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Wiebe

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[45] **Sept. 24, 1974**

[54] **HYDRAULIC TRUCK SNUBBER**

[76] Inventor: **Donald Wiebe**, R.D. No. 3, Sewickley, Pa. 15143

[22] Filed: **Apr. 15, 1971**

[21] Appl. No.: **134,126**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 857,274, Aug. 22, 1969, Pat. No. 3,595,350, which is a continuation-in-part of Ser. No. 709,142, Feb. 28, 1968, abandoned.

[52] **U.S. Cl.** ..... **105/197 DH**, 188/321, 267/4, 267/8 R, 267/127

[51] **Int. Cl.** **B61f 5/12**, F16f 9/06, F16f 9/32

[58] **Field of Search** ..... 105/197 R, 197 D, 197 DB, 105/199 CB, 199 R, 197 DH; 188/321; 267/4, 8 R, 127

[56] **References Cited**

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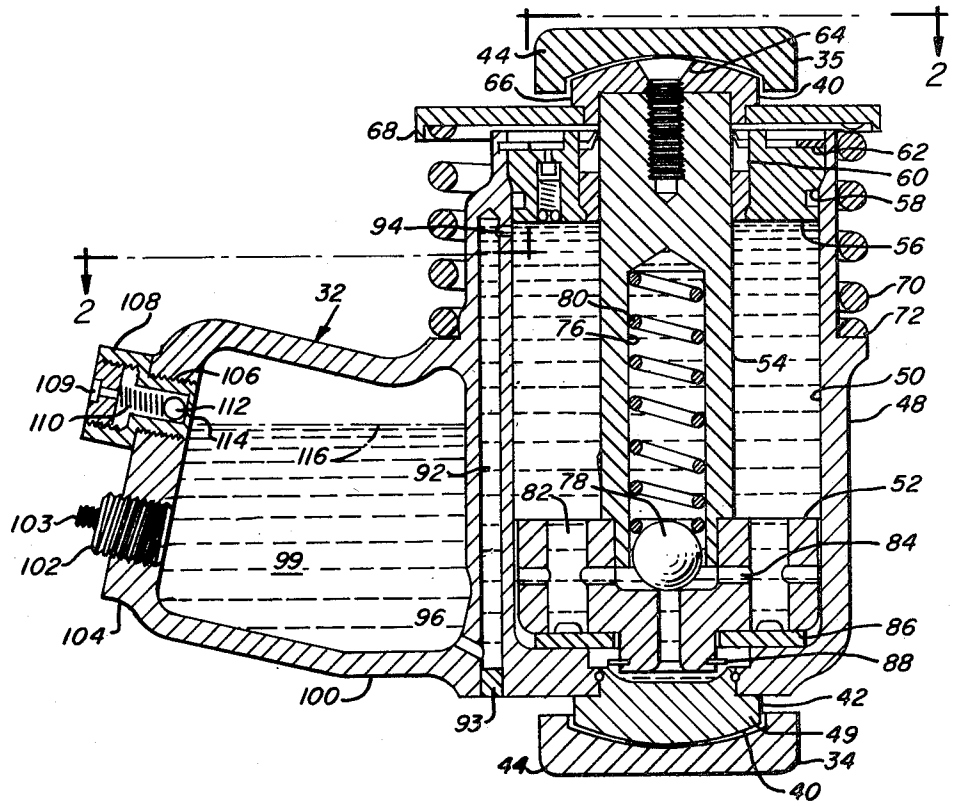
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Attorney, Agent, or Firm—Howard E. Sandler

[57] **ABSTRACT**

A hydraulic snubber device for railroad car trucks to be interposed between a bolster end and side frame member. This device being of minimum height for a given useful stroke because ullage volume is provided in a reservoir outside the snubber cylinder.

10 Claims, 9 Drawing Figures



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SHEET 1 OF 3

FIG. 1

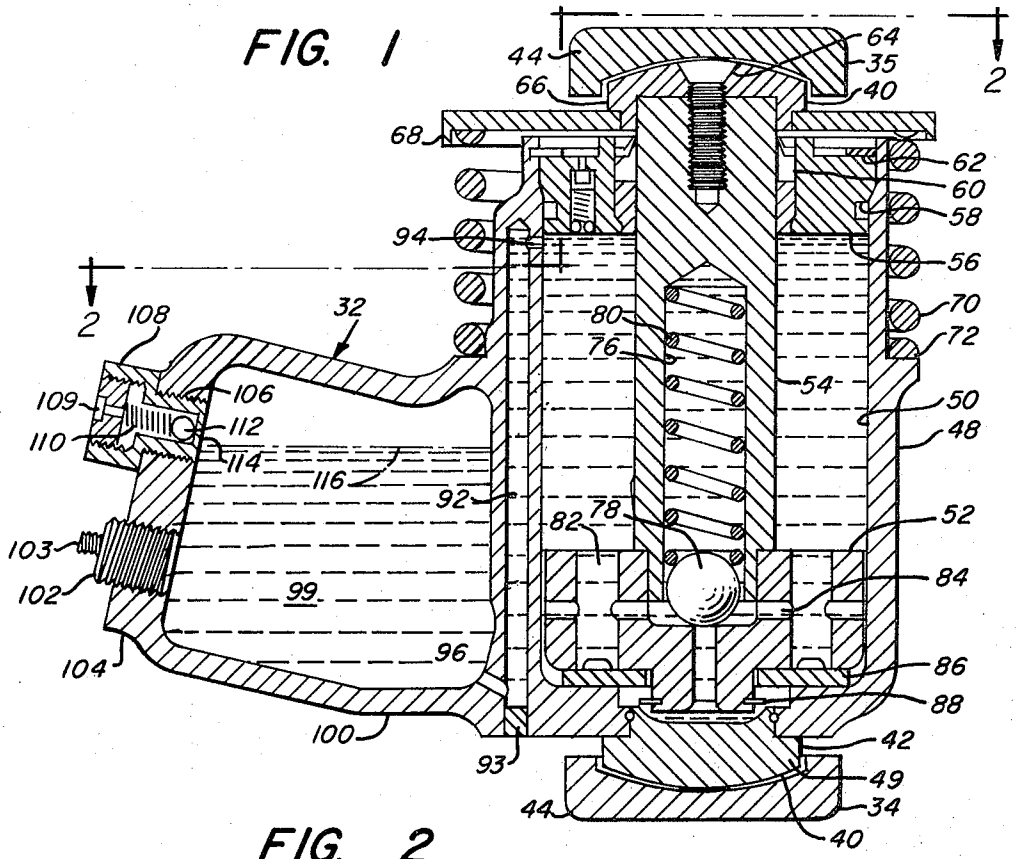
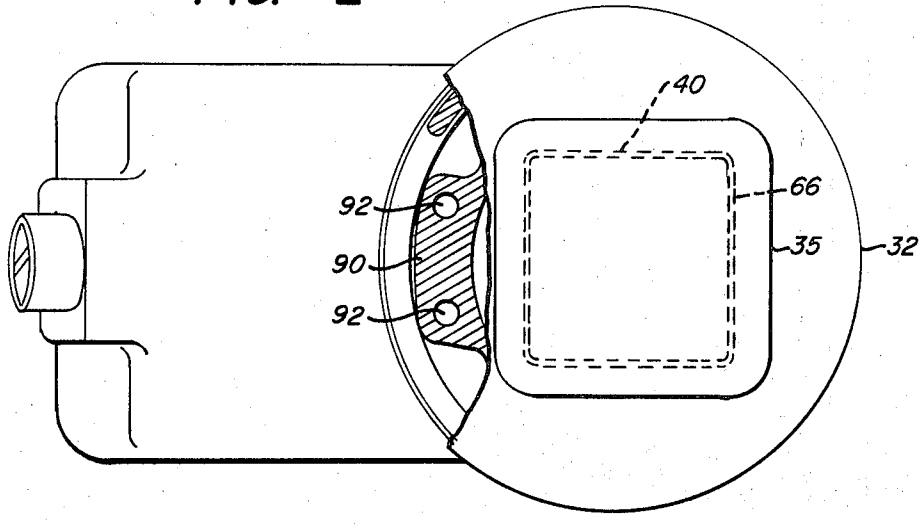


FIG. 2



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FIG. 9

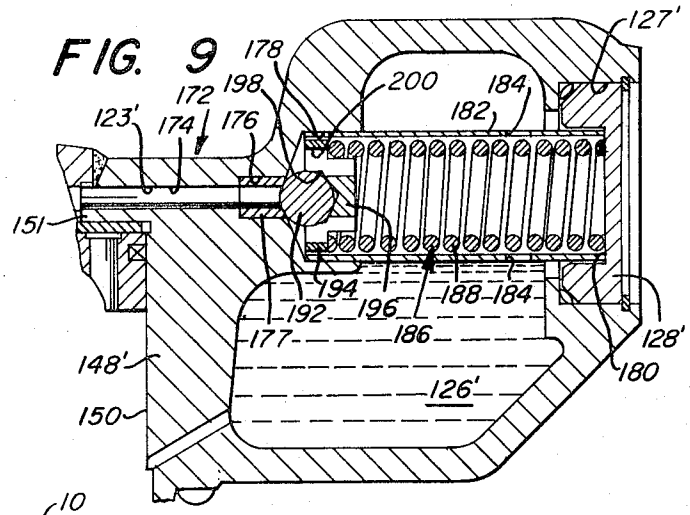


FIG. 3

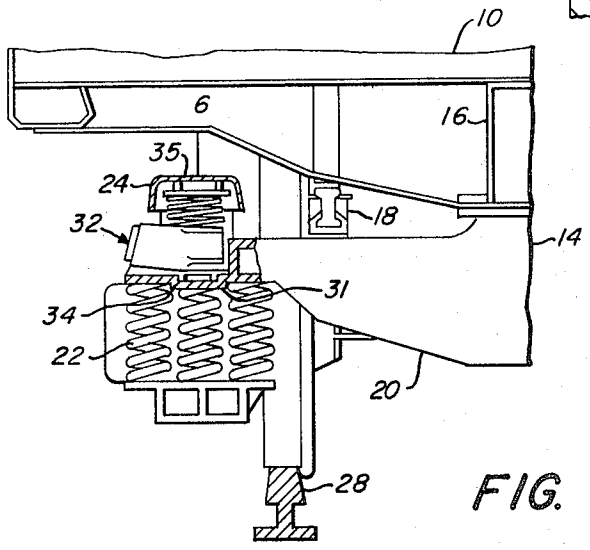
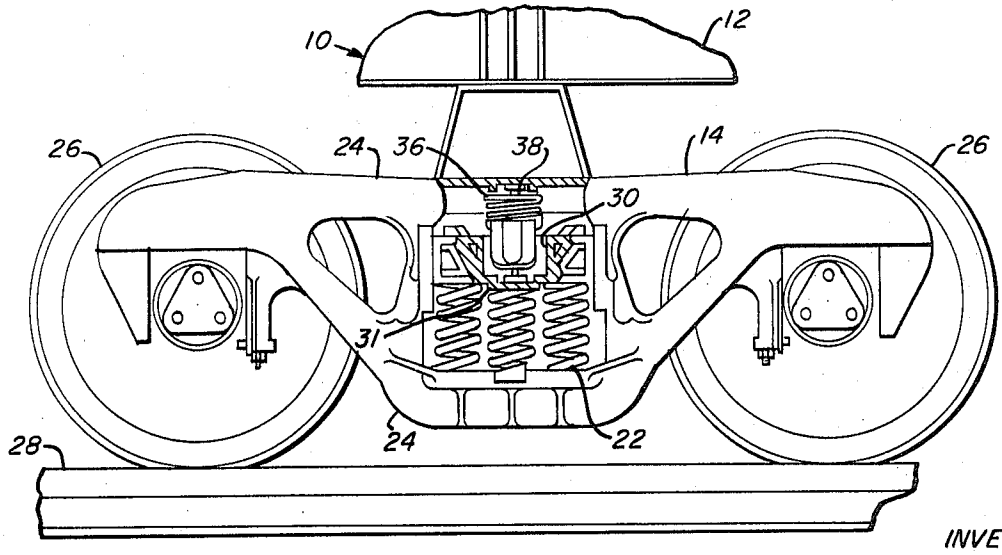


FIG. 4



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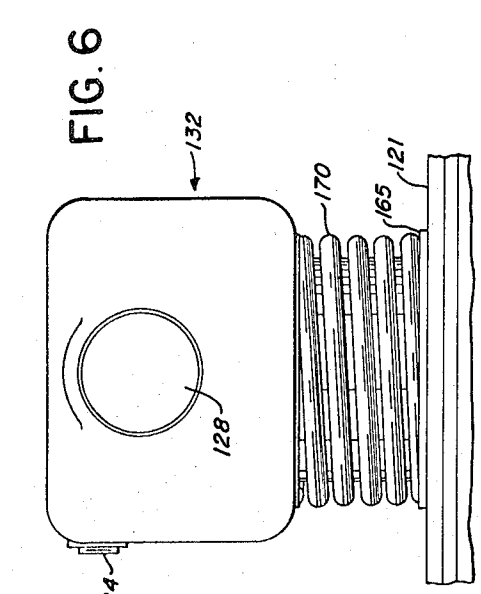


FIG. 6

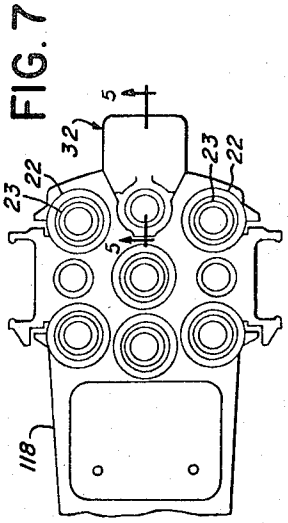


FIG. 7

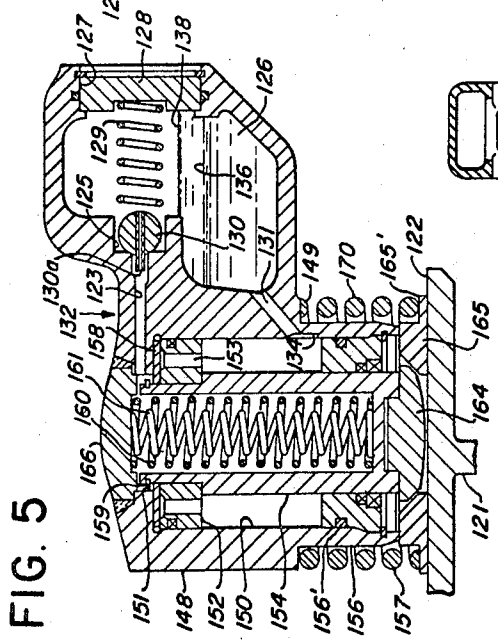


FIG. 5

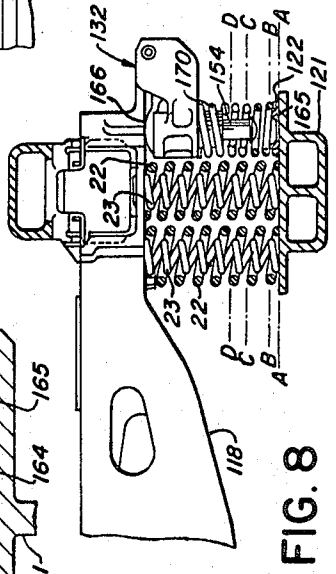


FIG. 8

HYDRAULIC TRUCK SNUBBER

This application is a continuation-in-part of U.S. Pat. application Ser. No. 857,274, filed Aug. 22, 1969, now U.S. Pat. No. 3,595,350 which in turn is a continuation-in-part of U.S. Pat. application Ser. No. 709,142 filed Feb. 28, 1968, now abandoned.

The structure of this invention provides an external reservoir for hydraulic fluid which cooperates with the snubber cylinder space to virtually eliminate the dead space or ullage volume normally necessary, at the top, within a closed hydraulic cylinder to provide for the volume of hydraulic liquid displaced by the piston rod when the piston is forced to the bottom of the cylinder. In the structure of this invention the external reservoir provides the ullage volume necessary for the operation of the piston within the cylinder so that the cylinder can be designed to operate effectively over its full stroke, with practically zero ullage volume within the cylinder.

It is therefore an object of this invention to provide a new and improved side frame snubber designed to operate at full efficiency as an energy absorbing structure throughout the full stroke of the piston within the cylinder.

These and other objects and advantages of the snubber of this invention will become more readily apparent upon consideration of the following description and drawings in which:

FIG. 1 is a median sectional view of a snubber constructed according to the principles of this invention;

FIG. 2 is a partially sectional view of the snubber of FIG. 1 taken substantially on line 2—2 of FIG. 1;

FIG. 3 is a fragmentary partially sectional and elevational view of a freight car body and truck incorporating the snubber of this invention;

FIG. 4 is a side elevational, partially sectional view of the structures shown in FIG. 3;

FIG. 5 is a sectional view of another snubber constructed according to the principles of this invention; taken substantially on line 5—5 of FIG. 6;

FIG. 6 is an end elevational view of the snubber of FIG. 5;

FIG. 7 is a top plan schematic view of a spring group incorporating the snubber of FIG. 5;

FIG. 8 is a fragmentary partially sectional schematic view of the spring group of FIG. 7;

FIG. 9 is a partial sectional view of still another snubber constructed according to the principles of this invention and similar to the embodiment shown in FIG. 5.

Referring now to the drawings, FIG. 4 shows a fragmentary portion of a railway car 10 comprising a freight car body 12 supported by a four-wheel truck (only one half being shown) by way of a center plate 16 and side bearings 18 (see FIG. 3) cooperating with a bolster 20, mounted upon two sets of compression type springs 22, mounted in a pair of side frames 24 each supported by a pair of suitably journaled wheels 26 resting upon a pair of tracks 28 all as well known to those familiar with the field of railway car design.

The bolster 20 is of conventional design except that an opening 30 has been formed in each end portion of the bolster 20 to provide space for mounting a snubber 32 constructed according to the principles of this invention. The bottom surface of the open space 30 has a downwardly recessed portion 31 positioned centrally

of the opening 30 to accept and maintain the positioning of a substantially square cup shaped lower mounting element 34 hereinafter more fully described (see FIG. 1).

Side frame 24 is likewise of conventional construction except that at a central portion of the underside of its top member there is formed a downwardly depending ring element 36 having a blind central opening of substantially square outline therein to accept, and maintain the positioning of a generally inverted cup shaped upper mounting element 35 (hereinafter more fully described, see FIG. 1) with the snubber 32 extending between the lower mounting element 34 and the upper mounting element 35 cooperating to form a pair of bearing surfaces for the reaction imposed upon the snubber 32 by the bolster 20 and the side frame 24 as hereinafter more fully set forth.

As shown in FIGS. 3 and 4 the mounting elements 34 and 35, respectively, are of generally rectangular or square outline with a concave internal depression 40 of partial cylindrical form in each mounting element 34, 35. The cylinder axis of each depression 40 is contained in a plane normal to the outer surface of the respective mounting element 34, 35 and also normal to opposite sides of the square outline of the respective mounting element.

Seated in and cooperating with the depression 40 of the bottom mounting element 34 is a snubber bottom member 42 of generally rectangular or square outline having a convex partially cylindrical bottom surface 44 and having its cylinder axis in the same plane as that described for the concave surface of the depression 40.

The snubber 32 comprises a generally hollow cylindrical body member 48 having a central opening 49 in the bottom thereof, closely receiving and retaining in fluid tight relationship an upwardly extending cylindrical portion of the snubber bottom member 42 to form a closed bottom for the internal cylindrical surface 50 of the body member 48 wherein a suitable piston 52 is axially reciprocable. The piston 52 is rigidly secured to and movable by an upwardly extending cylindrical piston rod member 54 which extends upwardly throughout the axial length of the body member 48, through and beyond an annular cylinder closure member 56 mated to and closely received by the cylindrical surface 50 and maintained in fluid tight relationship with the cylinder 50 and the exterior of the piston rod 54 by suitable sealing members such as O rings 58 and U-type seals 60, respectively, or other suitable sealing elements. A lock ring 62, or other suitable retaining means, secures the cylinder closure member 56 within the cylindrical surface 50 while the piston rod 54 is maintained in slidable relationship with the central bore in the cylinder closure member 56 as is well known in the hydraulic cylinder art. Mounted on the upper end of the piston rod 54 and rigidly secured thereto as by one or more threaded retaining elements such as a cap screw 64 is an inverted cup-shaped snubber top member 66 having a convex partial cylindrical reaction surface 44 thereon of the same character and radius as the reaction surface 44 of the snubber bottom member 42 herein before described.

Abuttingly engaged with a lower surface of the exterior of the snubber top member 66 is a spring retaining cap member 68 rigidly secured by the snubber top member 66 to travel with the piston rod 54 in axial reciprocation. A cylindrical compression type spring 70

is engaged between the underside of the cap member **68** and an external shoulder **72** formed on the outer surface of the cylindrical body member **48** and is sufficiently compressed so that in the absence of other forces the spring **70** will extend the piston rod **54** from the body member **48** until the piston **52** contacts the bottom of the cylinder closure member **56** in a manner common to single acting hydraulic cylinders.

The piston **52** and the piston rod **54** are similar to that described and shown in the above-cited copending application in that the piston **52** is provided with a central bore **74** which communicates with a blind central bore **76** in the piston rod **54** when the pressure on the bottom of the piston **52** is great enough to raise a ball valve **78** biased against the upper end of the central bore **74** by a spring **80** captively mounted in a compressed condition within the blind bore **76.** The piston **52** is also provided with a plurality of bores **82** extending therethrough from its bottom to its top surface and communicating with the central bore **74** by respective horizontal passages **84.** In the position shown in FIG. **1** the bores **82** are closed by a flat ring valve **86** covering the bottom ends of the bores **82** whenever pressure below the piston is substantially greater than pressure above the piston due to downward motion of the piston **52** within the cylinder **50.** The valve **86** is free to move downwardly with respect to the bottom of the piston **52** a limited distance and prevented from moving farther in the axial direction with respect to the piston **52** by a suitable snap ring **88** mounted on a downwardly extending cylindrical portion of the piston **52** as described in the above cited copending application.

The body member **48** has a thick wall portion **90** (see FIG. **2**) extending from the bottom of the body member **48** up to an area slightly above the bottom surface of the cylinder closure member **56** (as best seen in FIG. **1**). Within the wall portion **90** is formed a pair of passageways such as elongated bores **92** having axes parallel to the axis of the cylinder **50** and extending within the wall portion **90** from the bottom of the body member **48** nearly to the top of the thick portion **90** at least as far up as the bottom surface of the cylinder closure member **56.** At a point just below the bottom surface of the cylinder closure member **56** horizontal passageways **94** communicate between the interior of the cylinder **50** and the passageways **92,** respectively. Similar substantially horizontal passageways **96** communicate between lower end portions of the bores **92** and the interior space **99** of a generally rectangular, substantially horizontally extending reservoir or hollow tank element **100** formed as a lateral extension of the body member **48** secured to or formed integral with the lower half of the body member **48.** The bottom ends of the bores **92** are sealed by plugs **93** so that the interior space **99** communicates with the cylinder **50** through the passageways **96, 92** and **94** with the result that hydraulic liquid within the cylinder **50** can be displaced outwardly into the interior space **99** of the tank element **100** or caused to flow in the opposite direction as hereinafter more fully described.

The tank element **100** is provided with a threaded hollow plug **102** suitably threadedly engaged in a filler opening in the lower portion of an outer end member **104** of the tank element **100** and having a suitable check valved connection **103** thereon to provide for filling the interior of the tank element **100** with liquid by the application of a suitable pressurized fluid conducting element (not shown) to the valve fitting **103** in a well known manner. A second threaded bore **106** communicates with an upper portion of the interior of the tank element **100** and has threadedly engaged therein an adjustable valve **108** provided with an internally threaded stepped bore **114** in which is engaged an adjusting element **109** captively securing a spring **110** biasing a ball valve **112** into engagement with a smaller portion of the bore **114** which communicates between the upper portion of the inner chamber of the tank element **100** and the ambient atmosphere. The adjusting element **109** is suitably adjusted so that the ball valve **112** will remain seated and prevent communication between the interior of the tank element **100** and the ambient atmosphere until the pressure within the interior space **99** of tank element **100** exceeds that of the ambient atmosphere by at least a pre-selected amount, preferably approximately 2–5 atmospheres in the present embodiment.

OPERATION

With the above described snubber **32** fully assembled and in the upright position as shown in FIG. **1** but with the piston rod **54** fully extended and the piston **52** abutting the bottom surface of the cylinder head **56** a suitable liquid having the requisite physical and chemical characteristics for use as a pressure transfer medium within an hydraulic cylinder is pumped into the space **99** through the connection **103** until compression of the air within the space **99,** the bores **92** and the cylinder **50** produces a pressure of approximately 5 atmospheres. Under such pressure the air within the communicating spaces **99, 92** and **50** will be compressed to approximately one fifth its original volume with approximately four fifths of the tank space **99** and the cylinder **50** being filled with liquid so that the liquid in the tank reaches a level approximately that indicated by a horizontal line **116** across the space **99** (see FIG. **1**). The stepped bore **114** is suitably located so that its inner end portion communicating with the space **99** determines the level **116** so that liquid flows out of the bore **114** when the tank is being filled and whenever the pressure within the space **99** overcomes the spring **110** at the pressure for which the valve **108** has been set. The level **116** must be far enough above the level of bores **96** so that the bores **96** are always submerged under operating conditions.

When the piston rod **54** is pushed downwardly into the cylinder **50** the piston **52** travels downwardly with the valve **86** open as long as the downward motion of the piston **52** is slow enough to avoid substantial pressure differential between the upper and lower sides of the piston **52** so that the liquid below the piston can flow upwardly through the bores **82** into the space within the cylinder **50** above the piston **52.** During the inward motion of the piston rod **54** liquid and air must be displaced from the cylinder **50** because of the volume occupied by the increased portion of the piston rod **54** within the cylinder **50** (displacement volume). With a newly filled snubber **32** approximately one fifth of the space within the cylinder **50** will be occupied by air which, because of gravitational effect, will be accumulated at the top of the cylinder **50** so that displacement of the piston rod volume will increase the air pressure within the cylinder and force air in the top of the cylinder **50** to travel outwardly through the passageways **94,** downwardly through the bores **92,** horizon-

tally outwardly through the passages **96** into the space **99** where the air will rise in the form of bubbles through the liquid in the space **99** to become part of the trapped air volume above the level **116** within the space **99.**

When the piston rod **54** again moves upwardly within the cylinder **50,** removal of a portion of the volume of the rod **54** from the interior of cylinder **50** provides space for more oil within the cylinder **50** and this amount of liquid will be supplied by liquid from the space **99** flowing through the passages **96,** upwardly through the bores **92,** and horizontally inwardly through the passages **94,** into the cylinder **50.** Successive up and down motions of the piston rod **54** will thus cause an exchange of air in the cylinder **50** and oil in the space **99** until the cylinder **50** is completely filled with oil.

It is to be noted that the combined cross sectional area of the bores **92** or equivalent passageway means must be large enough to allow free flow of liquid therethrough (no orifice effect). Furthermore the total volume of such passageway or bores **92** must be small enough so that normal rod movement into cylinder **50** to within an inch of fully closed will displace more than enough liquid to completely fill the bores **92.** Or vice versa this amount of liquid must flow into the cylinder during rod extension to originally displace the air and thereafter to keep the cylinder full of liquid at all times.

It is to be appreciated that without the tank element **100** and the communicating passageways as hereinabove described it has always been necessary in prior art snubbers to provide at least some liquid free space or ullage volume at the top of the cylinder so that displacement of liquid by the piston rod entering the cylinder would not cause unwanted overpressuring of the cylinder **50** with resultant damage to the sealing elements and unacceptable loss of the hydraulic fluid.

Because of the transfer of ullage volume in the present invention from the top of the cylinder **50** to the top of the space **99** the snubber **32** of this invention is usable throughout the total length of piston stroke since the piston is always completely covered by and filled with the hydraulic liquid and no space need be left empty at the top of the cylinder as was necessary in prior art snubbers.

The minimum volume unfilled by liquid within the space **99** above the level **116** (hereinafter the ullage volume) should not be less than approximately 150 percent of the volume of that portion of the piston rod which moves into and out of the cylinder **50** below the cylinder head **56** (hereinafter the displacement volume), to avoid overpressuring the snubber at full stroke, and to avoid preventing the flow of the air which has been pressurized in the top of the cylinder **50** through the passageways **94** and **96** and the bores **92.** This ullage volume in the reservoir is preferably three to four times the volume of the bores **92** and the communicating passageways **94** and **96** with the passageways of a diameter to allow free flow of liquid with very little pressure drop. This ratio of volumes has been found to be great enough to give free volume above the level **116** sufficient to permit displacement of the column of liquid in the bores **92** to provide for purging of air from the bores **92** into the space **99.** Thus the volume of the bores **92** must always be less than one half the total piston rod displacement volume so that flow of air from the bores **92** into the space **99** will not be prevented by compressibility of the air.

Operation of the snubber **32** of this invention is similar to that described for the snubber of my copending U.S. Pat. application Ser. No. 801,884, now U.S. Pat. No. 3,626,864 except for the flow of liquid into and out of the cylinder **50** and the space **99** as hereinabove described. Such operation of course includes the "dead band operation" and the free flow of oil through the piston **52** during slow downward movement of the piston **52** within the cylinder **50** as well as the high pressure energy absorbing flow of oil through the passageway **74** in the piston **52** past the ball valve **78** after compression of spring **80,** during rapid downward movement of the piston **52** which closes the valve **86,** all as described with relation to the side frame snubber of the above cited application.

Referring again to the drawings, FIGS. **5** through **8** show another embodiment of a reservoir type snubber **132** constructed according to the principles of this invention and quite similar to the reservoir type snubber **32** of FIGS. **1** and **2** excepting the snubber **132** of this embodiment is a spring group snubber, i.e., the snubber **132** is designed to replace one of the springs **22** of the standard spring group interposed between a standard bolster **118** and a standard side frame **120** in the truck of a railway freight car such as that indicated at **10** in FIG. **3.**

The application of the snubber **132** is very similar to that described and illustrated in my copending U.S. Pat. application Ser. No. 801,884 filed Oct. 23, 1968 which also illustrates a spring group snubber. It is of course obvious that the spring group snubber type has the advantage of being applicable to a standard side frame and standard bolster with a minimum of reconstruction thus saving the expenses of designing and building special bolsters and side frames with the attendant expenses of special parts to be stocked and accounted for.

As best seen in FIG. **5** the snubber **132** comprises a body member **148** which provides a hollow cylindrical surface **150** in which a piston **152** is reciprocated by action of a piston rod member **154** which extends downwardly from the piston **152** through a closure member **156** rigidly secured in the lower open end of the cylinder **150** as by snap ring **157** and maintained in fluid tight relationship with the cylinder **150** by resilient members such as O-rings **156'** or the like.

The top end of the cylinder **150** is permanently closed by a top member **166** secured in a stepped portion of the cylinder **150** as by welding. The top member **166** is shown as having an upwardly convex surface contacting the underside of the bolster end in place of the conventional spring as best seen in FIG. **8.** It is to be seen that the snubber **132** replaces any one of the three outside springs **22** of the truck spring group along with one of the inner spring **23** shown in FIG. **8** to be coaxial with and cooperating with the outer springs **22** in a manner well known in railroad circles.

The bottom end of the piston rod **154** is provided with a solid bottom member **164** having a downwardly convex surface and a bottom edge chamfer adapted to be received in a mounting ring **165** secured or trapped in place between a spring **170** and the uppersurface **122** of the side frame bottom member **121.** The body support spring **170** surrounds a reduced diameter outside surface portion of the body member **148** and is in-

terposed between an annular shoulder **149** of the body member **148** and the shouldered top surface **165'** of the mounting ring **165.** As best seen in FIG. **8** the body spring **170** in this position supports the body member **148** in all relative positions of the bolster and side frame and holds the mounting ring **165** in place.

The internal workings of the snubber **132** are quite similar to those of the snubber **32** of the first embodiment with the difference that the snubber **132** is in many respects a top to bottom reversal of the snubber **32.** The piston **152** is provided with a ring of vertical through bores **153** having axes parallel to the axis of the piston rod **154** and circumferentially spaced about the axis of the piston **152** and radially equidistant therefrom. Covering the top ends of the bores **153** is an annular disc valve **158** loosely slidable upon a through piston extension portion of the piston rod **154** and prevented from displacement off this extended portion by means such as the snap ring **159** which nevertheless allows the valve **158** to move far enough away from the bores **153** to allow a free flow of hydraulic fluid therethrough. The piston rod **154** is of course sealingly slidable through the closure member **156** and the piston and piston rod **154** are biased downwardly by coaxial double compression springs **160** and **161** outer and inner, respectively. The piston **152** is movable upwardly in the cylinder **150** until it comes in contact with the shoulder formed by the transition from the full diameter portion of the cylinder **150** to a smaller diameter portion **151** and this smaller diameter portion **151** extends upwardly to the bottom side of the top member **166** forming a small diameter top cylinder portion at the extreme upper end of the cylinder **150.** This small diameter portion **151** communicates with a passageway **123** extending substantially horizontally to the right as seen in FIG. **5** to an enlarged passageway portion **125** which in turn communicates with the cavity of a reservoir **126** formed in a horizontally extending portion of the body member **148.** The bore **123** must be large enough to provide for free flow of hydraulic liquid (no orifice effect) probably not less than ⅛ inch in diameter. The reservoir **126** is provided with a large horizontal bore **127** coaxial with the passageways **123** and **125** through the outer wall of the reservoir **126.** Rigidly secured within the bore **127** is a closure member **128** provided with a snap ring and O-ring to maintain the fluid tight relationship of the closure member **128** with the bore **127.** The closure member **128** forms a seat for a valve spring **129** interposed between the inner surface of the closure member **128** and a spherical valve **130** which is positioned in the portion **125** to close off the reservoir end of the passageway **123** in a well known manner. An orifice **130*a*** is shown as a bore through valve **130** coaxial with the bore **123** and of a size to provide for viscous flow of hydraulic liquid under pressures ranging from a few atmospheres to whatever pressure will unseat the valve **130** probably around 140 atmospheres.

At this point it is well to note that the total volume of bore **123** plus the clearance volume within cylinder portion **151** with the piston at maximum height must be less than 1 percent of the piston displacement volume to provide for progressive clearing of air from the cylinder **150** to be replaced with liquid.

The reservoir **126** also communicates with the cylinder **150** through a passageway **131** extending from a lower portion of the reservoir **126** to a lower portion of the cylinder **150** wherein the passageway **131** is provided with a downwardly extending cylinder relief portion **134** extending downwardly from the passageway **131** in the wall of the cylinder **150** to a point upwardly adjacent the upper side of the closure member **156** for a purpose to be made clear.

When the snubber **132** is assembled with the body spring **170** it extends between the side frame bottom member **121** and the bolster bottom surface **168** as seen in FIG. **8.** Also as seen in FIG. **8** the top surface **122** of the side frame bottom member **121** will, when the bolster and side frame are assembled but not supporting a car, be at a level indicated by the line A—A relative to the bolster **118.** When a car body is placed on the truck of which this side frame **120** and bolster **118** are a part, the relative position of the top surface **122** of the side frame bottom member **121** will be at a position, relative to bolster **118,** represented by the horizontal line B—B. This would be the unloaded car position and it is well illustrated that in this position there would be little or no action by the snubber **132** even if the car should bounce somewhat or rock slightly as it was being propelled over the rails. The next horizontal line upward from line B—B namely line C—C represents the normal position of the top surface **122,** relative to bolster **118,** with a loaded car and it is to be seen that at this time the hitherto fully downwardly extended piston rod **154** will be forced upwardly into the cylinder **150** by the slight amount represented by the height of the line C—C above the downwardmost positioning of the bottom member **164** in FIG. **5.** The topmost of the horizontal lines namely D—D represents the position of the top surface **122** relative to the bolster **118** when the spring group has been completely collapsed into solid condition. At this positioning the piston **152** will be very nearly in contact with the shoulder at the top of the cylinder **150** while the mounting ring **165** is almost in contact with the bottom edge of the body member **148** with the parts almost in the position shown in FIG. **6.**

By using a plug **124** in the forward wall of reservoir **126** (see FIG. **6**) the inside of the body member **148** of the snubber **132** is properly filled with hydraulic liquid such as oil or other suitable liquid so that when in operation the level of liquid in the reservoir **126** will vary between a low level **136** shown as a broken line in FIG. **5** when the piston is at the bottom of the cylinder **150** and the rod **154** completely extended to the position shown in FIG. **8,** and rising to the level shown as line **138** in FIG. **5** when the piston **152** has been pushed to the top of the stroke approximately as seen in FIG. **5.**

OPERATION

In beginning the operation of a new snubber **132** there will likely be air trapped in the cylinder **150** and if the piston rod **154** is completely extended as seen in FIG. **8** all of the air in the cylinder **150** will be above the piston **152** by simple gravitational accumulation. At this time the level of liquid in the reservoir **126** will be at some unknown point higher than the level **136** because of the presence of air in the cylinder **150.** As the piston **152** rises cyclically in the cylinder **150** because of the motion of the car, air above the piston **152** will be pushed through the small cylinder portion **151,** ahead of oil present above the piston, into the passageway **123** and through orifice **130*a*** or around the valve

130 into the upper regions of the reservoir 126. Thus, with the rod 154 being cyclically pushed into the cylinder 150 the level of the liquid in the reservoir 126 will gradually fall during the first few strokes as more and more air is gravitationally accumulated at the top of the cylinder 150 in the portion 151 and forced outward through the passageway 123. After a reasonable number of piston excursions upwardly and downwardly in the cylinder 150 the cylinder 150 and the bores 153 will be essentially completely filled with liquid with very little if any air remaining at the top of the small bore portion 151 or in the passageway 123.

The snubber 132 is now ready for normal operation very similar to that described for the spring group snubber of the above copending application or for the embodiment of FIGS. 1 through 4 of this application. As hereinbefore mentioned, the limit of extension of the piston rod 154 precludes any action of the snubber 132 with a light car so that true operation of this device begins with a loaded car being moved along a railway and responding to the variations in track height in a well known manner. With the car standing level or traveling on a level track the normal position of the piston 152 will be slightly raised from the upper surface of the closure 156 with the liquid in reservoir 126 at a level slightly above the line 136 since a small amount of the piston rod 154 has been forced into the cylinder 150 displacing a small amount of liquid. As the car begins to rock a first motion could be the downward motion of the bolster 118 toward the side frame bottom member 121 forcing the piston 152 higher into the cylinder 150. This action would force liquid from the upper side of the piston through the small cylinder portion 151 and the passageway 123 through the orifice 130a or out under the spherical valve 130 against the force of the spring 129 concentrated on a very small area at the end of the bore 123. When flow of liquid from cylinder 150 is taking place only through the orifice 130a energy absorption will be of the viscous flow type. This type of flow will be significant only during relatively slow bolster movement with respect to the side frame. However, during more rapid and forceful bolster movement forced displacement of the liquid above the piston 152 through the narrow opening formed by the slightly displaced valve 130 provides constant pressure energy absorption in a manner well known to be valuable in preventing excessive spring action whether in railroad cars or other vehicles. As the piston 152 is forced into the cylinder 150 the piston rod 154 of course displaces more and more liquid from the cylinder 150 into the reservoir 126 raising the level of the liquid to the line 138. The volume represented by the difference in the height 136 and 138 is the ullage volume that would be the minimum necessary to leave free in the cylinder for displacement purposes if the cylinder were not connected to an outside reservoir such as the reservoir 126.

When the bolster 118 begins to rise with relation to the side frame 120 the piston travels downwardly in the cylinder 150 and is able to do so readily and rapidly because the annular valve 158 will lift off the surface of the piston 152 as soon as the pressure below the piston is even slightly greater than the pressure above the piston as it travels downwardly. Since the valve 130 acts as a check valve liquid will not come into the top of the cylinder 150 from the passageway 123, nor will air except a small amount by leakage or through the orifice 130a. But the liquid below the piston 152 will travel upwardly through the bores 153 to keep the top of the cylinder full of oil even though the piston is traveling downwardly and the piston rod 154 is being removed from the cylinder and displacing less and less liquid therefrom so that liquid must now travel downwardly through the passageway 131 into the cylinder 150 to maintain a full cylinder at all times. If a small amount of air should travel inwardly through the passageway 123 into the cylinder 151 it will remain at the top of the cylinder by gravitational accumulation and will be the first fluid expelled when the piston 152 is again forced inwardly of the cylinder 150.

With the snubber 132 there will be a small amount of non-absorbing or "dead band effect" for small rapid vibrations when the piston 152 moves rapidly downward forcing valve 158 off the top surface of piston 152 which then quickly moves upwardly a short distance before valve 158 has regained its seated position so that no piston displacement of liquid has occurred. For greater "dead band effect" a spring (not shown) can be interposed between valve 158 and piston 152 to prolong the above described action during less rapid or larger piston excursions.

It is further to be noted that the minimum volume of air space above the level 136 must be greater than one-fifth of the rod displacement volume to avoid overpressuring reservoir 126 and the minimum normal operating level would have a volume of oil between the top end of passageway 131 and level 138 at least equal to the total possible piston rod displacement to avoid adding air to cylinder 150 during the piston downstroke.

A further variation within the principles of this invention includes using a valve (not shown) similar to valve 130 but no orifice therein. Operation of such a snubber with no orifice would be limited to the constant pressure mode described above with a similar small "dead band effect" variable by use of a spring between piston 152 and valve 158 as earlier mentioned.

FIG. 9 is a partial cross-sectional view of still another embodiment of a snubber 172 constructed according to the principles of this invention. Snubber 172 is quite similar to the snubber 132 described hereinabove with the primary difference therebetween being in the passageway communication between the upper end of cylinder 150 and the reservoir 126′ and the valving arrangement therebetween. Accordingly, like elements will be designated by the same reference numerals and similar elements will be designated by the same reference numerals primed. Inasmuch as snubber 172 is identical to snubber 132 as set forth hereinbefore with the exception of the differences described hereinabove, FIG. 9 illustrates only such differences with the understanding that reference is to be made to FIGS. 5–8 for identical and similar features and positioning.

In snubber 172, portion 151 of cylinder 150 communicates with a passageway 123′ which extends substantially horizontally outwardly (to the right as seen in FIG. 13). Passageway 123′ communicates between portion 151 and the cavity of a reservoir 126′ formed in a horizontally extending portion of the body member 148′ and comprises: an inner portion 174; an intermediate portion 176 which has a diameter thereof larger than the diameter of portion 173 and receives an annular seating sleeve 177 therewithin and an enlarged diameter outer portion 178. The inner diameter of sleeve

177 is shown as being equal to the diameter of passageway portion 174.

The reservoir 126' is provided with a large horizontal bore 127' which extends through the outer wall of the reservoir 126' and is coaxial with bore 123'. A closure member 128' is sealingly secured within bore 127'. Closure member 128' has a circular seating portion 180 extending outwardly from the innermost end thereof. Portion 180 is of an outer diameter thereof substantially equal to the diameter of passageway portion 178 and is coaxial therewith. A cylinder 182 is positioned intermediate portions 178 and 180 and the respective axial ends thereof are seated within the portions 178 and 180. The outer diameter of cylinder 182 is substantially equal to the outer diameter of portions 178 and 180. A plurality of circumferentially spaced ports 184 extend radially through cylinder 182, are positioned intermediate the axial ends of cylinder 182 and communicate between the interior thereof and the cavity of the reservoir 126'.

A valve assembly 186 is received within cylinder 182. Valve assembly 186 comprises: a valve spring 188; a keeper member 190; and a spherical valve 192. Keeper member 190 has a generally stepped cylindrical configuration and compirses an inner portion 194 and a reduced diameter outer portion 196. Portion 196 has an outer diameter thereof substantially equal to the inner diameter of spring 188 and is received therewithin adjacent one end thereof. Portion 194 has a coaxial seat 198 formed within the inner surface thereof to provide a seating surface for valve 192. A plurality of bores 200 extend horizontally through keeper member 190.

Valve assembly 186 is positioned within cylinder 182 such that spring 188 has one end thereof seated on closure member seating portion 180. The length of spring 188 is such that the outer end thereof which has received keeper member portion 196 therewithin urges valve 192 into engagement with seating sleeve 177 thereby closing off the reservoir and the passageway 123' in a well known manner.

The general operation of snubber 172 is quite similar to the operation of the snubber 132 as described hereinbefore, however, when utilizing the snubber 172 it would be expected that such snubber would operate more efficiently than snubber 132. For example the fluid discharging from the passageway 123 into the cavity of snubber 132 could do so at a relatively high velocity thereby disturbing the air-oil interface and entraining air within the hydraulic fluid. After a period of time an accumulated air entrainment in the system of the snubber 132 could result in an air locked snubber. With an arrangement such as snubber 172 hydraulic fluid would overcome the bias of spring 188, flow through bores 200 into cylinder 182 and be discharged therefrom through ports 184 and into the cavity. The ports 184 are large enough to cut down the velocity of the discharging hydraulic fluid thereby decreasing the occurrences of air entrainment within the hydraulic fluid of the system.

An additional operating feature of the snubber 172 is that because the ports 184 provide a somewhat restricted path for the flow from cylinder 182 a back pressure within cylinder 182 will result thereby decreasing chattering (i.e., movement of valve 192 against adjacent surfaces). Such reduction of chattering decreases maintenance of the snubber for there is less wearing contact between adjacent surfaces. At this point it is to be noted that the diameter or number of ports 184 are determined by the necessity to have enough discharge area to maintain the velocity of discharging hydraulic fluid within an acceptable maximum while simultaneously providing a back pressure which is great enough to decrease chattering but not too great as to hamper the snubbing feature of the snubber 172. Still further the cooperation of sleeve 177 and seat 198 aid in maintaining valve 192 in a steady substantially non-chattering relative position. It is to be noted that it is comtemplated that sleeve 177 and keeper member 190 be made of a wear resistent material to withstand the continued frictional wearing thereof.

A further variation of snubber 172 within the principles of this invention includes using a valve 130 such as shown in snubber 132 which has an orifice therewithin. Operation of such a snubber would be essentially as described hereinbefore with reference to snubber 132.

The advantage of the snubber embodiments shown in FIGS. 5 through 9 resides almost completely in the characteristics of being able to be used in place of a normal pair of bolster springs with the attendant advantages as hereinbefore set forth.

Preferred embodiments of this invention having hereinbefore been described it is to be realized that variations in the structure embodying the principles of this invention without departing from the scope of such principles.

What is claimed is:

1. In a dampened railway truck assembly selectively operable in loaded and unloaded conditions and having a hydraulic snubber apparatus interposed in a spring group intermediate a bolster member and a side frame member, the improvement comprising: means interposed between said snubber apparatus and one of said members to bias said snubber apparatus towards the other of said members; said means being operative to bias said snubber apparatus out of operative engagement with said one of said members when said truck assembly is normally operating in an unloaded condition; and said means and said snubber apparatus being cooperable to initiate hydraulic snubbing by said snubber apparatus substantially only when said railway truck assembly is normally operating in a loaded condition, the bias of said means is partially overcome and said snubber apparatus is in operative engagement with both of said members.

2. In a railway truck assembly as specified in claim 1 wherein when said truck assembly is normally operating in an unloaded condition said snubber apparatus engages only said other of said members.

3. In a railway truck assembly as specified in claim 2 wherein when said truck assembly is normally operating in said loaded condition said snubber assembly is simultaneously in engagement with both of said members.

4. In a railway truck assembly as specified in claim 1 wherein said means biases said snubber apparatus into engagement with said other of said members.

5. In a railway truck assembly as specified in claim 1 wherein said snubber apparatus includes means biasing a portion of said snubber apparatus towards said one of said members.

6. In a railway truck assembly as specified in claim 1 wherein said means and said snubber apparatus replace a normal spring of said spring group.

7. In a railway truck assembly as specified in claim 1 wherein said one of said members is said bolster member and said other of said members is said side frame member.

8. In a railway truck assembly as specified in claim 1 wherein said one of said members is said side frame member and said other of said members is said bolster member.

9. In a railway truck assembly as specified in claim 1 wherein said snubber apparatus is interposed inwardly adjacent an outer peripherial portion of said spring group.

10. A railway truck snubber assembly comprising: a hydraulic snubber apparatus adapted to be interposed in a spring group intermediate a bolster member and a side frame member of a railway truck assembly; means in communication with said snubber apparatus and adapted to be interposed between said snubber apparatus and one of such members to bias said snubber apparatus towards the other of such members; said means being operative to bias said snubber apparatus out of operative engagement with such one of such members when such truck assrmbly is normally operating in an unloaded condition; and said means and said snubber apparatus being cooperable to initiate hydraulic snubbing by said snubber apparatus substantially only when such railway truck assembly is normally operating in a loaded condition, the bias of said means is partially overcome and said snubber apparatus is in operative engagement with both of such members.

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