Feb. 1, 1966 L. H. SMITH 3,232,443

CUSHION ARRANGEMENT FOR RAILWAY CAR

Filed July 24, 1964 3 Sheets-Sheet 1

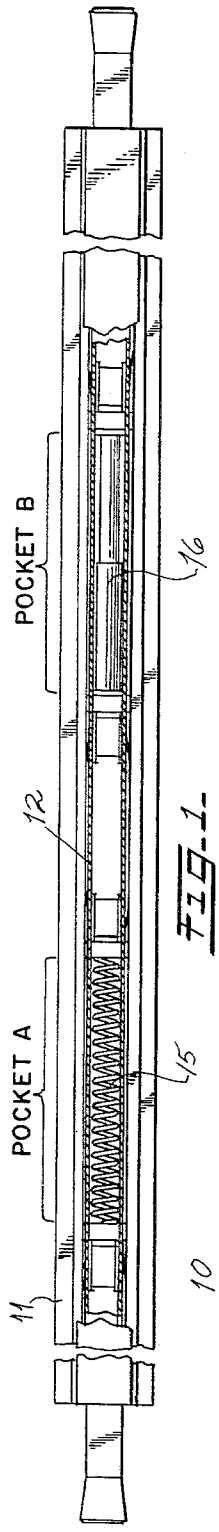


FIG. 1

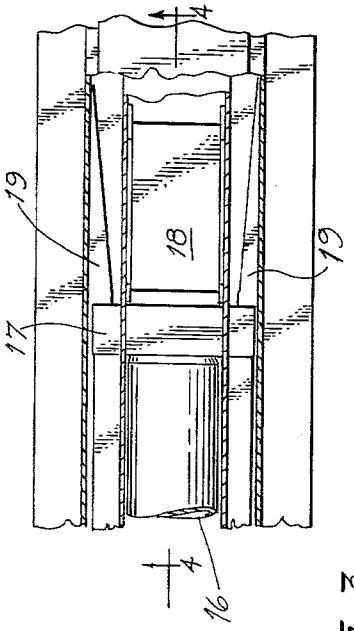
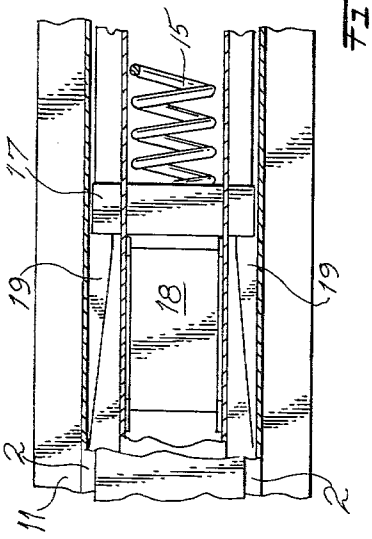


FIG. 3



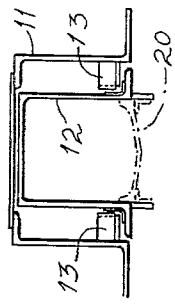


FIG. 2

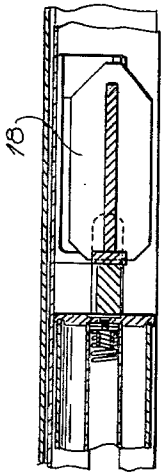


FIG. 4

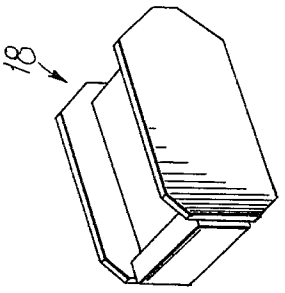


FIG. 5

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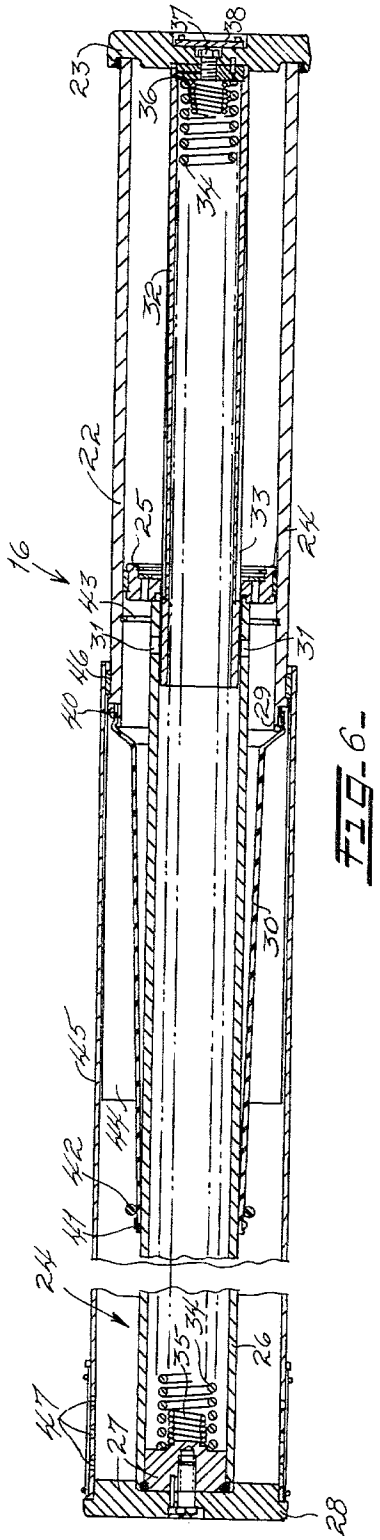


FIG. 6.

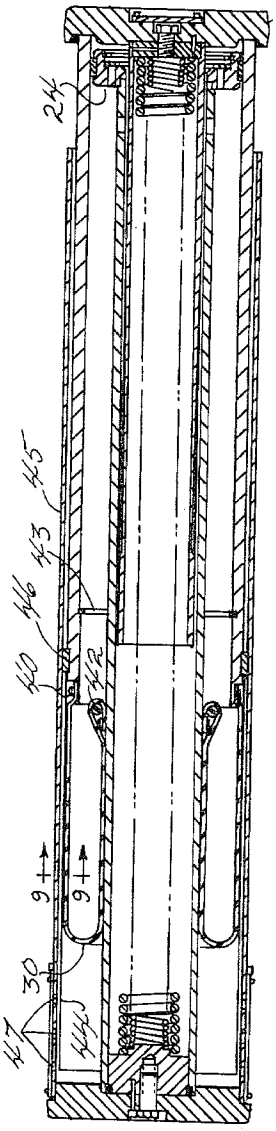


FIG. 7.

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CUSHION ARRANGEMENT FOR RAILWAY CAR

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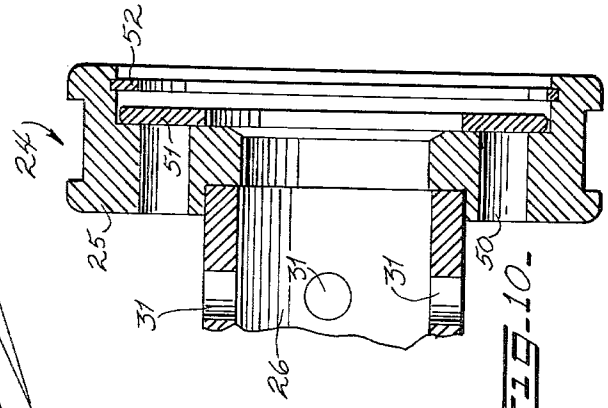


FIG-10-

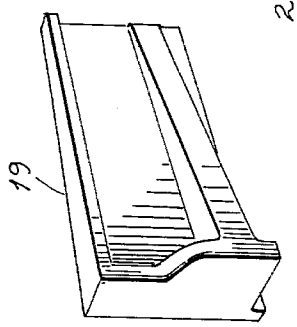


FIG-11-

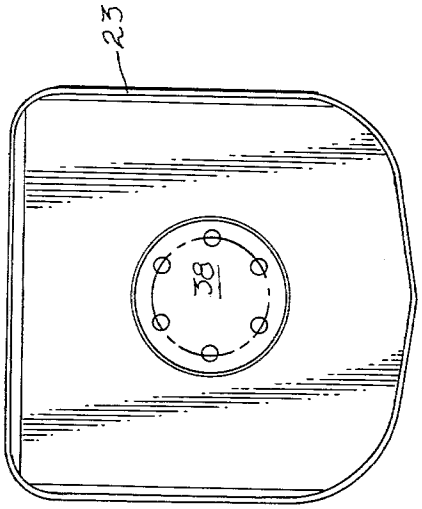


FIG-8-

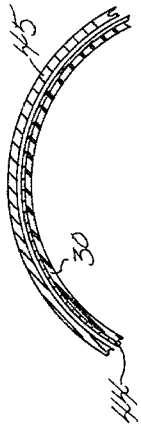


FIG-9-

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United States Patent Office

3,232,443

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3,232,443

CUSHION ARRANGEMENT FOR RAILWAY CAR

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Filed July 24, 1964, Ser. No. 385,017
9 Claims. (Cl. 213—8)

The present invention relates to an improved cushion arrangement for a cushion underframe car, or a cushion body car of the general type illustrated in Peterson Patent No. 3,003,436, granted October 10, 1961, and to a hydraulic cushion for use therewith.

Hydraulic cushions of this type are provided with extensible boots to avoid the necessity of providing sliding seals, the boot also accommodating the excess liquid represented by the displacement of the piston rod. The boot serves only as a protective seal and as a reservoir for the fluid.

Heretofore, hydraulic cushions have included a heavy return spring, the object of which is to cause return of the parts to their normal position. These return springs are so strong that they have resulted in cavitation of the hydraulic fluid and consequent ballooning of the boot with the result that the boot may become pinched by the mechanism of the cylinder or by the convolutions of the return spring which surround the cylinder. Pinching damages the boot and shortens its life, and in some situations, may perforate it.

Because ballooning involves an axial expansion of the boot, as well as a radial expansion, it is not possible to confine the boot within the cylinder overhang. Thus, the ballooning, in extreme situations, may result in rupture of the boot.

It is an object of my invention to provide an improved cushion arrangement which eliminates ballooning due to cavitation.

It is another object to provide an improved hydraulic cushion which avoids interference between the boot and the return spring.

According to my invention, I provide a construction in which the heavy return spring is located remotely from the hydraulic cushion, and in which the hydraulic cushion is provided with a comparatively weak return spring. The heavy return spring I refer to as the sill return spring, and the weak spring I refer to as the cushion return spring.

According to another aspect of my invention, I locate the cushion return spring within the hollow piston rod of the cushion mechanism to the end that there will be no interference with the boot.

Although the invention is applicable either to cushion body cars or to cushion underframe cars it is illustrated herewith in connection with the latter. In the cushion underframe type of car the center sill assembly comprises a hollow stationary sill forming a part of the underframe, and a sliding sill located within the same. The structure which transmits the impact to the cushion is referred to as the "pocket" and the pocket structure is such that relative movement of the sill parts in either direction results in a compression of the cushion.

According to my invention, I provide two pocket structures, one for the sill return spring, and one for the cushion. Thus, the sill assembly will be restored to its normal position by the sill return spring, whereas the cushion may be restored to its extended position by its self contained spring, and ordinarily the cushion restoration will take place more slowly than the sill restoration. As a result, the heavy force exerted by the sill return spring does not result in cavitation or ballooning because it is not transmitted through the cushion.

With reference now to the drawings in which like reference numerals designate like parts:

FIG. 1 is a plan view, partly broken away, of a center sill assembly embodying my invention;

FIG. 2 is an end view of the sill members;

FIG. 3 is an enlarged fragmentary plan section showing the pocket construction;

FIG. 4 is a sectional elevation taken along the line 4—4 of FIG. 3;

FIG. 5 is a perspective view of the sliding sill stop shown in FIG. 4;

FIG. 6 is a sectional view of the hydraulic cushion in its extended position;

FIG. 7 is a section similar to FIG. 6 but showing the same in its compressed position;

FIG. 8 is a right end view of FIG. 6;

FIG. 9 is a fragmentary section taken along line 9—9 of FIG. 7;

FIG. 10 is an enlarged detailed section showing the piston and the bypass valve; and

FIG. 11 is a perspective view showing the shape of the stationary sill stop.

The center sill assembly **10** of FIGS. 1 and 2 comprises a hollow stationary sill **11** and a hollow sliding sill **12**. The stationary sill **11** is a fabricated member in the shape of an inverted U, and the sliding sill **12** which is disposed within the same, is also an inverted U-shaped member. Suitable means, such as cross plates, not shown, are provided for retaining the sliding sill **12** within the stationary sill **11**. Guides **13** are provided for spacing the elements **11** and **12** from each other and to guide the sliding movement.

The sliding sill assembly includes certain pocket-forming structure providing pockets A and B. A sill return spring **15** is located in pocket A and a hydraulic cushion **16** is located in pocket B. The pocket-forming structure includes a horizontal member referred to as key **17** which is supported in suitable slots formed in the side walls of the sliding sill **12**. The key is supported for sliding movement in a direction lengthwise of the sill assembly. There is one key **17** at each end of each pocket. The position of the key **17** is determined by either one of the two stop means, the first being the sliding sill stop **18** shown in FIGS. 4 and 5, which is welded to the vertical walls of the sliding sill **12**. The other is the stationary sill stop means comprising two oppositely disposed forgings **19**, each forging being of a tapering buttress shape and being welded to a vertical wall of the stationary sill **11**. The stationary sill stop **19** is shown in FIGS. 3 and 11.

Any sill displacement in either direction will reduce the distance between the keys **17**. For instance if both stops **18** are displaced to the right of stops **19**, in FIGS. 1 and 3 for example, the position of left hand key **17** is determined by the displaced stop **18** which faces to the right, whereas the position of the right hand key **17** will be determined by the nondisplaced stop **19** which faces to the left. As a result the spring **15** in pocket A will be compressed, and the hydraulic cushion **16** in pocket B will also be compressed.

The spring **15** being very heavy, tends to restore the parts to the limiting, or normal position shown in FIGS. 1 and 3, in which each key of pocket A is pressed against both of the stop means **18** and **19**.

Suitable means, such as a bottom wall **20** shown in phantom in FIG. 2, is provided for retaining the sill return spring **15** and the hydraulic cushion **16** in their respective pockets.

The hydraulic cushion is shown in FIGS. 6 and 7, and comprises a cylinder **22** closed at one end by a cylinder head **23**. Slidably mounted within the cylinder **22** is a piston assembly **24**. The latter comprises a piston proper

25 which is mounted on a hollow piston rod 26. The remote end of the piston rod 26 is closed by a plug 27. A pressure pad 28 is suitably secured to the piston rod and plug.

The open end of the cylinder 22 is designated by the reference numeral 29. In order to avoid the use of a sliding seal between the piston rod 26 and an apertured cylinder head, a flexible rubber sleeve referred to as a boot 30 is secured at one end to the open end 29 and at the other end to a midportion of the piston rod 26. Thus the boot 30 cooperates with the interior of the cylinder 22 to provide an enclosure for the hydraulic fluid (not shown).

Ports 31 are provided in the hollow piston rod 26, as shown in FIGS. 6 and 10. In operation, as the hydraulic cushion is compressed, the movement of the piston 25 will cause the fluid ahead of the piston to pass through the ports 31 into the space behind the piston which space, as above indicated, is closed by the boot 30. The axial contraction and folding of the boot 30 is accompanied by a radial expansion with the result that the displaced fluid, represented by the volume of the piston rod, is accommodated within the radially expanded boot, as shown in FIG. 7.

In order to regulate the cushioning action of the device a metering pin 32 is provided which is suitably mounted at the front end on the cylinder head 23. The metering pin is provided with grooves 33 which serve as orifices where the pin passes through the cylinder head 25 to regulate the flow of fluid, and preferably the grooves 33 are of a tapered configuration to provide a constant force-travel characteristic as described in Peterson Patent No. 3,035,714, granted May 22, 1962.

Spring means are provided to return the cushion 16 to its extended position. A feature of the present invention is that the metering pin 32 is hollow so that the cushion return spring 34 may be disposed concentrically within the hollow piston rod 26 and the hollow metering pin 32. Thus, any problem of interference between the boot 30 and the convolutions of the return spring is eliminated. In the arrangement shown, a second cushion return spring 35 may also be provided, located concentrically within the spring 34.

The left ends of the springs 34 and 35 bear against the plug 27 of the hollow piston rods 26, and the right ends bear against a plate 36 which is welded in the end of hollow metering pin 32. The metering pin 32 is secured to cylinder head 23 by a screw 37 which extends through the cylinder head 23 and the plate 36. This screw 37 also serves as a filling screw because when removed it permits the filling of the cushion device with suitable hydraulic fluid. A removable cover plate 38 overlies the head of the filling screw 37 (FIG. 8).

The right end of the boot 30 is secured to the open end 29 of the cylinder 22 by means of a clamp ring 40, and a similar clamp ring 41 secures the smaller end of the boot to an intermediate point of the piston rod 26. A guard ring 42 of circular cross section, and preferably formed of rubber, surrounds the left end of the boot 30 just to the right of the clamp ring 41. This limits the flexing radius of the boot at this location, and hence reduces fatigue and is conducive to longer boot life.

A snap ring 43 forms a stop, limiting outward movement of the piston assembly as shown in FIGS. 6 and 7.

The radial expansion of the boot 30 is confined by a cylinder overhang, in the form of a separate tubular member 44 secured to the open end 29. If desired, the piston assembly 24 and the boot 30 may be enclosed by a telescopic shield 45 which surrounds the member 44 and is secured at its left end to the pressure pad 28. Preferably, an annular seal 46 of Teflon or the like is located at the open end 29 of the cylinder to facilitate the sliding movement of the outer shield 45. Suitable perforations 47 in the outer shield equalize the air pressure during compression and return of the cushion.

In order to permit more rapid return of the cushion, a return stroke check valve is provided, as shown in FIG. 10. The piston 25 is provided with a plurality of ports 50 which are overlain at the front end by a valve ring 51. A suitable snap ring 52 provides a stop for the valve ring. Thus considerable port area is available to accelerate the return movement of the piston 25 to the left, but during compression, the ports 50 are closed by the valve ring 51.

The cushion return springs 34 and 35 have a much lower rate than the sill return spring 15. In a practical example, when in extended position the springs 34 and 35 exert a total compressive force of 800 pounds, and when contracted, exert a total compressive force of 2400 pounds, and the total spring rate is approximately 55 pounds per inch. The sill return spring on the other hand, when in extended position, exerts a compressive force of approximately 8000 pounds and when in compressed position exerts a force of approximately 16,000 pounds, representing a spring rate of approximately 267 pounds per inch, over 30 inches of travel. The ratio of spring rates, in this example being five to one, gives a comparison of the forces involved which is valid, even though approximate.

If the grooves were infinitely small and the check valve 50–51 were eliminated, the cushion return springs 34–35 would have to be sufficiently weak so that the force exerted thereby would be less than a certain critical cavitation force, namely, the product of the piston area times the vapor pressure of the hydraulic fluid, expressed in pounds (per square inch) of vacuum. However, the provision of the check valve 50–51 enables one to exceed this theoretical limit by a factor of three or more without encountering cavitation, due to the dynamic condition. In the example shown, the port area 50 is about 1/13 of the piston area, and the piston diameter is about 9½ inches.

By virtue of the guard ring 42, and the elimination of ballooning due to cavitation, it is possible to use a thin wall boot construction which provides a longer boot life. In the example shown, the boot 30 is a molded rubber product having a wall thickness of 3/16 inch, and the circular cross section of the guard ring 42 is ¾ inch in diameter.

Although only a preferred embodiment of my invention is shown herein, it will be understood that various modifications and changes in the method and construction shown may be made without departing from the spirit of my invention as pointed out in the appended claims.

I claim:

1. A cushion arrangement for a railway car comprising a center sill assembly which includes a hollow stationary sill, a hollow sliding sill disposed within same, and first and second pocket forming structures longitudinally spaced from each other, a sill return spring disposed in said first pocket forming structure for maintaining said stationary and sliding sills in a normal relationship, and being compressed by said pocket forming structure upon relative movement of said sills, and a hydraulic cushion located in said second pocket forming structure and having a hollow piston rod and a cylinder head, a hollow metering pin having one end secured to said cylinder head and the other end disposed within said hollow piston rod, and cushion return spring means disposed within said piston rod and said metering pin, the rate of said cushion return spring means being substantially less than the rate of said sill return spring.

2. A hydraulic cushion for railroad car use comprising a cylinder having a cylinder head and an open end, a piston slidably mounted within said cylinder, a hollow piston rod for said piston and being closed at its remote end, a hollow metering pin mounted at one end on said cylinder head and extending through said piston and into said hollow piston rod, the space between the surface of

said metering pin and said piston defining an orifice for controlling the rate of movement of said piston in the direction toward said cylinder head, a flexible boot secured at one end to the open end of said cylinder and at the other end to an intermediate portion of said piston rod to provide an expansion chamber, port means formed in said piston rod communicating with said expansion chamber, and a cushion return spring located within said hollow metering pin and said hollow piston rod and confined between said cylinder head and the closed end of said hollow piston rod.

3. A hydraulic cushion for railroad car use comprising a cylinder having a cylinder head closing one end and the other end being open, a piston assembly slidably mounted within said cylinder and including a piston, a hollow piston rod, and a pressure pad mounted on the remote end of said piston rod, a hollow metering pin mounted at one end on said cylinder head and extending through said piston and into said hollow piston rod, grooves formed in the surface of said metering pin and said piston defining an orifice for controlling the rate of movement of said piston in the direction toward said cylinder head, a flexible boot secured at one end to the open end of said cylinder and at the other end to an intermediate portion of said piston rod, port means formed in said piston rod between said intermediate portion and said piston, and cushion return spring means located within said hollow metering pin and said hollow piston rod and confined between said pressure pad and said cylinder head.

4. A hydraulic cushion as claimed in claim 3 which includes a check valve by-passing said orifice and effective to permit fluid flow only during the return stroke of said piston assembly.

5. A hydraulic cushion as claimed in claim 3 which includes a series of ports extending through said piston, a valve ring overlying said ports on the cylinder head side of said piston, and means confining said valve ring for axial movement into and out of port closing position to permit fluid flow through said piston ports during the return stroke of said piston assembly.

6. A hydraulic cushion as claimed in claim 5 in which the port area of said piston ports is substantially one-thirteenth of the piston area, and in which the force exerted by cushion return spring means is substantially three times the critical cavitation force.

7. A hydraulic cushion as claimed in claim 3 which includes telescopic shield means extending between said open cylinder end and said pressure pad and surrounding said flexible boot.

8. A hydraulic cushion as claimed in claim 3 which includes a guard ring of circular cross section surrounding said piston rod at said intermediate portion and overlying said boot to limit the flexing radius of said boot.

9. A cushion arrangement for a railway car comprising a center sill assembly having a hollow stationary sill, a hollow sliding sill disposed within same, and first and second pocket forming structures providing two longitudinally spaced pockets in said sliding sill, a sill return spring disposed in said first pocket for maintaining said stationary and sliding sills in a normal relationship, and being compressed by said first pocket structure upon relative movement of said sills, and a hydraulic cushion located in said second pocket, said hydraulic cushion comprising a cylinder, a cylinder head closing one end, a piston assembly slidably mounted within said cylinder and dividing same into two chambers, said piston assembly including a piston, a hollow piston rod, and a pressure pad mounted on and closing the remote end of said piston rod, a hollow pin mounted at one end on said cylinder head and extending through said piston and into said hollow piston rod, a flexible boot extending between said cylinder and said piston rod, means providing communication between said two chambers, and a cushion return spring located within said hollow pin and said hollow piston rod and confined between said pressure pad and said cylinder head, the rate of said cushion return spring being substantially less than the rate of said sill return spring.

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