of the cushioning units to dissipate enough energy during draft travel or cushion return after a compression thereof. The cushion may be fully compressed by relatively low magnitude buff forces applied slowly over a sufficient period. On the other hand, the return rate from a full buff to a neutral position of the cushion may be about 15 inches per second, or 0.9 mile per hour, and therefore, the cushion will not absorb an appreciable amount of energy during train run-out unless the velocity of the coupler relative to the car exceeds this speed, or a relative velocity between adjacent cars of about 1.8 m.p.h. Thus, for cushions having an 11 inch stroke, the result during run-out from full run-in will be 22 inches of slack per car with no energy dissipation as the length of the car increases. This, then creates a sudden jerk when the slack is used up, and the rubber draft gears usually provided must absorb this sudden jerk or shock.

Summary of the invention

The present invention mitigates the run-out shock problem by reducing the shock absorber return speed threshold at which appreciable energy dissipation occurs to a value of 2 or 3 inches per second. This is done by using one-way valves which reduce the return speed without making the buff forces excessive. Since the return of the shock absorber unit, which is preferably of the hydropneumatic type, is considerably retarded, the unit may

be subjected to a succeeding impact before it has returned. For such eventualities the shock absorber is enabled to provide a small additional reserve cushioning stroke in buff and draft. Valves, serving as secondary metering means, are used for making the reserve cushioning effective under severe conditions. The outer cylinder of the shock absorber is integral with a yoke connected to the coupler and is formed so as to be confined by four corner rails or guides, while the inner cylinder and the piston at its inner end are stationary and attached to the center filler of the center sill.

Brief description of the drawing

The invention will be fully understood from the following description and the accompanying drawing, wherein:

FIGS. 1 to 3 are sectional views of a shock absorber in a normal position, an extended position, and a compressed position, respectively.

FIG. 4 is an enlarged sectional view of a portion of the shock absorber.

FIG. 5 is a top view of a shock absorber and its associated underframe structure.

FIG. 6 is a partly sectional view taken along the centerline of FIG. 5.

FIG. 7 is a partial side elevational view of the draft key area of FIG. 5.

FIG. 8 is a sectional view taken on line 8—8 of FIG. 6.

FIG. 9 is a sectional view taken along line 9—9 of FIG. 6.

Description of the preferred embodiment

Referring particularly to FIGS. 1 to 4, cushioning unit **10** comprises an outer cylinder **12** and an inner cylinder **14**. Cylinder **12** is integral with yoke **16** and has an axial perforated metering tube **18**. The inner end of cylinder **14** carries a piston **20** which has a close sliding fit on metering tube **18**. On the inner end of tube **18** is fixed piston **22**, and a floating piston **24** is positioned in cylinder **14**. The pistons define chambers **26**, **28**, and **30** adapted to be filled with oil and chamber **32**, which is maintained under a high gas pressure, to form a hydropneumatic shock absorber. The outer end of cylinder **14** is formed by cap **34**, which is adapted to be coupled to center filler **35** in the center sill of the car, and is equipped with an air valve **36** through which chamber **32** is charged to a high pressure. The space between the inner and outer cylinders forms an oil filled snubbing chamber **38** having openings **39** through which oil is forced into and out of chamber **38** to reduce the rate at which the cushion returns to its normal extended condition.

Tube **18** includes a number of orifices **40** dimensioned and spaced to meter the flow of fluid so as to provide a desirable force-travel characteristic of high efficiency. After piston **20** passes the last orifice **40**, in either direction, it would not normally be able to travel any further because the oil would then be trapped in chamber **26** or **28** and could not escape. Accordingly, pressure responsive check valves **42** and **44** and preset pressure relief valves **46** and **48** are provided at the ends of tube **18** for allowing liquid to flow into and out of tube **18** at both ends thereof, and thus allow piston **20** to travel the additional distance between the last orifice **40** and valves **42–48**. In a shock absorber having a normal buff stroke of 11 inches and a draft stroke of 2½ inches, for example, the additional travel may be one inch and a half inch respectively. Piston **22** has one or more check valves **50** which open only during compression of the shock absorber for a purpose which will be explained below.

Referring now to FIGS. 5–8, the center sill **52** of the car terminates in a flared end **54** for accommodating coupler shank **56**, which is pivotally connected to vertical pin

58. Coupler shank 56 is supported by an upwardly biased spring coupler carrier 60. Pin 58 extends through the forward end of yoke 62 which is integral with cylinder 12 of the shock absorber. A pair of keys 63, 64 extending through yoke 62 are held by retainers 65 and 66, which slide on rods 67, 68 and form abutments for draft spring 70 for centering cushion 10 in its normal position, from which it is capable of draft and buff travel. Retainers and draft spring abutments 65, 66 are guided by channels 71, 72 welded to the center sill along and between slots 73 and 74 in which keys 63 and 64 slide.

Cylinder 12 has cruciform similar ends or flanges 75 and 76, as indicated in FIG. 9. Substantially rectangular bar guides 77–80 are positioned in the corners of the cruciforms of ends 75, 76 and extend beyond their range of travel both forwardly and rearwardly. Guides 77 and 78 are welded in the upper corners of center sill 52, and guides 79 and 80 are welded to cover plate assembly 82 so that they constitute supports for cushion 10 when cover plate assembly 82 is fastened to center sill flanges 83, 84. Rear stops 85, 86 and forward stops 87, 88 are adapted to be encountered by key retainers 65 and 66 to limit buff and draft strokes of the cushion, so as to prevent bottoming of piston 20 and resulting damage thereof.

The construction shown and described herein permits straight-forward assembly and disassembly and easy inspection of the cushion, as will be evident to those skilled in the art. During assembly, for example, the gas pressure in the cushion is removed, and the cushion is inserted through the bottom opening of the center sill, which is uncovered by removing plate 82. The cushion is then extended to about its normal size and keys 63 and 64 are inserted. Each retainer 65, 66 is put in place and each rod 67, 68 is passed through its respective spring 70 and the retainer and pinned in place. Coupler pin 58 is inserted through coupler shank 56 and yoke 62 and held in place by any suitable means, such as a welded plate at the bottom of the center sill. The cushion 10 may then be charged to its proper gas pressure through valve 36. Cover plate 82, with guides and supports 79, 80, is then fastened in place.

The operation of the cushioning arrangement will now be described. The pressure in chamber 32 tends to expand cushion 10, while springs 70 act to compress the cushion. The gas pressure in chamber 32 and the springs 70 are proportioned so that piston 22 will occupy an intermediate position, about as shown in FIG. 1, so as to permit, say, about 11 inches of buff stroke and 2½ inches of draft strokes normally. During a buff stroke cylinder 12 moves rearwardly toward fixed piston 20, and therefore, liquid is forced out of chamber 26 through openings 40 into metering tube 18 and into chambers 28 and 30 and expanding chamber 38, effecting hydraulic cushioning and simultaneously compressing the air in chamber 32 to afford the necessary return force for extending the cushion after the end of the buff impact. At the beginning of the buff stroke there are few openings 40 communicating with chamber 28, and the effect of this would be a tendency to cause cavitation in chamber 28. To prevent such cavitation without increasing the speed of return, spring pressed check valves 50 are provided to permit free flow from chamber 30 to chamber 28 and to prevent flow through these valves out of chamber 28. Similar check valves may be placed in some of the metering tube holes 40 to permit flow into the tube but prevent flow out out of the tube to reduce the return velocity of the cushion. Since the return of the cushion is considerably retarded by snubbing chamber 38, the metering means and valves 50 to a value, say, of about two inches per second, the cushion may possibly be subjected to a second impact before it has adequately returned. Valves 42 and 46, therefore, permit about one additional inch of buff stroke beyond the normal buff stroke, that is, beyond the last opening 40 in the metering tube 18. Pressure relief valve 46 near the end of the last inch of chamber 26 prevents overload, as in the event of an excessive impact or a second impact before adequate return of the cushion following a first buff impact, by permitting flow out of chamber 26. Valve 42 permits flow into chamber 26 to enable the piston to return after such additional travel beyond the last hole 40 in the metering tube.

Valves 44 and 48 at the other end of metering tube 18 act similarly to valves 42 and 46 to permit an additional draft travel of, say, one half inch to prevent overload due to an excessive impact or a quick second impact before the cushion has adequately returned from a first impact. Since valve 48, like valve 46, is a preset pressure relief valve, it permits flow from chamber 28 only when a severe draft impact condition occurs.

For simplicity the shock absorber structure has been shown at one end of the car only, since the structure connected to the coupler at the other end is exactly the same.

I claim:

1. A railroad car having a coupler and end-of-car cushioning means comprising a hydraulic shock absorber including an outer cylinder and an inner cylinder in said outer cylinder for telescoping relative movement, each cylinder having a chamber filled with a liquid, means for fixing one of said cylinders to the car, means for connecting the other cylinder to said coupler, said inner cylinder having a piston on its inner end in sealing engagement with the outer cylinder, a floating piston in the inner cylinder forming at the outer end of the inner cylinder a chamber adapted to be filled with a gas under high pressure to provide an air spring tending to hold the shock absorber in an extended condition, first metering means interconnecting the liquid filled chambers for providing a metered flow of liquid therebetween over a normal predetermined cushioning stroke of said shock absorber, wherein the improvement includes secondary metering means for enabling said cylinders to travel relative to each other a relatively small additional distance beyond said normal stroke when a severe impact on the coupler occurs, said secondary metering means communicating with said outer cylinder at a point thereof beyond said normal cushioning stroke for metering the flow of liquid over said additional travel distance, said first metering means including an axial perforated tube extending from the outer end of said outer cylinder through said piston into the inner cylinder, said secondary metering means including a preset pressure relief valve in said tube located adjacent the outer end of said outer cylinder for admitting liquid from said outer cylinder to said tube.

2. The combination defined in claim 1, wherein said relief valve is located between the last perforation in said tube and the outer end of the outer cylinder.

3. The combination defined in claim 2, including a pressure responsive check valve in said tube adjacent the outer end of said outer cylinder for admitting liquid from said tube to said outer cylinder.

4. The combination defined in claim 3, including a pressure responsive relief valve in the wall of said tube at its inner end for admitting liquid from the chamber of the inner cylinder to said tube when said piston is positioned beyond the last perforation at the inner end of said tube during a draft stroke of said shock absorber.

5. The combination defined in claim 4, including a pressure responsive check valve in the wall of said tube at the inner end of said tube for admitting liquid from said tube to said chamber of the inner cylinder.

6. The combination defined in claim 2, including a piston fixed to the inner end of said tube and in sliding sealing engagement with said inner cylinder, and a pressure responsive check valve in said last mentioned piston for passing liquid during compression of said shock absorber.

7. In a railroad car having a coupler, a center sill having a center filler and an end of car hydraulic shock

absorber mounted for buff and draft cushioning and located in one end of the center sill between the coupler and the center filler, said shock absorber including an outer cylinder, a piston in said cylinder, and rigid cylindrical means connected to said piston, said cylindrical means including an inner cylinder extending rearwardly from said piston for telescopic movement in said outer cylinder, each cylinder having a chamber filled with liquid, and metering means interconnecting the liquid filled chambers for providing a metered flow of liquid therebetween, and spring means for holding said shock absorber in an extended condition normally, the improvement comprising: said cylindrical means extending rearwardly from said piston and having means at its rear end for fixedly connecting said cylindrical means center filler against axial movement in either direction, said outer cylinder constituting the forward portion of said shock absorber and yoke means integral with said outer cylinder and extending forwardly therefrom and pivotally connecting said shock absorber to said coupler.

8. Apparatus according to claim 7, wherein said outer cylinder has a pair of cruciform flanges near its front and rear ends and a plurality of longitudinal bars extending through said cruciform flanges in close registry

therewith for guiding the longitudinal movement of said outer cylinder.

9. Apparatus according to claim 8, including a removable cover plate connected to the bottom of said center sill below said shock absorber, a pair of said longitudinal bars being fixed to said cover plate and another pair of said longitudinal bars being fixed to said center sill.

10. Apparatus according to claim 7, including a key extending laterally through the yoke means and the center sill, a pair of retainers on the ends of said key, spring means acting on said retainers in a direction to compress said shock absorber, means for mounting said retainers and said key for longitudinal movement, and forward and rear stops fixed to the center sill for engaging said retainers to limit their movement and thereby limit the buff and draft travel of the shock absorber.

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